

**Explaining Young Adolescents' Physical Activity
Decision-Making Using the Prototype Willingness
Model of Health Behaviour**

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Abstract

Background: Health guidelines suggest young people spend 60 minutes per day in moderate-to-vigorous physical activity, but the proportion meeting this target falls during early adolescence, a developmental stage characterised by impulsive choices not accounted for by behavioural theories based on rational beliefs and intentions. The Prototype Willingness Model (PWM) is a dual-process account of reasoned and social reaction decision-making in which perceptions of prototypes, or social images, influence impulsive willingness to engage in behaviour.

Aim: To investigate whether prototype perceptions and willingness constructs can explain variance in young adolescents' daily physical activity (PA) over and above reasoned action variables of intention, attitudes and norms.

Study 1 used focus groups to explore constructs in the PWM. Thematic analysis revealed preliminary evidence that adolescents make both reasoned and more impulsive decisions about physical activity in the presence of peers. Participants were able to describe active and inactive prototypes.

Study 2 investigated how far PWM variables explain variance in objectively-measured daily average PA. In this prospective study, prototype perceptions and willingness explained additional variance over and above reasoned action variables. Perceived similarity to active images was a significant predictor.

Study 3 used implicit association tests to measure whether unconscious bias towards, and similarity to, active and inactive prototypes explained variance in physical activity. Explicit and implicit measures were only weakly correlated, but implicit bias towards active images was stronger in older participants.

Study 4 tested of the extent to which PWM variables explain variance in physical activity in large sample of young adolescents, $n=9,230$. Prototype similarity predicted significant variance in activity, and variables from the PWM's social reaction path explained 4% of variance over and above reasoned action variables.

Conclusion: This thesis makes a novel contribution to the explanation of adolescent physical activity with evidence that prototype perceptions explain unique variance in daily MVPA. Interventions that target perceived similarity to active and inactive prototypes have potential to increase activity levels.

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Parts of this thesis have been published or presented at conferences.

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Abbreviations

HBSC	Health Behaviour in School-Aged Children
IAT	Implicit Association Test
MVPA	Moderate to Vigorous Physical Activity
PA	Physical Activity
PBC	Perceived Behavioural Control
PE	Physical Education
PWM	Prototype Willingness Model
RIM	Reflective Impulsive Model
SCT	Social Cognitive Theory
SDT	Self Determination Theory
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action

1

Chapter One

Young Adolescents and Physical Activity: Prevalence, Promotion and Theoretical Perspectives

1.1 Introduction

Physical activity (PA) is crucial for maintaining public health and helping to protect against non-communicable diseases including heart disease, stroke, diabetes, cancers and depression (WHO, 2010). A wealth of evidence shows that an active lifestyle promotes physical and mental health and wellbeing (Public Health England, 2014), leading governments in the UK and around the world to adopt and publicise recommended levels of physical activity (Davies, Burns, Jewell, & McBride, 2011).

Yet in Britain and other developed nations there is an ‘inactivity crisis’: neither young nor old people are active enough for good health (Hallal et al., 2012; Inchley et al., 2016). In Britain alone, inactivity now contributes to an estimated one in six premature deaths, the same proportion as smoking. Regardless of weight, inactivity is a significantly greater predictor of early death than Body Mass Index (Ekelund et al., 2015). Inactivity costs the UK economy an estimated £7.4 billion a year in lost productivity (Public Health England, 2014) and, in England, it was linked to NHS spending worth £944 million in 2011 (Lee et al., 2012).

There are signs that activity could be low and declining among children as young as 7 (Basterfield et al., 2011). But there is strong evidence that PA falls sharply during adolescence (Sallis, 2000), the period from ages 10-19, between the onset of puberty and reaching legal majority, which is also a time of social and biological change (WHO, 2015). Policymakers are concerned by this trend (Public Health England, 2014) because PA promotes many positive outcomes in this age group, including lowered blood cholesterol, improved bone density, and controlled overweight/obesity (Janssen & LeBlanc, 2010), reduced depression and anxiety, better self-esteem, enhanced cognitive performance and higher academic achievement (Biddle & Asare, 2011). Furthermore, PA and sport participation in adolescence is associated with higher-than-average levels of activity into adulthood and through the life-course (Dollman, Norton, & Norton, 2005; Trudeau, Laurencelle, & Shephard, 2004).

Encouraging people of all ages to keep moving every day is therefore a key focus of public health policy. Creating an active society by changing attitudes to PA, encouraging teachers and healthcare professionals to promote PA, planning for activity in urban and rural areas, and scaling up theory-led, evidence-based,

interventions to change behaviour are key long-term goals (Public Health England, 2014).

This chapter reviews the literature on the prevalence of adolescent physical activity and describes theoretical perspectives concerning health behaviour in this age group. Section One defines physical activity, summarizes evidence concerning PA levels among British adolescents and briefly describes some current approaches to increasing PA in this age group. Section Two considers the key theoretical frameworks that have been used to understand, predict and change PA behaviour. Section Three concludes that models which assume that PA behaviour is planned - and that decisions concerning activity are reasoned - may fail to account for social and biological factors unique to adolescence. A dual-process approach to behavioural decision-making, which also accounts for reactions to social environments, may offer a more promising framework for explaining and predicting activity levels in this age group.

1.2 Section One: Definitions and Participation

1.2.1 Defining physical activity

Physical activity is defined as “any body movement produced by skeletal muscles that results in a substantial increase over resting energy expenditure” (Caspersen, Powell, & Christenson, 1985). PA can be classified in terms of frequency (bouts per day), duration (length of bouts), type (such as slow walking, light chores or brisk running or cycling) and intensity, which is typically described in terms of energy expenditure and measured in metabolic equivalents or METs (Caspersen et al., 1985). One MET is defined as 1kcal/kg/hour or “the resting metabolic rate, that is, the amount of oxygen consumed at rest, by sitting in a chair” (Jette, Sidney, & Blümchen, 1990). Light PA expends 1-3 METs, moderate PA is 3-6 METs and vigorous PA is defined as >6 METs. Moderate and vigorous PA are typically summed and reported as moderate-to-vigorous physical activity or MVPA (Troiano et al., 2008). Among young people, activities that could be classified moderate intensity include brisk walking (>2.5 mph) or cycling (<10mph) while vigorous activities include running and fast cycling (Ainsworth et al., 2000). In self-report surveys for adolescents, MVPA has been operationalized as activity that is enough to

raise the breathing rate, including sport, exercise and brisk walking or cycling for recreation or to get to and from places (Currie et al., 2012; Inchley et al., 2016; Lubans, Sylva, & Osborn, 2008; Scott, Morgan, Plotnikoff, & Lubans, 2015). Measuring PA is considered in Chapter 2.

Sedentary behaviour, historically considered as the absence of activity, is now defined as “any waking behaviour characterized by an energy expenditure < 1.5 METS while in a sitting or reclining position” (Barnes et al., 2012). For adolescents this might include using a computer or watching television (Edwardson et al., 2012). Not only are there relatively weak inverse relationships between PA and sedentary behaviour (Mansoubi, Pearson, Biddle, & Clemes, 2014), but sedentary behaviour is also associated with an increased risk of poor health outcomes, even when individuals are meeting the guidelines for MVPA (Koster et al., 2012).

1.2.2 Physical activity guidelines

Among young people, higher levels of MVPA are linked to improved cardio-metabolic health (Ekelund et al., 2012), a reduced risk of obesity (Ness et al., 2007), a reduction in the inflammatory markers associated with type 2 diabetes and cardiovascular disease (Carson & Janssen, 2011) and reduced depression (Carter, Morres, Meade, & Callaghan, 2016). Based on a review of the evidence at the time, Strong et al. (2005) recommended that adolescents accumulate at least 60 minutes of MVPA per day, a guideline that has since been adopted by government organisations in many countries including Britain (World Health Organisation, 2010). Specifically, the Chief Medical Officer now recommends that young people aged 5-18 should engage in MVPA for at least 60 minutes and up to several hours every day; vigorous intensity activities, including those that strengthen muscle and bone, should be incorporated at least 3 days per week; and the amount of sedentary should be minimised (Davies et al., 2011). To help adolescents meet the target, the UK Association for Physical Education recommends that at least 50% of secondary school PE lessons are spent in MVPA. The guidelines are different for adults, who should aim for at least 150 minutes of moderate activity per week in bouts of 10 minutes or more (World Health Organisation, 2016).

1.2.3 Physical activity participation

On average, less than a quarter of young British adolescents meet current MVPA guidelines, according to the Health Behaviour in School Aged Children (HBSC) survey for 2013/14, the latest period for which figures are available (Inchley et al., 2016). In England, just 25% of boys and 20% of girls aged 11 reported taking part in “any activity that increases your heart rate and makes you get out of breath some of the time” for 60 minutes on each of the previous 7 days (see Table 1). On average, girls are less active than boys across all age groups, and as adolescence progresses, there is a clear decline in the proportion of young people meeting the MVPA target. Similar patterns are evident in Europe and North America (Inchley et al., 2016). The percentage of adolescents in England and Wales reporting an hour a day of MVPA has declined since the previous HBSC survey for 2009/10 (Currie, 2012), although the proportion in Scotland has risen.

Table 1.1: Percentage of adolescents meeting MVPA target per day, 2013/14

Age	England		Wales		Scotland	
	Boys	Girls	Boys	Girls	Boys	Girls
11 years	25	20	26	15	29	21
13 years	23	14	20	12	19	13
15 years	18	9	21	9	16	8

Source: Inchley et al., 2016

In Britain and other developed nations, there is evidence that secondary school pupils do not meet the target of spending at least 50% of PE lessons in MVPA. A review of 15 studies in the USA, Australia and other nations including the UK (Hollis et al., 2017) found that, on average, middle school students (aged 10-13) spent 48.6% (41.3–55.9%) of the lesson in MVPA and high school students (aged 14-18) achieved 35.9% (28.3–43.6%). The most recent British analysis put the figure at 40% (Fairclough & Stratton, 2005). Both concluded that the proportion reported varied with the type of measurement used: studies employing accelerometers recorded lower percentages than those using human observers. PA measurement discrepancies are considered in Chapter 2.

Despite relatively low activity levels during PE, adolescents still appear to be more active on weekdays than during the weekend: the most recent study found that

sedentary behaviour among boys was higher on both weekend days than Monday-Friday, while girls were more sedentary on Sunday but more active on Saturday than on weekdays (Collings et al., 2014).

1.2.4 Current approaches to increasing activity: policy and practice

Public health interventions to increase physical activity across the population are widespread: they typically attempt to modify social, economic, environmental or cultural factors that are identified as barriers to PA (Baker et al., 2015). Individual differences in cognition and motivation, social and cultural norms, the built environment, physical education, organised leisure activities and urbanisation are all determinants of physical activity, according to ecological models (Bauman et al., 2012). Their relative importance changes through the life-course (Spence & Lee, 2003), but factors thought to be consistently associated with adolescent PA are sex (male), ethnicity (white), age (inverse), perceived activity competence, intentions, depression (inverse), previous physical activity, participation in community sports, sensation seeking, sedentary behaviour after school and on weekends (inverse), parent support, support from others, sibling physical activity, direct help from parents, and opportunities to exercise (Sallis, Prochaska, & Taylor, 2000). As a consequence, the broad goal of increasing physical activity across all ages, regions, socio-economic groups and ethnicities requires a portfolio of strategies (Bull et al., 2010; Pate, Flynn, & Dowda, 2016). A recent Cochrane Review protocol identified comprehensive integrated approaches, mass media campaigns, environmental change and person-focused strategies as the four key types of interventions (Baker et al., 2015). This review considers the last of these four.

School is a recommended setting for promoting adolescent physical activity: young people spend much of their time there and interventions can be directed at them without relying on family (Kriemler et al., 2011). Interventions to increase PA frequency, intensity and duration have involved strategies such as goal-setting, role-modelling, equipment provision, additional PE classes and discussion groups, in physical education (PE) classes, after-school clubs and in whole-school settings (Van Sluijs, McMinn, & Griffin, 2007). But to date their effectiveness has been limited (Metcalf, Henley, & Wilkin, 2012; Van Sluijs et al., 2007).

There is a growing consensus that to change health behaviour, government organisations and professional bodies must draw on insights from behavioural economics and behavioural science to nudge individuals into choices that are in line with their underlying motivations, or to foster positive social norms around healthier behaviours (Matjasko, Cawley, Baker-Goering, & Yokum, 2016); Cabinet Office and Behavioural Insights Team, 2010). A better understanding of the psychological factors that explain and predict physical activity in this age group could improve the effectiveness of behaviour change interventions (Lippke & Ziegelmann, 2008; Michie, Johnston, Francis, Hardeman, & Eccles, 2008). The following section considers some of these behavioural approaches to increasing volumes of adolescent physical activity in the UK and beyond.

1.3 Section Two: Theoretical Frameworks

1.3.1 The importance of theory as a framework for intervention

Over the past decade or so, the use of theory to underpin physical activity interventions has become more common. Theory-based interventions are consistently reported as having stronger effects sizes than atheoretical approaches, both in the field of adolescent physical activity (Metcalf et al., 2012; Pearson, Braithwaite, & Biddle, 2015; Van Sluijs et al., 2007) and in health behaviour more generally (Webb, Joseph, Yardley, & Michie, 2010). There is also evidence that multicomponent interventions, designed to target a range of factors associated with physical activity, have greater effect sizes among adolescent samples than interventions that focus on a single PA determinant (Van Sluijs et al., 2007). Crucially, theory-led, evidence-based approaches can be used to target hypothesised causal determinants of behaviour, to evaluate the proposed change mechanisms, and to develop them to fit different contexts and behaviours (Michie et al., 2008; Prestwich et al., 2014). What's more, theory-based approaches can be replicated and used in future research (Abraham & Michie, 2008). The following section critically examines four key physical activity behaviour change theories.

1.3.2 Theories of physical activity behaviour change

Numerous theories have attempted to explain and predict the complex interactions between biological, environmental, social, and psychological influences on physical

activity (Biddle & Mutrie, 2001). Of these, the four most prominent PA behaviour change models (Buchan, Ollis, Thomas, & Baker, 2012), are the Transtheoretical Model (Prochaska & DiClemente, 1983), Social Cognitive Theory or SCT (Bandura, 1986); Self Determination Theory or SDT (Deci & Ryan, 2000), and the Theory of Planned Behaviour or TPB (Ajzen, 1985, 1991).

The Transtheoretical Model is a stage-based model of change which assumes that individuals pass through several phases as they attempt to change their physical activity behaviour. The model proposes five stages, from 'pre-contemplation' where there is no intention to make changes, to 'contemplation', 'preparation', 'action' and 'maintenance'. The framework allows interventions to target each stage with tailored strategies. But there is evidence that, in the field of physical activity, the stages might not apply to young adolescents in a predictable manner (Spencer, Adams, Malone, Roy, & Yost, 2006): studies have found low rates of adolescents in the pre-contemplation and contemplation phases, and higher proportions already in the action or maintenance stages (Nigg & Courneya, 1998).

Social Cognitive Theory or SCT (Bandura, 1986) suggests that self-efficacy – the strength of an individual's belief in their capability to organise and execute an action to produce an effect – determines behaviour. Efficacy beliefs are thought to affect health behaviour directly and also indirectly through their influence on other determinants. For example, they are said to regulate motivation by influencing the goals individuals set themselves, as well as skills acquisition, perseverance and resilience (Bandura, 1998). In this way, SCT informs other continuum models of behaviour change in the field of physical activity (Plotnikoff, Costigan, Karunamuni, & Lubans, 2013). Self-efficacy in a given domain can be strengthened by mastery experiences, observation of others, social persuasion and mood enhancement: positive mood, including lowered stress, enhances self-efficacy perceptions (Bandura, 1998). There is evidence that efficacy beliefs mediate the effect of theory-based interventions to increase physical activity (Lubans, Foster, & Biddle, 2008).

Self Determination Theory or SDT (Deci & Ryan, 2000) suggests that environments which promote the satisfaction of basic psychological needs improve the quality of behavioural motivation and associated health outcomes (Ng et al., 2012). This social cognitive theory has been used extensively to understand and predict physical activity behaviour (Teixeira, Carraça, Markland, Silva, & Ryan, 2012) and as a basis for interventions in secondary school PE (Lonsdale et al., 2013).

SDT proposes that when parents, teachers or friends provide *autonomy support*, such as the provision of choice or rationale in a given context, they promote the satisfaction of three basic psychological needs. Motivation quality improves when these innate needs for *autonomy* – “perceiving one’s activities are endorsed by, or congruent with, the self”, *relatedness* – “feeling that one is close and connected to significant others” - and *competence* – “feeling that one can effectively bring about desired...outcomes” are satisfied (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). The theory describes a continuum of motivation (Deci & Ryan, 2000). Self-determined forms of PA motivation, where individuals take part in health behaviour because of intrinsic interests and enjoyment, and thought more likely to promote healthy outcomes, wellbeing, participation and adherence than more extrinsic forms of motivation that might include gaining reward or avoiding punishments (Gillison, Standage, & Skevington, 2006; Ng et al., 2012).

Adolescent physical activity interventions grounded in self-determination theory typically aim to manipulate autonomy support and the quality of motivation in a particular context, such as PE lessons (Lonsdale et al., 2013) or community sport (Duda et al., 2013). Yet meta-analysis has indicated that self-determined motivation has only weak-to-moderate positive associations with PA among children and adolescents (Owen, Smith, Lubans, Ng, & Lonsdale, 2014). Also, although trans-contextual models of motivation (Hagger & Chatzisarantis, 2007; Vallerand, 2007) seek to explain how better quality motivation in one context, such as PE, might also increase PA levels in another context, such as after-school leisure time, a possible criticism of SDT interventions is that their impact may be limited to the context in which they are delivered (Hagger & Chatzisarantis, 2016).

The Theory of Planned Behaviour, which builds on its predecessor, the Theory of Reasoned Action or TRA (Ajzen & Fishbein, 1977) proposes that behavioural choices follow reasoned intentions. According to the TRA, individuals’ attitudes (their affective and instrumental evaluation of a behaviour) and subjective norms (perceived social pressure from friends or family to engage in or abstain from the behaviour) determine intentions, which predict behaviour. The Theory of Planned Behaviour adds to the TRA by specifying perceived behavioural control or PBC (self-efficacy and mastery of our environment in a given domain) as a third antecedent of intentions. PBC is also said to directly predict behaviours that are relatively difficult to perform (Madden, Ellen, & Ajzen, 1992).

Over the past 25 years the model has been used to explore and predict a range of health behaviours including physical activity (Armitage & Conner, 2001). PA investigations in this framework have been conducted among a variety of social and demographic groups (Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002). The theory is regarded as a useful and relatively parsimonious model for explaining PA intentions and behaviour: a meta-analysis of 72 TPB studies in the physical activity domain (Hagger et al., 2002) found that attitude, subjective norms and perceived control together explained 45% of the variance in PA *intention*. Perceived control and intention together explained 27% of variance in *behaviour*. As a consequence the model has been used extensively as a basis for interventions (Hardeman et al., 2002).

Despite empirical support for the TPB's ability to predict intention and – to a lesser extent - behaviour, there remains a large proportion of unexplained variance in the model when applied to physical activity, even once measurement error has been taken into account: there is often a discrepancy between what people intend and what they actually do (Rhodes & Bruijn, 2013). The 'intention-behaviour gap' (Sheeran, 2002) has led researchers to propose further variables such as 'anticipated regret' - 'I will feel bad if I'm not active' - and descriptive norms – 'most of my family and friends are active' - to explain additional variance in both intention and behaviour (Rivis & Sheeran, 2003; Sheeran & Orbell, 1999). More theoretical research is needed to establish explanations for additional variance (Plotnikoff et al., 2013) in physical activity.

Crucially, age is an important moderator of the PA intention-behaviour relationship. Hagger et al. (2002) found that in younger samples (under 25) there was a significantly weaker relationship between intentions and behaviour ($r=.48$) than among older groups ($r=.57$). In other words, adolescent intentions to be physically active are significantly less likely to be translated into behaviour than those of adults.

1.4 Section Three: Dual Process Accounts of Health Behaviour

1.4.1 The role of implicit processes in adolescent health behaviour

The Theory of Planned Behaviour and other social cognitive theories assume that individuals consciously reflect and form explicit intentions before engaging in physical activity or healthy eating, for example (Ajzen, 1991). More recently,

researchers have suggested that unconscious impulses and implicit cognitive processes could also guide health behaviour, and that theories of change based on rational, reflective processes alone might be too narrow (Marteau, Hollands, & Fletcher, 2012; Sheeran et al., 2016; Sheeran, Klein, & Rothman, 2017).

There is growing evidence that implicit processes - unintentional habits, impulses and non-conscious goals - can also inform health decisions (Papies, 2016). Much of the research in this field has concentrated on attentional bias and its impact on incidental PA (Sheeran, Gollwitzer, & Bargh, 2013): for example, physically active individuals are more likely to notice exercise cues such as stairs versus the lift (Calitri, Lowe, Eves, & Bennett, 2009). By contrast, distracting alternatives sometimes prevent conscious intentions to perform healthy behaviours from being translated into behaviour. Implicit processing of environmental stimuli is thought to be a particularly important determinant of behaviour when it takes place under stressful or hurried circumstances (Damásio, 2001; Strack & Deutsch, 2004). Acting on these kinds of impulses –hopping on the bus instead of walking as it starts to rain, for example - might help explain the intention-behaviour gap (Sheeran et al., 2016) and influence overall levels of physical activity (Dimmock & Banting, 2009).

Adolescent decision-making is uniquely inclined to be influenced by impulsive, implicit processes (Arnett, 1992; Blakemore & Mills, 2014). Social cognition during this developmental stage is characterised by anxiety about peer evaluation and exclusion, susceptibility to social pressure and willingness to take risks in the presence of observers (Blakemore & Mills, 2014; Sebastian et al., 2011). Adolescence is also a period of rapid social and environmental change: in Britain and other countries, the transition from primary to secondary school occurs around the onset of puberty, putting adolescents in new learning environments, with unfamiliar peers, at the bottom of an age hierarchy (Cotterell, 1982; Santrock, 2005).

From a neuroscience perspective, different rates of maturation in two areas of the brain are thought to predispose adolescents to risk-taking and impulsivity (Steinberg, 2008). The prefrontal cortex or PFC – the area of the brain that is implicated in planning, decision-making and behavioural moderation – is thought to mature more slowly than the limbic regions that control motivation and reward, and which prompt sensation-seeking involving new and pleasurable experiences. As a consequence, it is argued that the PFC is unable to fully exert top-down cognitive

control over adolescent impulse and emotion, which in turn limits rational, conscious decision-making (Steinberg, 2008).

Furthermore, young people become particularly sensitive to their changing social environments as a result of puberty's impact on the 'social brain', a network of brain regions involved in social cognitive processes (Blakemore & Mills, 2014; Dumontheil, Apperly, & Blakemore, 2010). This sensitivity underpins 'mentalizing' - the ability to attribute mental states such as beliefs, emotions and intentions to others. Seeking peer acceptance, or avoiding social exclusion by conforming to social norms, is thought to motivate adolescent behaviour (Silverman, Greca, & Wasserstein, 1995). Adolescence is therefore characterised by a shift in social affiliation from family to peers (Steinberg & Morris, 2001) as young people become preoccupied with, and influenced by, what others their own age think of them (La Greca & Lopez, 1998; Steinberg, 2005). Positive peer evaluation is particularly salient for females who appear to be more responsive to social signals than boys (McClure, 2000; McClure, Laibson, Loewenstein, & Cohen, 2004), and more concerned about others' opinion (La Greca & Lopez, 1998). The discrepancy between boys and girls has potential implications for targeting interventions.

Young people's heightened sensitivity to their social environment and their propensity for sensation-seeking has been linked to numerous risky health behaviours that emerge during this stage of development, including drinking, smoking and taking drugs (Inchley et al., 2016; Sawyer et al., 2012; Steinberg, 2008). Indeed, adolescent decision-making has been described as maladaptive because it does not always correspond with 'good' or healthy outcomes (Reyna & Farley, 2006). But some researchers have argued that enhanced attention to the social environment has beneficial consequences too: individuals who grasp social norms are more likely to navigate increasingly complex social environments and form mature personal relationships (Baumeister & Leary, 1995). Positive peer evaluation can also be important for well-being: in a study by O'Brien and Bierman (1988), adolescents reported that peer evaluations affected their feelings of social or personal worth, and that peer rejection indicated their unworthiness. In other words, the impulsivity that underpins adolescent decision-making is associated not only with risk-taking but also with increasing experience, independence and self-sufficiency (Romer, Reyna, & Satterthwaite, 2017).

1.4.2 Dual process theories of decision-making

Dual-process models of decision-making account for the impulses that can drive our actions by proposing two distinct paths to health behaviour (Hofmann, Friese, & Wiers, 2008). These theories draw on social psychological accounts of information processing such as the Reflective Impulsive Model or RIM (Strack & Deutsch, 2004). The RIM suggests that there are two qualitatively different modes of information processing. The reflective system generates consciously-intended behavioural decisions based on a rational analysis of knowledge, values and probabilities, while the impulsive system makes unconscious, heuristic decisions based on a store of associations that are activated by perceptual inputs outside of awareness. Hofmann et al. (2008) describe a conflict between conscious and non-conscious processes, and the dispositional factors such as self-control that might facilitate (or inhibit) one or other of the pathways.

Dual-process models have a long history: it's now more than 40 years since Schneider and Shiffrin (1977) proposed a theory of controlled and automatic processing. Since then, Reyna and Brainerd (1995) have described a 'fuzzy-trace' model of memory and reasoning that involves two types of mental representations. 'Gist' traces are fuzzy mental representations of the general semantic meaning of information and experience while 'verbatim' traces are precise recollections of a past event. The theory suggests that individuals prefer to reason about behavioural risk and reward with gist traces, leading to an *intuitive* form of decision-making – although it is important to note that they are capable of reasoning with either type of representation.

Kahneman and Tversky's Prospect Theory (2013; 1974, 1981) contrasts System 1 – the brain's fast, automatic approach – with System 2, its slower, reasoned approach to decision-making. System 1 uses rules of thumb and association to draw intuitive conclusions, while System 2 uses logic and reasoning to arrive at reasoned choices. Typically, individuals prefer to rely on less effortful System 1 thinking, which tends to depend on a collection of cognitive biases that pass for reasoning. These can sometimes be useful, but they can also introduce systematic errors of which individuals must be aware if they are to make optimum decisions.

There is evidence of dual-process decision-making in childhood and adolescence. In non-social tasks, reliance on reasoning appears to increase with age,

while in social problems, older participants appear to depend more on heuristics (Klaczynski, 2001). Taken together, the evidence suggests that dual-process models might offer a fuller account of health behaviour than theories based on conscious intentions alone, leading researchers to argue that it is ‘time to retire’ the Theory of Planned Behaviour (Snihotta, Pesseau, & Araújo-Soares, 2014).

1.4.3 The Prototype Willingness Model

The Prototype Willingness Model or PWM (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008; Gibbons & Gerrard, 1995; Gibbons, Gerrard, Blanton, & Russell, 1998) is a dual-process model of health behaviour that accounts for impulsive (and sometimes maladaptive) decisions taken in the type of social contexts that facilitate risky behaviour. The PWM was originally conceived to account for non-intentional but volitional adolescent decisions to engage in health behaviours such as drinking, smoking or unprotected sex: young people may not form an intention to drink alcohol and get drunk, but they may do so anyway given the opportunity and certain social circumstances. More recently, the model has been applied to a wider variety of activities including organ donation (Hyde & White, 2010), doping in sport (Whitaker, Long, Petróczi, & Backhouse, 2014), tanning (Ratliff & Howell, 2015) and feminist activities (Redford, Howell, Meijs, & Ratliff, 2018).

Building on the Theory of Reasoned Action, the PWM describes two paths to health behaviour. The *reasoned action* path, in line with the TRA, proposes that past behaviour, attitudes and descriptive norms determine intentions and behaviour. In the *social reaction* path, a faster route that operates at the edge of conscious control (Gerrard et al., 2008), behaviour is predicted by ‘willingness’ or openness to engage in the behaviour. In a given social context, adolescents’ willingness to be identified by their peers as, for example, a ‘smoker’ or a ‘drunk-driver’ determines their behaviour. Behavioural willingness is said to explain unique variance in behaviour over and above intention (Gibbons, Gerrard, & Lane, 2003) although, like other dual-process theories, the PWM suggests that the reasoned action and social reaction pathways can operate simultaneously.

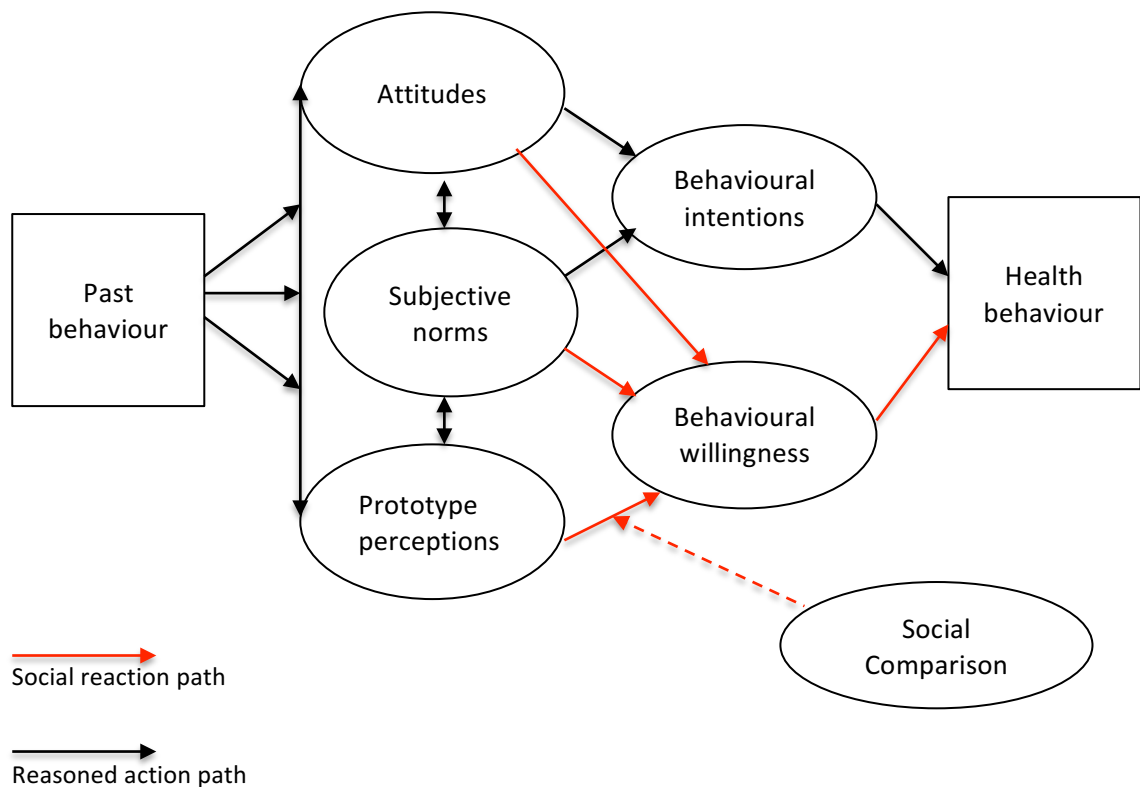


Fig 1.1: Prototype Willingness Model (Gerrard et al., 2008; Gibbons & Gerrard, 1995)

Willingness in turn is determined by perceptions of prototypes, or images of the type of person who engages in the target activity. During adolescence young people tend to be very preoccupied with social images (Lloyd & Lucas, 1998; Manning & Allen, 1987). For example, an adolescent drinker prototype might be considered ‘fun’ or, alternatively, ‘reckless’. To adolescents, these images represent the social consequences of a behaviour (Gibbons & Gerrard, 1997). Prototypes therefore prompt behaviour through a process of social comparison: the more *favourably* adolescents view these images, and the more they believe themselves *similar* to them, the more willing they are to engage in the behaviour (Gibbons & Gerrard, 1997). Individual differences in social comparison tendencies are a key moderator of the relationship between prototype perception and willingness (Rivis, Sheeran, & Armitage, 2011). As Figure 1.1 illustrates, past behaviour is also an important component of the model because it influences behaviour through both pathways. Willingness is said to operate at the edge of consciousness without deliberation about behavioural risks and consequences (Gibbons, Gerrard, Ouellette, & Burzette, 1998).

There is evidence that intention comes to influence decision-making more than willingness as adolescents become older and more experienced. For example, once young people have smoked on impulse and enjoyed the consequences, they may start planning to do so – or having been drunk they might intend to avoid it in future.

Furthermore, adolescents are typically more susceptible to social influence than older adults (Pasupathi, 1999). Pomery, Gibbons, Reis-Bergan, and Gerrard (2009) found that among older adolescents, and those with experience of smoking, intentions to smoke were more predictive of smoking behaviour than willingness.

Conversely, Ravis, Abraham, and Snook (2011) found that prototype perceptions of intoxicated drivers predicted older but not younger people's willingness to drive drunk, although this result has not been replicated. More recently, a meta-analysis of PWM studies found that intention explains a greater proportion of variance in behaviour among young adult samples than among adolescents (Todd, Kothe, Mullan, & Monds, 2014). Overall, the PWM explained 20.5% of variance in behaviour and willingness accounted for 4.9% of variance in behaviour over and above intention. These findings support the PWM overall and suggest that the model might be particularly appropriate for exploring young adolescents' decision-making and behaviour.

1.4.4 Prototype perceptions

According to the PWM, adolescents hold clear prototypes of the 'typical' person who engages in a specific behaviour such as smoking or binge-drinking (Gibbons & Gerrard, 1995). These images are typologies, including physical and social characteristics, rather than mere physical descriptions (Gerrard et al., 2008) and they are assumed to be widely recognised and agreed on (Gerrard et al., 2006). As well as being distinct, these social groups must be large enough to be identifiable yet small enough to be discriminable (Smith & Zarate, 1992). The more salient an image, the more influential it becomes (Gerrard et al., 2002; Skowronski & Carlston, 1989).

Positive prototype perceptions promote willingness (rather than desire) to engage in behaviour while negative perceptions inhibit willingness. Blanton et al. (2001) argued that negative evaluations have a greater impact on behaviour than positive perceptions: young people are more motivated to avoid association with negative images than to gain association with positive characteristics. They based

their hypothesis on the idea of ‘negativity bias’ in social perception, which suggests that negative information carries greater weight than positive information during impression formation (Skowronski & Carlston, 1989). In their study, the authors found that holding a strong negative image of an unsafe sex prototype was more predictive of condom use than having a strong positive image of a condom user.

Early research assumed that, for some adolescents, health risk images represented positive goal states. For example, Leventhal and Cleary (1980) suggested that the image of the adolescent smoker is tough, sophisticated and independent, although health education programmes have undoubtedly influenced perceptions since then.

More recently, studies have shown that adolescent prototypes are more nuanced than they perhaps appear to adult researchers: risky images are not uniformly good or bad, and image perceptions can vary among different groups of young people. For example, younger adolescents have described drinkers as the type of people who succumb to peer pressure, while older adolescents describe them as ‘cool’ (Davies, Martin, & Foxcroft, 2013). Heavy drinker prototypes have been characterised as ‘sad’ and ‘dependent’ while moderate drinker images have been described as ‘self-confident’ and even ‘healthy’ (Lettow, Vermunt, Vries, Burdorf, & Empelen, 2013). In other words, prototypes can both facilitate and inhibit health behaviour (Rivis, Sheeran, & Armitage, 2006).

A handful of studies have examined exerciser and physical activity images. Rivis and Sheeran (2003) found that these prototypes were positive. They asked university students to write down 3 characteristics of exercisers: only one characteristic (‘bore’) was negative, and more than 70% of participants suggested ‘physically fit’, ‘motivated’ and ‘healthy’. Ouellette, Hessling, Gibbons, Reis-Bergan, and Gerrard (2005) found that university students held vivid prototypes of exercisers and non-exercisers, and that these images were clearer than those of other health-behaviour prototypes including smokers and drinkers.

Nevertheless, these studies, now more than a decade old, involved college students rather than younger adolescents. Together, the evidence points to the importance of exploring and understanding contemporary adolescent prototypes before designing interventions.

1.4.5 Using healthy prototypes to predict behaviour

Historically, healthy behaviour has been considered rational and has been framed in terms of intention, while risky or socially unacceptable activities have been thought of as impulsive and modelled by dual-process theories such as the PWM. A recent meta-analysis of 90 PWM studies found that just 3 focused on positive health behaviours - exercise and flu vaccination (Todd et al., 2014).

Yet there is evidence that the PWM can explain variance in healthy behaviours including physical activity. Prototypes are thought to influence willingness and behaviour by representing *goal states*, or at least (in the case of some health-risk images) socially acceptable states. For example, a study on prototype matching found that the closer the correspondence between students' self-perception and perceptions of the 'typical' person who lives in a certain type of housing, the more they wanted to live in that type of housing (Niedenthal, Cantor, & Kihlstrom, 1985). Goal states can be possible future selves (Gerrard et al., 2008) which are linked to social context and reflect the social consequences of the behaviour. They can also be self-images (Rivis et al., 2011) linked to internal processes and reflecting self-perception. For example, a study by Hertel and Mermelstein (2012) found that the more adolescents reported that smoking was a defining aspect of who they are, the more likely it was that their smoking behaviour escalated. Goal states can be both positive (to be approached) and negative (to be avoided), but to motivate willingness and behaviour they must be salient.

Gerrard et al. (2002) presented initial evidence that adolescents have strong reactions to healthy, non-risk images: positive images of non-drinkers were associated with abstaining from alcohol. Rivis et al. (2006) drew a distinction between actor and abstainer images, suggesting that adolescents hold prototypes for individuals who engage in healthy activities, such as exercise, as well as those who avoid risk behaviour, such as teetotallers. Their study found evidence that healthy-actor images, including exercise prototypes, predicted behavioural intentions. Rivis et al. (2011) examined the extent to which prototype identification, versus intention, predicted a range of health behaviours, including exercise. They also measured whether control of behaviour by intention versus identification was linked to individual differences in social comparison and the 'Big Five' personality traits (McCrae & Costa Jr, 1999). The study found that identification predicted additional

variance in behaviour over above intention and perceived control from the Theory of Planned Behaviour. Social comparison tendencies and personality factors led to greater control by identification.

Recently, Gibbons and Gerrard (2016) p45 said that positive, health promoting images such as “fitness buff, healthy eater, condom user” could be just as salient as risky images and that “there is no reason why positive behaviours could not come within the purview of this model.” The evidence presented suggests that PWM’s dual-process approach, which accounts for reactions to social environments, may offer a more promising framework for explaining and predicting adolescent physical activity levels than models based only on rational processes.

1.4.6 Effectiveness of interventions using the PWM

There is growing evidence that interventions targeting only explicit attitudes and beliefs lead to modest and temporary changes in health behaviour, and especially habitual behaviours (Sheeran et al., 2016). To date, interventions to halt the decline in adolescent PA by targeting intentions have had limited success: typically, medium-to-large changes in intention lead to only small-to-medium changes on behaviour (Webb & Sheeran, 2006). The PWM offers a promising explanation for health-promoting behaviours, and, although interventions using this framework to encourage physical activity are very limited, a number of studies have shown that the model may provide an appropriate basis for behaviour change. A Delphi study to elicit expert feedback on suitable behaviour change techniques to reduce adolescent alcohol misuse identified potential strategies linked to the PWM that were drawn together into the Alcohol Smart Quiz (Davies, Martin, & Foxcroft, 2016). For example, supplying information about others’ behaviour and providing a positive (or negative) group identity can help change prototype perception, and suggestions about how to resist social pressure can help reduce impulsive behaviour.

Changing prototype perceptions by asking participants to spend time contemplating these images, or by supplying information that manipulates their positive and negative characteristics, has been used as a behaviour change strategy in a number of interventions. For example, the Strong African American Families Programme, an intervention based on prototype alteration, was successful in postponing the onset of drinking alcohol among children for up to two years (Gerrard

et al., 2006). The programme targeted both the reasoned path (via intentions) and the social reaction path (through willingness), consistent with the PWM's dual-process approach which suggests that both pathways influence behaviour. Children took part in group discussions that had three purposes: to demonstrate that young people associate more negative than positive characteristics with early drinking; to draw a distinction between reasoned and impulsive decisions to drink; and to challenge perceptions that peers accept early alcohol use.

A number of interventions, including the Strong African American Families programme, have asked participants to consider the consequences of health-risk behaviour, based on the assumption that willingness reflects a tendency to avoid contemplating these potential downsides. For example, university students shown UV images of their own faces, to demonstrate the damage caused by tanning, showed a significant decline in attitudes to tanned prototypes, willingness to tan and tanning behaviour (Gibbons, Gerrard, Lane, Mahler, & Kulik, 2005). Participants are also encouraged to consider the available responses to risk-conducive situations.

In the physical activity domain, Ouellette et al. (2005) found that systematic contemplation of exercise images could produce changes in PA behaviour. Participants were asked to consider, and write down their thoughts about, their own and other people's health and appearance 10-20 years in the future, thinking about whether, over that period, they exercised regularly or not. The study showed that participants who contemplated others' future images and were high in social comparison tendencies increased their own exercise, as did future-oriented participants who considered their own future image.

Blanton et al. (2001) presented participants with one of two fake newspaper articles that described the result of a study on sexual behaviours and personality characteristics. In the first report, the type of person who does not use a condom was described as 'less responsible' and more selfish'. In the other article, the prototype was framed positively: people who do use condoms were described as 'more responsible' and 'less selfish'. Participants who read the negatively-framed report were less willing to have unprotected sex than those who read the positive report.

Interventions that encourage social comparison have also had some success. For example, a study that encouraged young adults to compare themselves with drinkers found that participants who perceived a dissimilarity became less willing to drink (Lane, Gibbons, O'Hara, & Gerrard, 2011). This type of intervention is

distinct from personalised normative feedback strategies, which aim to prompt behaviour change by drawing attention to differences between personal levels of, say, drinking, and normative levels among peers.

In the multicomponent Drinktest intervention in the Netherlands, van Lettow, de Vries, Burdorf, Boon, and Van Empelen (2015) used personalised prototype alteration strategies to reduce excessive alcohol consumption among adults. Participants received tailored feedback that related to prototype characteristics such as “you have consumed x glasses of alcohol...your peers generally regard excessive drinking as annoying, uncontrolled, volatile..”. The study found that prototype alteration reduced alcohol consumption. Overall, evidence suggests that the social reaction pathway of the PWM can offer an appropriate theoretical basis for health behaviour change interventions, and that more evidence concerning adolescent physical activity in this context would be beneficial.

1.4.7 Conclusion and Thesis Aims

The decline in physical activity during early adolescence is a serious public health concern. To date, interventions to help young people achieve recommended levels of moderate-to-vigorous activity have had only limited success, perhaps because they are based on the assumption that physical activities are consciously planned. In fact, evidence suggests that intentions to be active do not always lead to behaviour, especially in this age group. Dual process theories account for young people’s impulsive approach to decision-making and may offer a more promising theoretical framework for explaining and predicting health behaviour.

The research question this thesis addresses is whether constructs in the social reaction path of the Prototype Willingness Model can explain additional variance in young adolescents’ daily physical activity levels over and above reasoned action variables. Evidence that prototype perceptions and willingness significantly predict young people’s PA could support the use of interventions involving prototype manipulation. To the author’s knowledge, this is the first exploration of young British adolescent PA using the PWM. A secondary aim of this research programme is to measure the proportion of young people in this age group who meet the physical activity guidelines for health. The overarching question is addressed in 4 studies.

Study 1 (Chapter 3): Using focus groups, an exploration of reasoned and social reaction decisions concerning physical activity, and the characteristics of active and inactive prototypes, to establish whether the PWM might improve our understanding of young adolescent PA.

Study 2 (Chapter 4): An investigation of whether, and to what extent, prototype perceptions and willingness explain variance in young adolescents' objectively-measured daily average MVPA, over and above reasoned action variables.

Study 3 (Chapter 5): An exploratory test of whether implicit prototype evaluations, operating at the edge of consciousness, are better predictors of objectively-measured adolescent PA than explicit measures.

Study 4 (Chapter 6): In a large sample, a full test of how far active and inactive prototype similarity and favourability, and willingness, explain variance in self-reported PA over and above intentions, attitudes, norms and past behaviour.

Chapter 2 provides an overview of research methodology used in this thesis. It describes the development of a self-report questionnaire to measure constructs in the Prototype Willingness Model; the construction of an Implicit Association Test to measure non-conscious positive and negative bias towards prototypes, and procedures for measuring average daily physical activity. Further details on methods are provided in each experimental chapter.

2

Chapter Two

Developing a Research Methodology

2.1 Introduction

This thesis uses mixed methods to explore whether prototype perception and willingness constructs in the PWM, a dual-process account of decision-making, explain variance in young adolescents' physical activity. In this age group there is evidence of impulsive behavioural choices (Arnett, 1992; Blakemore & Mills, 2014) that may account for the relatively large 'gap' between planned intentions and PA behaviour when compared to adult samples (Hagger et al., 2002; Sheeran, 2002). Evidence in the model's favour could support the use of interventions involving prototype manipulation to encourage more young people to achieve the target of 60 minutes of moderate-to-vigorous physical activity per day.

Measures for use with young people must be designed to match their levels of attention and comprehension (de Leeuw, 2011). Chapter 2 describes the development of a self-report questionnaire and the construction of an Implicit Association Test to investigate prototype evaluations and willingness among participants aged 11-13. The results of Study 1, an exploration of constructs in the PWM with adolescent focus groups (reported in Chapter 3), helped inform the development of these measures. This chapter also considers appropriate methods of measuring adolescent daily physical activity and provides details of ethical approval, recruitment and participant consent, which were guided by a larger study. Further details on methods are provided in each experimental chapter.

2.2 Fit to Study

This research programme took place as part of Fit to Study, a large-scale interdisciplinary trial investigating the impact of physical activity during secondary school PE on the brain, cognition, wellbeing and academic attainment. Fit to Study is funded by the Education Endowment Foundation and the Wellcome Trust. Seven schools took part in the trial's pilot phase and 104 were recruited to the main trial. Ethical approvals, recruitment and participant consent for all the studies in this thesis were arranged and administered in accordance with Fit to Study protocols.

2.2.1 Ethical Approval

The Central University Research Ethics Committee of the University of Oxford, which is leading the trial, approved all four studies in this thesis. Participants and parents were able to opt out of data storage; all data collected are confidential and stored securely.

2.2.2 Recruitment

Staff from Oxford Brookes University recruited 7 state secondary schools from Oxfordshire and Berkshire to take part in the pilot phase. Socio-economic status can affect PA participation (Humbert et al., 2006), so it was important to select schools with different characteristics to capture a range of possible activity levels. In pilot schools the percentage of pupils receiving free school meals, an income-related measure of socio-economic disadvantage (Taylor, 2017), was relatively low, ranging from 14.3% -3.4%, against the national average of 13.2% (Department of Education, 2016). Studies 1, 2 and 3 (group 1) used purposeful samples from these schools.

In January-May 2017, the National Foundation for Educational Research approached 1,348 state secondary schools, from a geographical area ranging from the West Midlands to Hampshire, Kent and Northamptonshire, to take part in the Fit to Study main trial. Of these, 106 consented to take part, 104 began the trial in June 2017 and 82 completed some or all of the Fit to Study baselines tests of fitness, cognitive ability, mental health and wellbeing. Between June and July 2017 a total of 9,304 pupils from 81 schools completed the measures used in Study 4, as part of a larger battery of psychosocial tests. In this sample, 1,347 pupils (14.5%) claimed free school meals, 56.1% were white, 17.9% were Asian/British Asian, 11.6% were Black/Black British, 6.9% were of mixed ethnicity and 7.5% were none of these or did not specify.

The author collected additional data for Study 3 (group 2) during an opt-in MRI study, conducted in a laboratory outside school hours, that was part of the main Fit to Study trial. This sub-study involved a brain scan, so volunteers from six schools were screened for a number of characteristics including, for example, claustrophobia and metal implants.

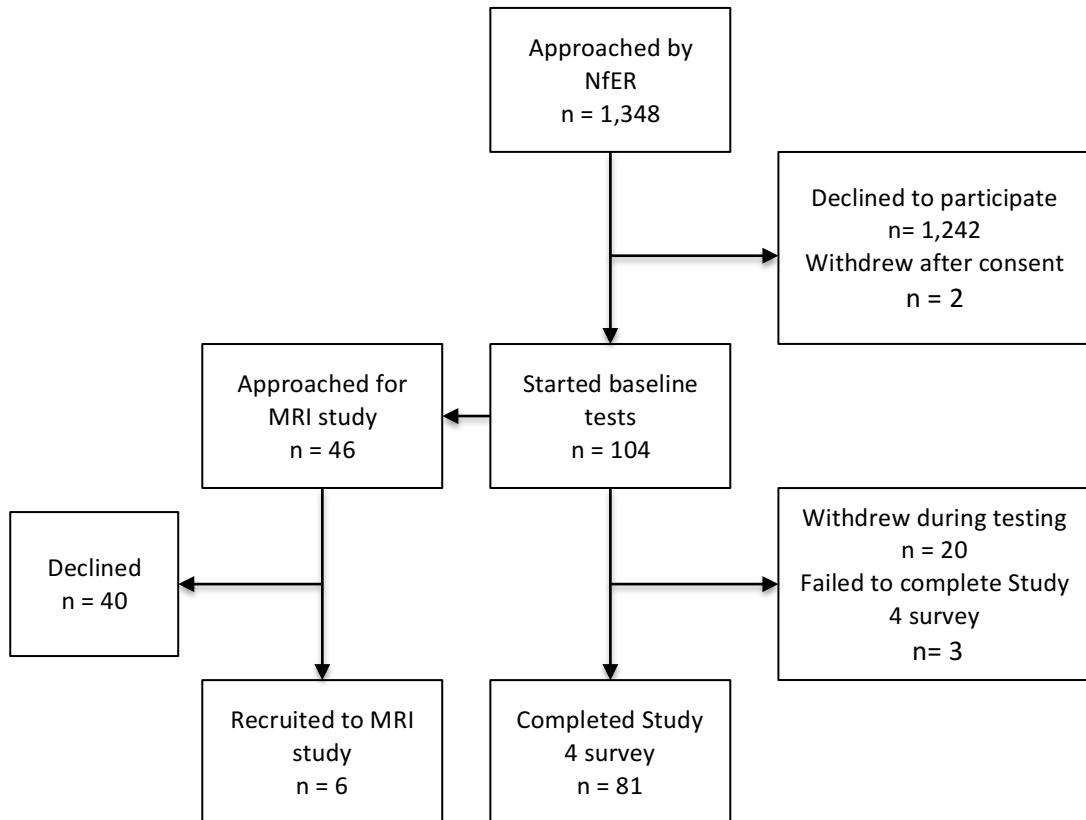


Fig. 2.1: School recruitment flow chart for Fit to Study trial and MRI study

2.2.3 Participant information and consent

Schools opted in to both the pilot phase and the Fit to Study main trial. Parents received information sheets, and pupils received simplified information. Parents had the opportunity to opt out of participation and/or data storage on behalf of their children. For studies in the pilot phase, participants also gave verbal assent on the day and they could withdraw at any time. For the Study 4 survey in the main trial phase, testing took place as part of normal school activities, so pupils did not have the option to withdraw, in line with ethical approval.

2.2.4 Age of Participants.

All participants in Studies 1, 2 and 3 (group 1) were aged 12-13, in Year 8 of secondary school. Students taking part in Study 3 (group 2) and Study 4 were aged 11-12, in Year 7. As discussed in Chapter 1, this is the developmental stage at which adolescents display impulsive decision-making become more susceptible to peer

influence (Blakemore & Mills, 2014) and during which physical activity declines (Inchley et al., 2016).

2.3 Developing a questionnaire to measure PWM constructs

Research at scale in secondary schools is challenging: self-report questionnaires must be simple for teachers to administer, and brief enough not to interfere unduly with delivering the curriculum (Strange, Forest, Oakley, & Team, 2003). After consultation with teachers, the author developed a short survey to measure constructs in the TPB and PWM that could be completed either during 20-minute tutor time or in a single 40-minute PE lesson. The questionnaire is available at Appendix 2.

2.3.1 Developing and selecting measures

All items relating to constructs from the Theory of Planned Behaviour (intention, attitudes, norms, perceived control) were developed according to established theoretical (Ajzen, 1985, 1991) and practical (Fishbein, 2010; Francis et al., 2004) guidelines. Content validity and reliability is important when designing a survey (Everitt, 1996). Multiple-item scales are likely to have better psychometric properties than single-item measures, which cannot capture conceptually-complex constructs and whose internal reliability cannot be measured (Fisher, Matthews, & Gibbons, 2016). In spite of these criticisms, researchers have successfully used single items to measure, for example, stress symptoms (Elo, Leppänen, & Jahkola, 2003) and self-esteem (Robins, Hendin, & Trzesniewski, 2001). Minimising respondent burden, reducing criterion contamination and increasing face validity are thought to be acceptable reasons for using single-item measures (Fisher et al., 2016). For brevity and to maintain participants' attention, the author therefore opted to use single-item measures where they already existed in the literature. All answers were rated on a 7-point Likert scale as there is evidence that they provide a more accurate reflection of participants' evaluations and they are more suitable for electronically-distributed surveys (Cummins & Gullone, 2000; Finstad, 2010).

Behaviour. The aim of this thesis was to determine whether, and to what extent, social reactive constructs might make suitable targets for interventions to promote an hour of daily MVPA (Davies et al., 2011). It was therefore important to define this behaviour clearly and accurately (Francis et al., 2004). The description of

moderate-to-vigorous activity was drawn from the Health Behaviour in School Aged Children survey (Inchley et al., 2016) and a single-item questionnaire measuring PA (Scott et al., 2015).

Participants were instructed to think of physical activity as “*any activity that raises your heart rate and makes you breathe harder and feel warmer. Fast cycling to and from school, running around during school breaks, doing PE and taking part in after-school sports clubs are all examples of physical activity*”. Participants were instructed that “*An hour of physical activity can either be in one block, such as football or netball practice, or several shorter activities that add up to an hour, such as cycling to and from school and running during break and at lunchtime.*” Questions referred to this behaviour in terms of target (implicitly, the respondent), action (engage in an hour of physical activity), context (in school term) and time (during a typical week) as recommended by Francis et al. (2004).

Past behaviour. A single item was used in line with Ravis and Sheeran (2003), 1 = never to 7 = always: “*Thinking about the past six months, how often have you been physically active for an hour every day during a typical week in school term?*”

Attitudes. Attitudes were assessed using a semantic differential scale, anchored with items drawn from the results of the thematic analysis reported in Chapter 3 and from previous research by Ravis and Sheeran (2003). The items *unimportant/important* and *stressful/relaxing* captured instrumental dimensions of attitude, while *boring/fun* and *dissatisfying/satisfying* measured affective dimensions. The Cronbach’s alpha reliability for this scale was good, $\alpha = .82$.

Subjective norms. There were four items measuring subjective norms (1 = ‘strongly disagree’ to 7 = ‘strongly agree’). Two items assessed injunctive norms, or perceived approval of physical activity, among *people in my family* and *most of my friends*: “*People in my family **think I should** be physically active for an hour every day in a typical week during term.*” A further two items captured descriptive norms, or prevalence of the behaviour among *people in my family* and *most of my friends*: “*Most of my friends **will** be physically active for an hour every day in a typical week during term.*” Cronbach’s alpha was adequate, $\alpha = .71$.

Perceived behavioural control. There were two measures of PBC (1 = ‘strongly disagree’ to 7 = ‘strongly agree’). The first tapped self-efficacy: “*If I wanted to, I am confident that I could be physically active for an hour every day in a*

typical week during term.” The second captured controllability: “*Whether or not I am physically active for an hour every day in a typical week during term is completely up to me.*” Cronbach’s alpha was poor, $\alpha = .37$. This finding echoes results from some other studies in the TPB framework and may reflect discrepancies between adolescents’ perceived and actual control (Armitage & Conner, 2001; Norman & Hoyle, 2004). This issue is further addressed in the discussion section of Study 2 (Chapter 4) and in the concluding chapter.

Intention. In line with previous studies (Rivis et al., 2006), intention to be physically active was measured with a single item (reversed): “*I intend to be physically active for an hour every day in a typical week during term*”, 1 = ‘definitely yes’ to 7 = ‘definitely no’.

Prototype favourability. Participants read a definition of a prototype, based on a description given by Gibbons, Gerrard, and McCoy (1995) p85: “*The following questions concern your images of people. We are interested in your ideas about typical members of different groups. For example, we all have ideas about what typical celebrities are like or what typical teachers are like. When asked, we could describe one of these images – we might say that the typical celebrity is attractive or rich, or that the typical teacher is strict or clever. We are not saying that all celebrities or all teachers are exactly alike, but rather that many of them share certain characteristics.*” Participants were then asked to consider active and inactive prototypes: “*Think of someone **your age** who is physically active for an hour every day in a typical week during school term*” and indicate “*how far the following words describe*” this type of person (1 = ‘not at all’ to 7 = ‘extremely’) using four adjectives (*confident, popular, determined, attractive*) drawn from the thematic analysis reported in Chapter 3. This methodology is drawn from previous studies (Gibbons et al., 1995). For active images, Cronbach’s alpha was adequate, $\alpha = .71$ and for inactive images it was good, $\alpha = .80$.

Prototype similarity. In line with previous research (Rivis et al., 2006) perceived *similarity* to active and inactive prototypes were measured with single items (1 = ‘very dissimilar’ to 7 = ‘very similar’): “*In general, how **similar** are you to the type of person who is physically active for an hour every day in a typical week during term?*”

Behavioural willingness. In line with previous research (Davies, Martin, & Foxcroft, 2016; Gibbons et al., 1998) willingness was measured by presenting participants with imaginary scenarios and asking them how they might behave in each one. Respondents were asked to imagine two situations in school where they could choose to be physically active or inactive in the presence of peers, based on the results of the thematic analysis reported in Chapter 3.

Scenario 1: *“It's lunchtime at school and the teachers have organised an obstacle race on the playing field for a challenge. Some students are taking part and others are watching”.*

Scenario 2: *“Imagine it's nearly the end of the school year. To celebrate, the teachers have organised some activities. You have been offered the option to either spend the afternoon doing some sort of physical activity such as canoeing or ice-skating - or going home early.”*

For each scenario, 2 items (1 reversed) assessed whether participants would be willing to *choose* or *avoid* watching physical activity (1 = ‘extremely unlikely’ to 7 = ‘extremely likely’). For the 4 items, Cronbach’s alpha was good, $\alpha = .80$.

Risk. Behavioural beliefs about incurring health risks by avoiding physical activity were measured with a single item, drawn from Weinstein et al. (2007) from 1 = highly unlikely to 7 = ‘highly likely’: *“If you were to avoid being physically active for an hour every day in a typical week during term, what are the chances that your health would suffer as a consequence?”*

2.3.2 Piloting questionnaire measures

An initial version of the questionnaire was completed by a group of six students (three male) aged 12-13 from a secondary school in Oxfordshire. The time taken was recorded at between 11-14 minutes. Afterwards, students answered verbal questions to check for clarity, comprehension and credibility of the ‘willingness’ scenarios. Students confirmed they understood the concepts of a ‘physically active image’ and a ‘physically inactive image’ - and that these images were clear and vivid in their minds.

Piloting led to a number of changes. An initial version measured prototype favourability with an ‘evaluation thermometer’ (Haddock & Zanna, 1994): participants were asked to indicate their evaluation of a physically active (and

inactive) image on a scale of 1-100. Several students said they did not understand this concept. Some also reported that they did not comprehend the accompanying question ‘*how favourable is your evaluation....?*’ The author therefore replaced the evaluation thermometer with the rating described above. In addition, some instructions were simplified.

A number of measures were changed for use in Study 3 and Study 4 (Chapters 5 and 6). One item from the attitude scale, *important/unimportant*, was removed for brevity and to further improve internal reliability. For ease of understanding, the single item measuring intention was no longer reversed. The second ‘willingness’ scenario describing leisure activity with peers from school was substituted with one that took place during break time. The item exploring behavioural risk was removed. Further details are provided in the experimental chapters that follow.

2.3.3 Presentation of questionnaires

Study 2 participants completed paper questionnaires, which were simple for teachers to administer. But a missing data analysis (reported in Chapter 4) showed that participants tended to skip questions at the bottom of a page or at the end of the survey. Furthermore, subsequent data entry invites human error and is labour-intensive at scale.

Therefore Study 3 participants completed the self-report measures online either in the school computer suite or in the laboratory using Qualtrics software (Qualtrics XM, Provo, UT). This method of data collection appeared well-tolerated by participants, although, anecdotally, the organisational burden for the participating school was greater than in Study 2.

For Study 4, after discussion with researchers with expertise in this area, paper questionnaires were judged impractical due to printing, distribution and data entry costs. The author therefore created an online survey and associated secure database in collaboration with researchers at the University of Oxford, Oxford Brookes University, Vassar College, NY; and programmers at Exprodo Software (Exprodo, Didcot, UK). In line with ethical approval, the survey was constructed so that participants could not skip questions, which removed the issue of missing data.

Two schools agreed to pilot the online version. In response to feedback, the author changed the layout of items to eliminate the need to scroll down, and

highlighted questions in bold. A function was included that prevented participants from progressing to the next page until all questions had been answered.

2.4 Measuring adolescent physical activity

As described in the previous chapter, the focus of this thesis is adolescents' daily average minutes of moderate-to-vigorous physical activity, combining a range of different free living, sport and leisure activities, performed at different intensities and varying lengths of time, over a defined period.

Measuring this type of activity presents a challenge to researchers because choosing among the available methods involves a trade-off between accuracy, flexibility, compliance and cost (Sirard & Pate, 2001). For example, the doubly-labelled water method, widely regarded as the gold standard measurement of energy expenditure (Schoeller et al., 1986), is both expensive and inflexible. Self-report questionnaires are inexpensive and easy to administer, but the answers are subject to presentation bias, and the cognitive challenge associated with estimating exercise participation over time can lead participants to over- or under-report activity (Adams et al., 2005). Accelerometry, although relatively expensive and time-consuming, offers a more objective measure of activity, including second-by-second detail about frequency, intensity and duration. Yet compliance over seven days can be poor, and there is still debate surrounding the most effective measurement and data reduction protocols (Cain, Sallis, Conway, Van Dyck, & Calhoun, 2013; Trost, Loprinzi, Moore, & Pfeiffer, 2011).

This research programme is concerned with investigating what might influence adolescents' decisions to engage in an hour's daily moderate-to-vigorous activity, so an accurate measure of frequency, intensity and duration of exercise is important. The author therefore opted to use accelerometry in studies where the samples required to answer the research question were relatively small. Study 4 (Chapter 6), which involved a very large sample, used a self-report measure of physical activity.

2.4.1 Selecting an accelerometer

To measure objective physical activity, the author used the Axivity AX3, a wrist-worn tri-axial accelerometer designed by Open Lab, Newcastle University, UK. The

AX3 detects and captures movements in three dimensions, and it has demonstrated equivalent performance to the GENEActiv accelerometer (Ladha, Ladha, Jackson, & Olivier, 2013), used extensively in adolescent physical activity research (Troiano, McClain, Brychta, & Chen, 2014). Wrist-mounted devices appear to overestimate MVPA when compared to hip-worn accelerometers (Rowlands et al., 2014). But there is evidence that they are less likely to be removed for sleeping, changing clothes and sports than waist and hip-worn devices (Colley, Gorber, & Tremblay, 2010). This was an important consideration, given that compliance rates tend to be relatively low among adolescent populations (Crocker, Holowachuk, & Kowalski, 2001). Overall, the author judged that the AX3's potential for superior compliance compensated for slightly lower validity when compared to waist and hip-worn devices.

2.4.2 Accelerometer wear time

There is no universally-accepted measurement protocol setting out the number of days, and hours per day, over which physical activity should be measured to gain a reliable estimate of average daily MVPA (Cain et al., 2013). Nevertheless, a seven-day protocol (five weekdays and two weekend days) is sufficient to obtain a reliability coefficient of 0.8 or above when assessing adolescent physical activity (Trost, Pate, Freedson, Sallis, & Taylor, 2000). A valid wear day is typically defined as ten hours (Troiano et al., 2008). In Study 2 (Chapter 4), a valid wear day was 12 consecutive hours from 08.00 to 20.00, which was intended to capture both travel to and from school, and any after-school and evening sport and physical activity. In Study 3 (Chapter 5), the ratio of the number of participants tested to the sample size required was smaller than in Study 2, so the author chose to widen the inclusion criteria by defining a weekend valid wear day as any consecutive 10-hour period.

2.4.3 Movement sampling

The devices were programmed to sample movement at a frequency of 100Hz (or once every 0.01 seconds), which is sufficient to capture foot acceleration during the heel strike of walking and running (Welk, 2002). The dynamic range – the difference between the largest and smallest force that the accelerometer can capture – was set at +/- 8g, where g is acceleration due to gravity, 0.98ms^{-2} . This range is

sufficient to capture the acceleration of moderate-to-vigorous activities such as running (Welk, 2002).

2.4.4 Piloting seven-day accelerometer wear

Two males aged ten and 13 agreed to wear the devices for a week to test for potential compliance issues and to trial the data analysis protocol. The devices can be set to flash during recording, but participants found this disturbing at night, so the function was turned off for the study. Overall, the AX3s were well-tolerated.

2.4.5 Raw data analysis

Axivity's Open Movement GUI software was used to convert the raw accelerometer data into physical activity 'counts' per 60-second period, or epoch. The programme then calculated whether an epoch was spent in sedentary, light, moderate and vigorous activity by applying 'cut-points', or defined counts per epoch, that correspond to different activity intensities. Both studies used cut-points established by Phillips, Parfitt, and Rowlands (2013) validated for use with the GENEActiv accelerometer among children aged 8-14 years. In line with previous adolescent PA research - eg Cain et al. (2013) and Heil, Brage, and Rothney (2012) - the author employed 60-second epochs because they adequately capture the length of moderate-to-vigorous activity bouts necessary to deliver health outcomes (Strath, Holleman, Richardson, Ronis, & Swartz, 2008). Furthermore, they offer an acceptable trade-off between measurement accuracy and the volume of raw data to be stored and processed (Trost, McIver, & Pate, 2005). Total minutes of sedentary, light, moderate and vigorous activity per day were summed using an Excel programme written by Oxford Brookes University. Non-wear time was defined as periods of at least 30 consecutive minutes of zero activity counts. Participants who had at least three valid weekdays and one valid weekend day were included in the analysis (Troiano et al., 2008). The following formula was used to standardize daily average MVPA to one week for all participants (Menai et al., 2017):

$$\frac{(5 \times \text{Mean Daily Weekday MVPA Minutes}) + (2 \times \text{Mean Daily Weekend MVPA Minutes})}{7}$$

7

2.4.6 Selecting a self-report measure of physical activity

Researchers have developed numerous questionnaires to measure the frequency, duration and context of physical activity over a variety of recall periods and in different populations, including adolescents (Chinapaw, Mokkink, van Poppel, van Mechelen, & Terwee, 2010). These instruments typically ask participants to recall whether they engaged in specific activities such as football or cycling, and also what activities they completed during given time periods such as morning, evening or break time. They can take up to 15 minutes to complete, which potentially represents a burden in a school setting. As well as issues of presentation bias and cognitive challenge, many of these self-report measures also fail to provide estimates of MVPA that can be compared with the suggested guidelines of 60 minutes per day (Aaron et al., 1995). Furthermore, there are discrepancies between self-reported and objective MVPA: adolescents tend to over-estimate their activity levels, and inactive young people appear to inflate their estimates by more than their active counterparts (LeBlanc & Janssen, 2010). Indeed, in their review, Chinapaw and colleagues (2010) noted that assessing PA questionnaires' validity is problematic because the benchmark measures against which they are assessed – such as accelerometry or heart rate monitoring – are themselves imperfect measures of activity. These authors concluded that the Oxford Physical Activity Questionnaire (D R Lubans, Sylva, & Osborn, 2008), a multi-item 7-day recall survey, is among the most reliable adolescent PA questionnaires, with acceptable validity when compared with accelerometry. Overall, then, researchers have only a limited choice of questionnaires that deliver a valid and reliable measure of the number of days per week in which young people achieve the target of 60 minutes per day of MVPA.

Two decades ago researchers developed a screening tool, for use among young people in primary care settings, to identify non-compliance with MVPA guidelines (Prochaska, Sallis, & Long, 2001). The measure was adapted for the *Health Behaviour in School Aged Children* survey, an international investigation of the health, wellbeing and associated social environments of children in 44 countries, published every four years by the World Health Organisation. The measure initially included two items measuring PA 'over the past seven days' and 'during a typical week'. These items were found to be both reliable (intraclass correlation = .77) and to correlate significantly ($r = .40, p < .001$) with objective PA data from United States

adolescents (Currie et al., 2010). Given the need for brevity, the 2013/14 HBSC survey included a description of MVPA and a single item:

“Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, school activities, playing with friends, or walking to school. Some examples of physical activity are running, brisk walking, rollerblading, biking, dancing, skateboarding, swimming, soccer, basketball, football and surfing. Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? Please add up all the time you spent in physical activity each day.”

A recent study demonstrated that the measure showed acceptable validity for measuring non-compliance with PA guidelines among 15-17 year-olds (Ridgers, Timperio, Crawford, & Salmon, 2012), while studies from Finland and China observed acceptable test–retest reliability (Liu et al., 2010; Vuori et al., 2005). More recently, Scott et al. (2015) built on the HBSC measure to develop a single-item designed to assess MVPA over the previous week, using government health guidelines as a framework:

‘In the past week, on how many days have you done a total of 60 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise and brisk walking or cycling for recreation or to get to and from places’. Participants select the appropriate response from an 8-point ordinal scale, 0-7 days,

The measure demonstrates reliability that is comparable to the OPAQ (Scott, Morgan, Plotnikoff, & Lubans, 2015). Specifically, the single item’s intra-class correlation coefficient (ICC) = 0.75, 95% CI = 0.64–0.83, $p < 0.001$, while the correlation with objectively-measured MVPA is medium, $r = 0.44$, 95% CI = 0.24–0.63, $p < 0.001$). This measure has been used in recent studies (eg Lubans et al., 2016). The author opted to use this measure for brevity, as discussed in section 2.3.1.

A meta-analysis of 57 studies exploring associations between accelerometry and self-report measures of PA across all age groups concluded that objective and subjective measures are associated (Skender et al., 2016); a third of the studies included reported $r \geq .40$ and correlations tended to be higher for younger age groups. Nevertheless, the self-report measure captures the number of days on which participants achieve target health guidelines while accelerometry data gives a continuous measure of minutes per day of physical activity.

2.5 Developing an Implicit Association Test for non-conscious bias

The Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998) measures mental associations, or biases, that exist outside of conscious awareness but which can nevertheless influence our behaviour (Strack & Deutsch, 2004). IATs allow researchers to explore implicit attitudes that participants are unable (or unwilling) to access, and which are therefore unavailable to explicit self-report measures. Study 3 included two IATs measuring non-conscious bias towards prototypes, and non-conscious self-perceptions. Both were developed according to theoretical guidelines set out by Greenwald et al. (1998); Greenwald, Nosek, and Banaji (2003); Nosek, Greenwald, and Banaji (2005) and Greenwald, Poehlman, Uhlmann, and Banaji (2009).

The IAT is a computer-based sorting task which assesses the relative strengths of associations between a target concept (*'active' or 'inactive'*) and a target attribute, such as an evaluation (*'positive' or 'negative'*) or an identity (*'me' or 'not me'*). In the task, participants must classify stimuli – in this case words and images – according to whether they are *active/inactive* or *positive/negative* as quickly as possible. The task rests on the assumption that the more strongly participants associate two concepts (eg *'active'* and *'positive'* or *'active'* and *'me'*) the faster and more accurately they perform.

Since its introduction, there has been much debate about IAT design, analysis and interpretation. Because attitudes are inferred from response latencies rather than directly interrogated via questionnaire, IATs are said to avoid the problem of self-presentation bias (Greenwald et al., 1998). But others have argued that implicit bias is confounded by mere familiarity with the concepts (Ottaway, Hayden, & Oakes, 2001). De Houwer (2001) suggested that it is possible to confound concept and attribute (for example an attractive, inactive person) and that an unclear valence will affect overall task performance. Westfall, Judd, and Kenny (2015) have raised the stimulus-as-fixed effect fallacy, which suggests that researchers' conclusions apply only to the stimuli presented and cannot be generalised to, for example, all physically active prototypes. Some researchers have also suggested that, because the test uses relative measures such as *active/inactive*, there is an underlying assumption that participants favour one over the other, whereas in fact they might be ambivalent (Blanton, Jaccard, Gonzales, & Christie, 2006).

2.5.1 IAT platform and software

Historically, IATs have been run in laboratory settings using local computers. But recently there has been a move towards large-scale testing using web browsers in schools or universities (Gosling & Mason, 2015). In these settings, researchers typically run online IATs using a commercial platform such as Inquisit, which requires participants to install plug-ins on their personal computers; or they build and host their own websites using, for example, JavaScript. Both options are costly, and require time and programming expertise. The author therefore used *iatgen*, a free, validated tool that runs in Qualtrics and allows researchers to combine implicit tests and explicit self-report measures in a single survey (Carpenter et al., 2017). *Iatgen* runs a standard seven-block IAT (Greenwald et al., 1998), described in more detail in section 2.5.2 on IAT design. It also cleans data and calculates scores using the algorithm recommended by Greenwald et al. (2003).

2.5.2 IAT design

The Prototype Favourability IAT measured adolescents' implicit attitudes towards physically active and physically inactive images. The Prototype Similarity IAT, which draws from the Self-Concept IAT (Greenwald & Farnham, 2000) and the Drinker Identity IAT (Gray, LaPlante, Bannon, Ambady, & Shaffer, 2011) measures the extent to which active/inactive characteristics are a defining aspect of participants' identity.

Target concepts. Category labels should directly reflect the constructs of interest (Nosek et al., 2005). The words '*active*' and '*inactive*' represented the concept of the physically active prototype and the physically inactive prototype. To ensure participants understood these concepts, and that they did not confound 'physically active (inactive)' with 'physical activity', the on-screen instructions also described "*the sort of person your age who is physically active (inactive).*"

Attribute concepts. The favourability IAT used 'positive' and 'negative' as evaluative attributes, while the similarity IAT used 'me' and 'not me'.

Stimuli. The number of stimuli were limited to 4 in each category of target concept and attribute (i.e. 16 overall), which is sufficient to maintain validity without sacrificing brevity (Nosek et al., 2005).

a) *Physically active (inactive) stimuli*. In both IATs, the stimuli used to represent physically active (inactive) prototypes were images of stick-people so that the activity level changed while all other individual characteristics were held constant: concept and attribute were not confounded.

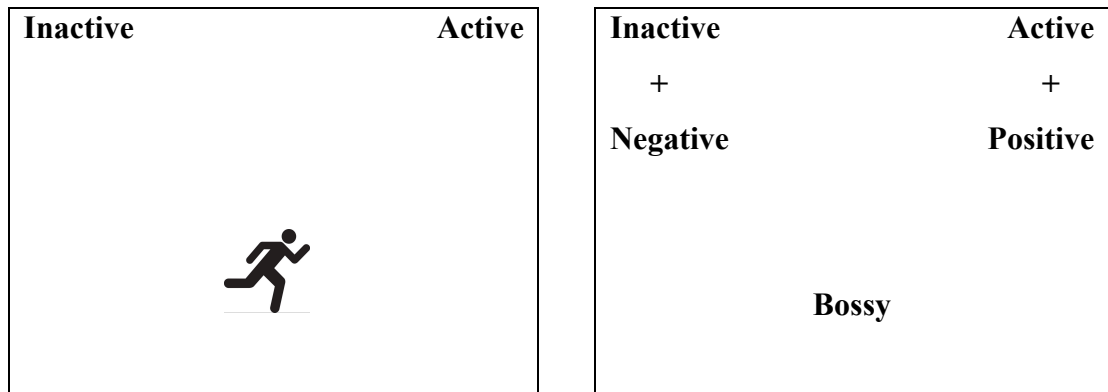
b) *Positive (negative) stimuli*. These were words describing social characteristics. Word stimuli need not be letter- or syllable- matched, but they should be equally salient to all participants (Rothermund & Wentura, 2004). Therefore both positive attributes - *confident, popular, determined, attractive* – and negative attributes - *annoying, bossy, judgmental, grumpy* - were drawn from the thematic analysis of young adolescent focus groups reported in Chapter 3. These terms matched the explicit self-report measures used throughout the research project.

c) *Me (not me) stimuli*. In line with previous research (Greenwald & Farnham, 2000), these were synonyms for me/not me: *I, my, mine, self* and *they, them, their, others*.

2.5.3 IAT procedure

Participants begin by placing their left and right fingers on the ‘E’ and ‘I’ keys on a computer keyboard. They then complete seven blocks of sorting trials. In the first block, participants practice sorting stimuli by target concept. For example, if a stick person sitting down appeared in the middle of the screen, a participant would press E, the left key, to correspond to ‘Inactive’ written on the left of the screen. If a running stick-person appeared, they would press I, on the right, where ‘Active’ is written. In the second block, they sort by attribute concept, pressing one key for ‘Positive’ if ‘attractive’ appears and the other key for ‘Negative’ if, for example, ‘bossy’ appears. Trials advance only when a correct response is given, to encourage accuracy. These blocks help familiarise participants with the concepts and stimuli; they are not scored.

Figure 2.2: Example IAT screens showing target and stimuli



Next, concept and attribute appear together. Now, if a running person appears, participants are required to press the key for ‘*Active + Positive*’. If the word ‘bossy’ appears, they press they key for ‘*Inactive + Negative*’. In the third trial the congruent concepts are paired (‘*Active*’ + ‘*Positive*’), and in the fourth they are switched (‘*Active*’ + ‘*Negative*’). In total there are 60 trials, of which 20 are practice (block three) and 40 are critical (block four). The next block, also not scored, consists only of the target concepts, but ‘*Active*’ and ‘*Inactive*’ switch sides. Finally, participants complete another set of trials with concept and attribute combined and in their new positions. Now, ‘*Active + Negative*’ appear on the left of the screen. Again, there are 20 practice trials (block six) and 40 critical trials (block seven). If participants make an error, a red cross appears on the screen and remains until the correct response is given. For blocks three, four, six and seven, iatgen software records a response latency, measured in milliseconds and defined as the time from the onset of stimulus presentation to when a response key (correct or incorrect) is pressed. The IAT takes approximately 5 minutes.

2.5.4 Data cleaning and processing

Following the procedure recommended by Greenwald et al. (2003), participants who record <300ms for more than 10% of responses are removed, and individual trials over 10,000ms are deleted. Where participants have made an error, the time spent correcting the mistake is included in latency score. The IAT score, or D score, is calculated as follows. First, the programme computes the mean latency per block. Next, it subtracts the mean scores on the congruent blocks from the mean score on

the incongruent blocks (block 6 minus block 3, and block 7 minus block 4) and divides the difference by its associated pooled standard deviation. Finally, these two figures are averaged. A positive score indicates that participants have relatively stronger associations between the congruent target and attribute (*'physically active'* and *'positive'*) than between the incongruent target and attribute (*'physically active'* and *'negative'*).

2.5.5 Piloting

Five participants aged 11-14 were asked how well 12 target images represented physically active (inactive) people using a 3-point Likert scale, 3 = very good, 2 = okay and 1 = not so good (Andrews, Hampson, Greenwald, Gordon, & Widdop, 2010). The 4 active (inactive) images with the highest mean score were selected. The same participants were able to sort all the proposed word stimuli into either good/bad or me/not me categories. Once the IATs were uploaded into Qualtrics, 14 adults and children checked the clarity of the instructions and the visual design. The software was trialed on one participating school's computer network prior to testing.

The experimental studies that follow refer back to the methodologies outlined in this chapter.

3

Chapter 3

A Focus Group Study of Constructs in the Prototype Willingness Model

3.1 Introduction

Chapter 1 outlined the health benefits of physical activity (PA) in adolescence (Biddle & Asare, 2011; Janssen & LeBlanc, 2010). Informed by research, government guidelines suggest that to obtain these benefits, young people should spend at least 60 minutes per day in MVPA (Strong et al., 2005; Davies, Burns, Jewell & McBride, 2011). The proportion of young people meeting the MVPA target falls sharply through adolescence (Inchley et al., 2016), despite the development of numerous interventions to increase activity in this age group (Van Sluijs, McMinn & Griffin, 2007). In Britain and elsewhere, the decline in PA at age 11 coincides with the transition from primary to secondary school, a time of significant social and environmental change (Cotterell, 1982; Santrock, 2005) and changes in self-rated quality of life (Gillison, Standage & Skevington, 2008). Theory-based PA interventions have been found to have stronger effect sizes than atheoretical approaches (Metcalf et al., 2012) so it is important to explore constructs that might make effective targets for interventions (Michie, Johnston, Francis, Hardeman & Eccles, 2008).

The Theory of Planned Behaviour (Ajzen, 1985, 1991) is a model of reasoned decision-making used widely to investigate PA behaviour (Hagger, Chatzisarantis & Biddle, 2002). Attitudes, subjective norms and perceptions of behavioural control are thought to shape intentions, which in turn predict behaviour. But when applied to PA, the model leaves a large proportion of variance in behaviour unexplained (Hagger, Chatzisarantis & Biddle, 2002). Reasoned PA intentions do not always lead to action (Rhodes & Bruijn, 2013). Furthermore, the relationship between exercise intentions and actual behaviour is significantly weaker among samples under age 25 than among older groups (Hagger et al., 2002; Rhodes & Bruijn, 2013). This limitation is critical because the TPB underpins many adolescent PA interventions (Hardeman et al., 2002).

Research from a cognitive neuroscience perspective indicates that adolescent decision-making is characterised by susceptibility to peer pressure, heightened self-consciousness and propensity for risk-taking in the presence of other young people (Blakemore & Mills, 2014; Steinberg, 2008). Evidence suggests that impulsive

behavioural choices prompted by social factors, not accounted for in the TPB, might influence decision-making about PA – and that dual-process models that propose both a reasoned and a reactive path to decision-making might provide a fuller explanation of adolescent health behaviour (Reyna & Farley, 2006; Ravis et al., 2006).

The Prototype Willingness Model (Gibbons & Gerrard 1995; Gerrard et al., 2008) builds on the TPB and its predecessor, the Theory of Reasoned Action, by adding a second decision-making pathway to account for impulsive or unplanned behaviour. In the ‘reasoned action’ path, intentions and behaviours are determined by attitudes, descriptive social norms and past behaviour, while the ‘social reaction’ pathway accounts for unplanned, impulsive behaviour in social situations. In this path, decisions are predicted by ‘willingness’, or openness to engage in behaviour. This in turn is determined by perceptions of prototypes: to adolescents, these images represent the social consequences of the behaviour (Gibbons & Gerrard, 1997). The PWM has been used widely to describe health-risk behaviours including smoking and drinking, and, more recently, to explore health promoting behaviours such as healthy eating and safe sex (Todd et al., 2014; van Lettow, de Vries, Burdorf, & van Empelen, 2016). The few studies that have used the PWM to investigate physical activity have shown promising results (Ouellette et al., 2005; Ravis & Sheeran, 2003). Because willingness to engage in behaviour is determined by perceptions of prototypes, and their associated social consequences, it is important to evaluate whether, and to what extent, adolescents have a positive or negative evaluation of the typical active (and inactive) person of their age. A more thorough understanding of how this group thinks about constructs in the PWM could help establish whether the model might improve the effectiveness of multi-component interventions to increase activity.

3.1.1 Physical activity and constructs in the Prototype Willingness Model

Although the TPB has been widely used to explore adolescent PA (Godin & Kok, 1996; Hagger et al., 2002), and studies have explored attitudes and norms concerning activity in this age group (Allender, Cowburn, & Foster, 2006), less is known about how young British adolescents perceive and evaluate PA constructs in the PWM’s social reaction pathway. Qualitative methods are suited to this type of exploratory

work because they provide the researcher with a thorough understanding of how the target population thinks and feels about the behaviour (Patton, 2002). The following section summarizes key qualitative findings concerning adolescents' attitudes, subjective norms and prototypes concerning activity.

3.1.2 Adolescent PA attitudes, subjective norms and prototype perceptions

Previous qualitative research has considered adolescents' attitudes and beliefs about PA, although investigations of PA prototypes have used quantitative methods.

Attitudes. There is evidence that adolescents have clearly-defined affective and instrumental attitudes towards physical activity. For example, a focus group study of Canadian adolescents identified beliefs about the benefits and consequences of activity including maintaining physical and mental health and taking part in activities with friends (Bélanger et al., 2011). For young girls, concerns about body shape and weight management are key reasons for participation according to a review of qualitative studies (Allender et al., 2006). An American focus group study identified concerns about safety as a barrier to active commuting to and from school (Bauer, Yang, & Austin, 2004).

Subjective norms. Both parents and friends appear to influence adolescent physical activity. For example, the Canadian study found that gestures of parental support such as attending sports matches, buying equipment and offering lifts facilitate activity. The examples set by siblings and parents have also been identified as an important influence in qualitative research (Bélanger et al., 2011). For young British girls, behaving as friends do is a particular concern (Whitehead & Biddle, 2008), while an Australian study found that sport is not perceived as a normative behaviour for girls (Slater & Tiggemann, 2010).

Prototypes. Existing evidence is drawn from samples of university students or from participants outside the UK. Research in the USA describing physical activity images suggests that exerciser and non-exerciser prototypes are not only clear, but also more vivid than those of other healthy-behaviour images such as non-smokers (Ouellette et al., 2005). Ravis and Sheeran (2003) found that British university students perceive active images positively. When asked to write down three words to describe an exerciser prototype, most participants said 'physically fit', 'motivated' and 'healthy'. The only unambiguously negative evaluation, mentioned by a small

fraction, was a ‘bore’. A Hungarian study also explored physically-active prototypes with young people aged 14-21 (Keresztes, Piko, Gibbons, & Spielberger, 2009). Here, active prototypes were again positive, and were divided in ‘personality’ characteristics and ‘health and fitness’ characteristics.

3.1.3 Aims of Study 1

Although there is qualitative evidence that attitudes and norms from the ‘reasoned action’ path of the PWM are relevant to the target population, less is known about how young British adolescents think and feel about active and inactive images, and how they might influence willingness and behaviour. Previous studies show that preliminary qualitative work with adolescents can help establish how a target population thinks about and describes prototypes (Davies, Martin & Foxcroft, 2013). The overarching objective of this study was therefore to establish whether the PWM might improve our understanding of young adolescent PA by exploring whether theoretical constructs in the model are relevant to this population in the context of physical activity. In particular, evidence of dual-process decision-making would suggest that the PWM provides a fuller explanation of young people’s PA than models based on rational intentions alone. The primary aims were therefore to search for evidence of:

- widely-recognised and agreed-upon active and inactive typologies that include social characteristics as well as physical descriptions
- planned (reasoned) and impulsive (social reactive) decision-making concerning physical activity

To inform subsequent studies, secondary aims were to:

- explore contexts in which planned and unplanned decisions take place to aid the construction of questionnaire items designed to measure ‘willingness’ as described in section 2.3.1.
- select adjectives to construct questionnaire items designed to rate prototype evaluation (see Section 2.3.1)

3.2 Method

3.2.1 Design

Prototypes are defined as widely-accepted social images (Gibbons & Gerrard, 1995), so it is important to understand how young adolescents discuss, describe and agree upon their impressions of typical active and inactive peers. Focus groups are an appropriate method to explore participants' perceptions about prototypes because they stimulate peer-led responses and reflections (Kitzinger, 1995). During focus groups, participants' responses are prompted by other members and could differ from the answers they might give on a one-to-one basis (van Teijlingen & Pitchforth, 2006). As a consequence, answers might more closely reflect how participants might act in social situations. Previous studies have successfully used focus groups to explore young people's attitudes to prototypes (Davies et al., 2013).

The author chose a purposive sampling technique, asking PE teachers to identify and select articulate participants who were willing to share, and reflect upon, their knowledge and experience of PA in a school setting (Patton, 2002). Teachers with knowledge of Year 8 pupils were therefore asked to nominate six participants (three male and three female) who were active in PE or school sports teams, and another six (three male and three female) who were inactive in these settings, from a range of ethnic backgrounds, to take part in the study. From these, the author constructed mixed-gender groups with five or six participants arranged by school attended and activity level, to encourage participants to share their common thoughts about, and experiences of, PA in the school setting. Focus groups – eight in total – were held until no new codes emerged.

All data was collected and reported with reference to the 32-item COREQ checklist for qualitative studies (Tong, Sainsbury, & Craig, 2007).

3.2.2 Participants

Forty-five participants (22 male, aged 12-13) were recruited from four of the state secondary schools in Oxfordshire and Berkshire taking part in the Fit to Study pilot phase. Of the 48 students nominated, 1 withdrew and 2 were absent on the day. Socio-economic status can affect PA participation (Humbert et al., 2006) so although all the schools were in urban locations, the institutions had different socio-economic characteristics to capture a range of possible activity levels. The percentage of pupils

receiving free school meals, an indicator of economic deprivation, was 14%, 12.9%, 8.1% and 4.6%, against the national average of 13.2% (Department of Education, 2016). There were no incentives to participate, and participants were unaware that they had been nominated as active or inactive.

3.2.3 Procedure

The schedule consisted of three main questions and a number of prompts, prepared after reviewing the PWM literature and discussions with a practiced moderator. The author, who has experience of working with adolescents but no prior knowledge of the participants, conducted the focus groups in a quiet location on school premises. She audio-recorded the discussions (which lasted 30-40 minutes), took supplementary notes, and transcribed the recordings within a week.

As an icebreaker, participants were asked:

“The Chief Medical Officer (‘Britain’s top doctor’) advises that young people take part in 60 minutes of physical activity a day – activity that raises your heart rate, makes you breathe harder and feel warmer. What are your views about that?” (Davies et al., 2011).

The first question probed images participants held of people their own age who meet (and do not meet) these guidelines. This question was grounded in the literature on prototype perception:

“I am really interested to know your ideas about typical members of different groups. When we think about the typical person who does something we often get an image in our heads about that person. For example if you were to ask me what the typical grandmother is like I might say that she is sweet. If you asked me about the typical movie star I might say they are pretty or rich. Can you tell me what words you might use to describe the image of the typical person of your age who takes part in physical activity for an hour every day?” (Gibbons et al., 1995) p87. Participants were also asked to describe the images of a typical person of their age who does not take part in PA for an hour every day.

Next, participants were asked to explore situations or places where they might choose to be active or inactive during school hours and in leisure-time:

“Can you think of any situations or places where people your age would be have the option to engage in or skip physical activity? I am thinking about times

when you travel to and from school, break and lunch time, after school and at the weekend.”

Finally, participants could raise any other personal observations about PA: *“Is there anything else we have not discussed about taking part in physical activity for an hour a day that you would like to add?”*

3.2.4 Data Analysis

Qualitative research is a systematic enquiry into social phenomena in their natural settings: it seeks to understand the meaning that participants ascribe to their experiences (Patton, 2002). The researcher plays an active role in interpreting data, so the author used meetings of the Oxford Brookes Qualitative Forum, and discussions with one of her supervisors, to reflect on, and acknowledge, her values and judgements, and the potential for personal bias during analysis.

The author used thematic analysis, a theoretically flexible yet rigorous and systematic method of exploring how unique personal experiences are understood (Braun & Clarke, 2012). This type of analysis allows the researcher to play an active, reflective role in the interpretation of participants’ accounts of their experiences, and to identify, report and analyse patterns within the data (Boyatzis, 1998). To achieve this, the author first took a realist approach to the data. An initial deductive analysis searched for explicit, semantic themes relating to the prototype willingness model, following the six phases described by Braun and Clarke (2006): familiarization; generating initial codes; searching for themes; reviewing themes; defining and naming themes; and producing a report. The author also used inductive analysis to identify latent themes, more common in a constructivist paradigm (Burr, 2015), to further explore and understand the thoughts and feelings that might underpin decisions about physical activity, and to provide a richer description of the data overall.

Analysis took place using NVivo 10 software. Two researchers, the author’s supervisor and a doctoral student with experience of thematic analysis, each randomly selected and recoded two transcripts. These researchers, with the author, discussed and revised categories to establish coding precision and coherence. Participants did not review the transcripts or the data. After additional discussions, all researchers produced a mutually agreed, final set of codes. The author developed a table showing main themes and their links with sub-themes.

3.3 Results

In relation to the study's primary aims, the initial, deductive analysis found evidence of active and inactive prototypes that were widely-recognised and shared (described in Theme 1) and of planned and impulsive decision-making concerning PA (described in Theme 2). This phase of the analysis also supported a third main theme concerning attitudes to PA. Further inductive analysis established evidence for two sub-themes of social anxiety about peer evaluation and playground norms which provided further indications that physical activity in this age group is not driven by rational intentions alone. Active and inactive groups broadly agreed on their prototype descriptions, but there was stronger evidence that social anxiety influenced PA decisions among inactive participants. Themes and sub-themes are presented in Table 1, below.

In relation to the study's secondary aims, the contexts in which planned and unplanned decisions are made are described in Theme 2. Attitudes towards prototypes, which helped inform the choice of adjectives to construct questionnaire items, are described in Theme 1 and further illuminated by self-descriptions provided in Subtheme b) of Theme 2. How adjectives were selected for constructing the prototype rating scales is described in Section 3.4.1, below.

3.3.1 Theme 1: Prototypes

Most participants could agree on and describe the typical physical and social characteristics of active and inactive young people. A small number were unwilling to define these prototypes: they suggested that all individuals were different.

Subtheme a): Active images have positive and negative characteristics. Both high and low-active participants had a broadly positive image of active young people. The active prototype appeared to consist of social as well as physical characteristics. This type was often described by both groups as 'fit', 'healthy' and 'lean' – and also as 'energetic', 'competitive' and, less positively, 'judgmental'. The general perception was that this type of person has a high social profile: inactive groups described them as 'popular'. Participants also appeared to suggest that this prototype might not be interested in academic achievement.

Table 3.1: Themes and Subthemes Relating to the Prototype Willingness Model

Main Theme	Sub Theme
1: Prototypes	a) Active images have positive and negative characteristics b) Inactive images have negative characteristics c) There are no prototypes, only individuals.
2: Planned/impulsive decisions	a) Social anxiety about peer evaluation b) Playground norms c) Impulsive PA decisions d) Planned PA decisions
3: Attitudes	a) Affective attitudes b) Instrumental attitudes c) Attitudes to school PE

Active groups tended to view this prototype particularly positively, stressing characteristics such as confidence, leadership, determination and focus. An active female from School Four said:

“I feel like if you’re into like a sport, and you really want to do it, then you know your goals and you know what you want to do, so you’re more focused on things rather than being, like, kind of happy-go-lucky.”

Some inactive groups discussed experiences of being judged negatively by these types of people, describing them as ‘bossy’, ‘image-conscious’ and ‘show-off’. One inactive male from School One observed:

“Sometimes they can be quite arrogant, um, in terms of they think that they are just like unbeatable, and they sometimes – this is the image I get – that they just maybe assume that they are better than the, um, than other people because they are better at certain sports.”

Subtheme b): Inactive images have negative characteristics. Both groups seemed to have a more negative image of the inactive prototype, describing this type of person as ‘lazy’, ‘fat’, ‘unmotivated’ and a ‘gamer’ who plays with electronic devices. There appeared to be a belief that this type of person lacks physical energy

but is, if anything, focused on academic achievement. Among active groups, there was a perception that this type of person does not care about appearance or competing, although some suggested they were ‘smart’. An active female from School Three suggested:

“They may use like their intelligence instead of necessarily doing sports and things like that. Like they might be really good at art and not as good at sports.”

Conversely, inactive groups talked about how the inactive prototype is very concerned about how physically competent they appear. This type of person is:

“...very embarrassed and very self-conscious about their look and their image,” according to an inactive female from School One.

Subtheme c): There are no prototypes, only individuals. A small number of participants from both groups suggested they had no clear mental picture of PA prototypes, arguing that individuals were active or inactive at different times, and for various reasons. A group of active females from School Four said:

Female 1: *“Everyone has their strengths, everyone has their weaknesses, and everyone is different in their own way. Everyone kind of has their own sort of area of expertise, so like, in like forms and stuff, I think - ”*

Female 2: *“It’s such a range of people - ”*

Female 1: *“Yeah, there a load of random people but we’ve all got our, we’ve all got similarities and we’ve all got differences.”*

3.3.2 Theme 2: Planned and impulsive PA decisions

Participants described daily opportunities to be active in contexts including the commute to and from school, activities during recess, PE, after-school sports clubs, weekend leisure activities and competitive sports. There was evidence of both planned and impulsive, unplanned decision-making. Impulsive activities were often presented as responses to an environmental context characterised by social anxiety about peer evaluation, and playground norms. By contrast, planned activities appeared to be routine and often supported by parents.

Subtheme a): Social anxiety about peer evaluation. Active and inactive participants discussed how they had become aware of, and concerned about, peer evaluation since starting secondary school. Inactive females from School One said:

Female 1: *“Yeah, like in primary nobody really cared about judging you and like here everyone like focuses on you and sees what you don’t know.”*

Female 3: *“Everyone focuses on your looks.”*

Female 2: *“If you’re popular... it’s all about popularity and where you stand in the chain.”*

Female 1: *“In primary nothing happened like that.”*

Evidence suggested that peers judged physical appearance and competence in a PA context. Inactive participants mentioned concerns about appearing clumsy or incompetent, feeling self-conscious and being laughed at or patronised:

Female 1: *“Because like if you’re fat, and like don’t really want to be running in front of people, because you might be like ‘Oh-’”*

Female 2: *“They’re slow-“*

Female 1: *“Yeah, people might think, “Oh you are slow and fat, what are you doing?”* (Females, Inactive, School Three).

They suggested that, although these evaluations are a ‘natural’ feature of adolescence, they can lead to negative feelings including fear, anxiety and self-consciousness. One inactive female from School One noted that:

“It makes you really uncomfortable and you just don’t enjoy sports as much as you used to.”

Active participants expressed ego-oriented concerns, describing how they feel pressure to maintain their reputation for competence. They talked about feeling ‘worried’ if others are better at sport. One active female from School One said that: *“You kind of want to show everyone that you can do it.”*

Sporting ability in school seemed linked with social popularity among peers. Both high and low-actives suggested that PA is judged positively and brings social credit, according to an active male from School Three:

“If you’re good at sport then people know you for being good at sport and so you get a bit more popular.”

Some active participants mentioned that although they had a high profile as a consequence of sporting success, they were considered a ‘show-off’. Both active and inactive groups suggested that PE lessons explicitly encourage peer appraisal

because the main goal is no longer ‘having fun’ but ‘winning.’ Students described being streamed by ability and put into overtly competitive situations. Inactive groups talked about how pupils complain when they are allocated team-mates they perceive to be bad at sport. They also discussed how they were evaluated for making mistakes. An inactive male from School One commented that:

“People are going to judge you if you don’t get it right so you make your team lose.”

Subtheme b): Playground norms. An active female from School Two described how social norms in secondary school playgrounds were less active those in primary school:

“It’s like a big jump from primary school. Because at primary school like you’ve got the playg – so you eat in the lunch hall, and then you go into the playground, and usually you find that you run around and you play games. But at secondary school because you are getting older I find that you don’t, like, do as much.”

Some active participants described joining a football or basketball game, but inactive participants appeared to prefer fitting in with prevailing playground behaviour, which involves sitting and talking. An inactive male participant from School Four noted that:

“In primary school, like, everyone would run about at break and lunch. At secondary school you are like, if you run around, like, like, round here or something, it would look a bit weird so no one would really do it.”

Female participants described how they would be unlikely to join male-dominated playground games, such as football, as this behaviour would be considered ‘embarrassing’. One active female from School Four said:

“People might find it weird if you, like, start up your own, like, space where girls are playing football. Or you can’t really go and join in because you would probably feel like intimidated or you wouldn’t know people, you wouldn’t enjoy it.”

Subtheme c): Impulsive PA decisions. Both active and inactive groups discussed unplanned or impulsive decisions to engage in PA, such as playing with siblings in the garden or going to the park when friends called unexpectedly. These

seemed to occur outside the school setting. They also described impulsive decisions to avoid PA during school break, which appeared driven by a desire for peer acceptance. One inactive female from School Three noted that:

“We kind of just make a group decision on what to do, and we just do it.” An inactive male from the same school stressed how choices are influenced by friends’ preferences:

“I guess it kind of depends on what your friends are doing as well, because if they’re not going to do it with you, then you kind of don’t want to do it.”

Subtheme d): Planned PA decisions. Both active and inactive participants discussed walking or cycling to school as planned, routine PA, disrupted only by practical issues such as bad weather or the need to carry heavy items. Participants who travelled on public transport or by car mentioned barriers including distance to school and dangerous roads. Both groups talked about attending non-school sports clubs as planned activities, supported by parents. They discussed how the social environment at these clubs is less judgmental. An active female from School Three observed:

“Like at school it’s kind of like, what those things you are expected to do, but outside school you can just do what you want. It’s a different environment.”

Active participants seemed particularly aware of competing demands on their time, and of making explicit choices between sports and other activities. Some mentioned how they sacrificed time with friends to pursue sport. An active male from School One evoked the clash between studying and PA:

“I used to do swimming which was around five times a week but I decided to stop because it was too much on top of all the, er, school work and I also wanted to do football and I just couldn’t balance all three of those.”

3.3.3 Theme 3: Attitudes Towards PA

Subtheme a): Affective attitudes. Evidence from the transcripts suggested participants hold strong affective attitudes towards PA, although there were clear individual differences in which activities were “fun” and which were “boring”. Participants appeared to place emphasis on physical sensations: active adolescents described feeling “adrenaline” and a “happy rush” while inactive participants

mentioned feeling “out of breath” and “pain”. Adolescents appreciated the freedom to move energetically in the fresh air in contrast with desk-based lessons, according to one inactive male from School Three:

“Yeah, I enjoy sports a lot because you are not just stuck in a stuffy classroom”.

An active female from School Four commented that:

“PE is, like, the best bit of the day because it’s, like, outside.”

Subtheme b): Instrumental Attitudes. Participants also discussed feelings of psychological well- or ill-being including pleasure at achieving mastery, enhanced mood, and improved self-esteem. An active male from School Two said:

“I like it when you find something hard, and then you practice at it, and then you become better, and it starts to feel more comfortable, and then you get like new PBs.”

By contrast, inactive participants described feelings of performance anxiety. One inactive female from School One said:

“I get like all quiet and shy and all that - that’s when I don’t take part in lessons.”

Both active and inactive adolescents talked about how PA is ‘healthy’ although the key perceived benefit is that it compensates for poor eating habits. An active female from School Three commented that:

“I like eating junk, but then I do eat fruit and stuff and I try to be healthy, but I know that if I don’t do sport I would get very big.”

Most participants appeared to be know they should spend at least 60 minutes per day in MVPA, yet there was a general lack of concern about the long-term health-risks of inactivity, as described by an inactive male from School One:

“I know like all the stuff that they say about, you know, it being really healthy and important, but I just don’t feel like I need to do that.”

Subtheme c): Attitudes to PE. School PE, and teachers, appeared to provoke strong affective and instrumental evaluations, of which the balance appeared negative. Both active and inactive participants complained that some sports were “boring” and that they disliked being compelled to take part in these activities. Some participants felt that lessons were not active enough, that they lacked “choice” and

could be “pointless”; and that the emphasis on rules and technique was frustrating.

As one inactive male from School Two put it:

“What I don’t like about sports is when you’re having fun with your friend in PE and then your teacher calls you over to talk to you and stuff like that. I don’t like that. I just want to carry on.”

3.4 Discussion

To the author’s knowledge, this study is the first to explore whether the PWM might improve our understanding of young adolescent PA by seeking qualitative evidence that theoretical constructs in the model – and in particular dual-process decision-making - are relevant in this context. In support of the study’s primary aims, it appeared that young British adolescents in this sample held both active and inactive prototypes that included social and physical characteristics. Participants also described planned PA, such as commuting to school or taking part in after-school sports, and more spontaneous decisions concerning activity, often in response to feelings of social anxiety or playground norms.

This study adds to the relatively little known about PA prototypes and suggests a number of avenues for future research. Participants appeared to agree on descriptions of an active prototype, and generated some of the same characteristics reported by Ravis and Sheeran (2003) in their work with older adolescents. These included ‘fit’, ‘healthy’ and ‘popular’. Other descriptions from this sample - such as ‘determined’, ‘focused’ and ‘energetic’ - evoked dynamic qualities, suggesting that this prototype is regarded as a healthy-behaviour actor rather than a risk-behaviour abstainer. But participants also described negative social characteristics, including ‘judgmental’, ‘image-conscious’ and ‘show-off’, indicating that PA prototypes are more nuanced than suggested by earlier research, which found these images were almost universally positive (Keresztes et al., 2009; Ouellette et al., 2005; Ravis & Sheeran, 2003). These results indicate that young adolescents may hold unfavourable as well as favourable evaluations of active types, and that active prototypes do not necessarily represent goal states for all young people.

To the author’s knowledge, this is the first study to explore inactive prototypes and find evidence that adolescents also hold clear images of inactive types. Both the physical and social characteristics of the typical inactive adolescent were judged

negatively, and, on balance, it appears that this type is considered a healthy-behaviour abstainer rather than a risk-behaviour actor. Characteristics including 'lazy' and 'unmotivated' suggest an absence of incentive and enthusiasm rather a positive decision to embrace a risky behaviour. Together, these results have implications for adolescents' willingness or openness to engage in PA, and for framing health messages in the future: unlike some smoking or drinking prototypes, for example, the inactive prototype is already perceived negatively.

Earlier research suggested that exerciser prototypes are not only clear, but also more vivid than those of other healthy-behaviour images such as non-smokers (Ouellette et al., 2005). Yet some young adolescents said they could not explicitly call to mind active or inactive prototypes. One possible explanation is that participants, who themselves felt 'judged', were reluctant to label others. Another is that these images are perceived and evaluated at a non-conscious level, and that using implicit measures to access positive or negative bias towards prototypes could be fruitful.

The results of this study also support the assumption that there are two pathways to PA behaviour. There was evidence of planned behaviour, but some decisions about PA - especially activity in the school playground - appear to be impulsive reactions to the social environment. Some participants portrayed spontaneous decisions to engage in unstructured activities among trusted family and friends. Others described impulsive choices to avoid PA in school: these decisions seem influenced by social anxiety about peer evaluation, and playground norms. These choices also seemed to reflect self-perceptions that participants were not similar to active types, and that an attempt to portray themselves as such would lead to judgement from peers. Further, participants seemed concerned not to appear childish by running in the playground, especially if peers were disinclined to join in. Instead, they adopted the behaviour of older adolescents by sitting and talking during break. Inactive participants, and girls, expressed reluctance to join in with established groups playing active games. Inactive types appeared worried about being judged incompetent during school PE. By contrast, active participants feared being thought a show-off. This suggests that perceived low similarity to an active prototype, and an unfavourable evaluation of this type of person, might have particularly negative implications for activity levels.

Further research is needed to establish how, and to what extent, prototype perceptions influence willingness to take part in PA. According to the PWM, adolescents are willing to adopt a behaviour as a way of aligning their self-image with the social image or prototype (Gibbons & Gerrard, 1997). For example, teenagers are more willing to drink if they perceive images of drinkers positively as ‘cool’ or ‘fun’. A key issue raised by these results is that, in the case of the inactive prototype, similarity and favourability do not appear to align: inactive participants seemed to have negative evaluations of this image. Previous studies have noted a similar pattern: in cases of extreme negative prototypes such as the binge-drinker, similarity is not associated with favourability (Gerrard et al., 2002). One suggestion is that those who are high in similarity and low in favourability might be aiming to *give up* the relevant behaviour, (Gibbons, Gerrard, Lando, & McGovern, 1991). If inactivity is in fact *abstaining* from healthy behaviour, it could be that these people might be aiming to *take up* the behaviour. These individuals could make particularly appropriate intervention targets.

For subsequent studies, it was important to create willingness scenarios that would prompt a range of different responses, according to participants’ prototype perceptions. Participants’ descriptions of their willingness (or unwillingness) to engage in school-based PA, and especially activities structured by teachers, suggested the scenarios used in the following empirical chapters.

Although exploring attitudes was not one of the study’s primary aims, they are a key construct in the PWM and evidence concerning young adolescents’ thoughts and feelings about PA were presented in Theme 3. In line with previous qualitative research using the TPB framework, and as predicted by the PWM (Gerrard et al., 2008), the results indicate that positive instrumental and affective attitudes towards PA are linked with active behaviour. Most participants appeared to know that an hour’s daily PA delivers health benefits, but there was little evidence that they regarded inactivity as a risky health behaviour. One likely interpretation is that young adolescents are more motivated to gain shorter-term, visible health benefits such as weight control than to avoid long-term health risks such as heart disease. This is consistent with evidence that adolescents are less influenced than adults by the long-term consequences of their behaviour (Steinberg et al., 2009) and suggests that messages targeting the health benefits of exercise may not be the most effective.

3.4.1 Selecting adjectives for constructing prototype rating scales

Some studies (eg Rivis, Sheeran & Armitage 2006) measure prototype favourability using the evaluation thermometer (Haddock & Zanna, 1994), a 100-point scale ranging from *extremely unfavourable* to *extremely favourable*. Participants are asked to reflect privately on the characteristics they themselves believe describe a prototypical drinker or smoker, for example, before indicating their favourability rating on the thermometer. To help participants construct a clear mental image of the prototype before marking the scale, some studies require participants to complete a number of semantic differential items using prototype descriptors – for example, *popular/unpopular*; *pleasant/unpleasant* (eg Zimmermann & Sieverding, 2010). Piloting with adolescents showed that the concept of the evaluation thermometer was not well understood in this age group. Therefore, in line with previous research (eg Elliott et al., 2017) the author opted to use an alternative approach to measuring prototype evaluation, using Likert rating scales based on prototype descriptors that are shared and understood among the population of interest. A further advantage of this method is that the adjectives can also be used as stimuli in an IAT designed to measure implicit prototype evaluations.

Researchers (eg Hammer & Vogel, 2013; van Lettow, Vermunt, de Vries, Burdorf, & Van Empelen, 2013) have typically selected these descriptors by asking a group of pilot respondents to write down as many words as they can think of to describe a prototype, calculating the most frequently-mentioned adjectives, and then asking a second group of pilots to rate how well these words describe their own image of a typical drinker or smoker, for example. Others have drawn on qualitative research to generate a list of attributes (e.g. Gerrard et al., 2002), an approach which this study adopted.

The author opted not to use a formal content analysis (Elo & Kyngäs, 2008) of interview transcripts to select adjectives because focusing only on individual words and their semantic meaning would not capture the latent attitudes apparent in the data. Instead, an inductive approach was used to explore and understand attitudes towards active and inactive types and to generate a list of potential descriptors that reflected participants' underlying thoughts and feelings. From this analysis an initial list of adjectives was derived for active and inactive types

Table 3.2: Prototype attributes derived from inductive thematic analysis

Active Prototype	Inactive Prototype
Fit	Lazy
Healthy	Fat
Lean	Unmotivated
Energetic	Annoying
Competitive	Gamer
Judgmental	Smart
Popular	Self-Conscious
Confident	
Leader	
Determined	
Focused	
Bossy	
Image-conscious	
Show-off	
Tired	

From these it was necessary to select eight adjectives, four positive and four negative for use in the remaining studies. Some of the words that emerged – ‘*fat*’, ‘*lean*’ – were rejected because they referred to physical rather than social characteristics. Previous studies (Keresztes, Piko, Gibbons, & Spielberg, 2009; Ravis & Sheeran, 2003) have found that ‘popular’ and ‘attractive’ were frequently used to describe active types, so these adjectives were retained. Given that the attributes were also to be used as IAT stimuli, it was necessary to attempt to match the words as far as possible (Rothermund & Wentura, 2004). ‘Confident’, ‘determined’, ‘annoying’ and ‘judgmental’ were therefore selected because they all had three syllables. Finally, it was important that the descriptors could describe both active and inactive types, so ‘bossy’ and ‘grumpy’ were selected as the final two adjectives.

3.4.2 Limitations

A key limitation of this study is that active and inactive participants were selected by their PE teachers rather than using self-reported or objective measures of PA. There was evidence from transcripts that some participants in the inactive groups took regular moderate PA and attended some organised sport activities out of school. It is therefore possible that some participants from inactive groups did not believe they were similar to the inactive prototype they described. A further limitation is that the findings were not validated with participants.

3.4.3 Conclusions

This study is among the first to indicate that the PWM might more fully explain adolescent PA than behavioural models that consider reasoned decision-making alone, and that social reactive processes may influence young adolescents' impulsive choices about PA. There is evidence that this age group can describe active and inactive prototypes, that there are social consequences attached to activity among peers, and that concerns about peer evaluation may influence willingness to be active. The results also suggested potential for exploring implicit bias towards these images. Evidence concerning attitudes and norms was in line with previous research, and helped inform the development of measures for future studies in this thesis. Together, these findings highlight a potential new direction in the development of multicomponent PA interventions, especially in school settings, incorporating young adolescents' social anxieties in response to a challenging playground environment.

To provide additional quantitative evidence of the model's utility, the following chapter describes an exploratory investigation of the extent to which constructs in the PWM explain variance in young adolescents' objectively-measured daily average MVPA.

4

Chapter Four

Prototype Perceptions Predict Young Adolescents' Objectively-Measured Physical Activity

4.1 Introduction

Chapter 3 described evidence that young adolescents' physical activity appears influenced by constructs in both the reasoned action and the social reaction pathways of the Prototype Willingness Model. Participants were able to describe both active and inactive prototypes, and there was evidence of both planned and impulsive decisions to be physically active (and inactive). Although the PWM was conceived to explore adolescent risk behaviour, the results of Study 1 add to evidence that the model might also explain variance in health-promoting choices and behaviour (Gibbons & Gerrard, 2016). The findings suggest that physically-active, healthy-behaviour prototypes contain both positive and negative characteristics, but that inactive, healthy behaviour-abstainer prototypes are viewed negatively. It also appeared that perceived low similarity to an active prototype, and an unfavourable evaluation of this type of person, might have particularly negative implications for activity levels.

So far, little is known about whether such perceptions of PA prototypes might explain variance in young adolescents' daily average MVPA. The overall purpose of Study 2 is therefore to further explore active and inactive prototype perceptions and young adolescent PA levels, to investigate the associations between them and to measure the extent to which social reactive variables explain variance in objectively-measured PA.

4.1.1 The TPB and the PWM as an explanation adolescent physical activity

Over the past three decades, numerous studies have developed empirical support for the TPB's ability to predict PA *intention* and, to a certain extent, behaviour (Hagger, Chatzisarantis, & Biddle, 2002). But the 'intention-behaviour gap' (Sheeran, 2002) – especially in younger populations – has led researchers to explore additional variables such as 'anticipated regret' (Abraham & Sheeran, 2003) that might explain variance in health behaviours - including PA - over and above intentions.

As described in Chapter 1, the PWM proposes a second, social reaction pathway, a faster route to behavioural decision-making that operates at the edge of conscious control (Gerrard et al., 2008). Behavioural willingness is said to explain unique variance in behaviour over and above intention (Gibbons, Gerrard, & Lane,

2003) and the dual pathways are said to operate simultaneously. The limited research examining the PWM's ability to explain PA behaviour has taken as its starting point that reasoned intention is a key predictor, and then focused on the extent to which the model's social reaction variables might help to explain additional variance *over and above* intention. Specifically, the study by Ravis and Sheeran (Ravis & Sheeran, 2003) assessed the predictive validity of prototype perceptions in relation to exercise behaviour after controlling for TPB variables. A later study by Ravis, Sheeran and Armitage (2011) evaluated intention versus prototype similarity as predictors of individuals' health behaviours. Unlike the TPB, the reasoned action path does not include perceived behavioural control because, for *risky* health behaviours, which do not typically represent goal states, it is thought that opportunity is more important than a sense of control (Gibbons, Houlihan, & Gerrard, 2009). However, for health *promoting* behaviours, such as PA, PBC has been found to account for significant variance explained in PA studies (Godin & Kok, 1996).

In their meta-analysis of studies examining predominantly health-risk activities, Todd and colleagues (2014) examined the relative contributions to variance explained made by the two PWM pathways. They found that, overall, the PWM explained, on average, 20.5% of variance in behaviour. Reasoned intentions predicted 15.6%, while the addition of willingness explained a further 4.9% of variance in behaviour. Evidence that social reaction constructs account for similar variance in young adolescent PA *over and above* those in the reasoned action pathway would suggest that the PWM can help explain activity in this age group. The present study therefore examines the contribution that social reactive variables make to variance in PA behaviour explained over and above the more widely-used reasoned action variables in the TPB.

4.1.2 Prototype perceptions

According to the PWM, two aspects of prototype perception predict decision-making and behaviour: prototype *favourability* and *similarity*. The more positive the evaluation, and the greater the perceived similarity, the more likely adolescents are to engage in the behaviour.

Prototype favourability appears to influence willingness and behaviour when adolescents are alive to the social consequences of their choices (Gerrard et al.,

2008). Health-protective images such as exercisers, condom users and people who sleep and eat well, have been shown to facilitate behaviour by acting as goal states or ‘desired selves’ (Blanton et al., 2001; Ravis et al., 2006). Yet Study 1 showed that active images, like other health-related images such as drinkers (Gerrard et al., 2002), can be complex and may also, in some cases, act as negative goal states, to be avoided. It is possible, therefore, that the favourable ‘confident’ and ‘popular’ dimensions of the active image that emerged in Study 1 might encourage PA, but the unfavourable ‘judgmental’ and ‘annoying’ elements might be inhibitive. Further, these negative aspects might have greater salience as a consequence of negativity bias in social-image perception (Skowronski & Carlston, 1989). Healthy-abstainer prototypes such as non-exercisers have been shown to have similar predictive validity to risky-actor prototypes (Ravis et al., 2006), suggesting that the negative aspects of inactive images such as ‘lazy’ and ‘unmotivated’ might also influence behaviour.

Similarity is said to exert an influence over behaviour that is relevant to self-identity and self-perception (Gibbons & Gerrard, 2016; Ouellette et al., 2005). There is some evidence that perceived similarity to healthy behaviour-actors and abstainers might influence willingness and behaviour: in a study of undergraduates, (Ravis & Sheeran, 2003) found that the more similar participants judged themselves to be to the type of person who exercised three times per week, the more likely they were to engage in subsequent PA.

To understand how to target prototypes via interventions, it is therefore important to further explore perceptions of both active and inactive images – in terms of both favourability and similarity – and the extent to which they predict willingness and behaviour. There is strong evidence that gender is associated with daily minutes of MVPA: typically, young male adolescents are more active than their female counterparts (Inchley et al., 2016). It is therefore also important to explore whether interventions targeting these constructs should take any gender differences in prototype perceptions and willingness into account.

4.1.3 Behavioural beliefs about risks of physical inactivity

In Study 1, participants suggested that PA is ‘healthy’ and most appeared to know about government guidelines recommending they spend at least 60 minutes per day in MVPA. Nevertheless, they seemed unconcerned about the long-term health-risks

of inactivity. In other words, there was evidence that while adolescents believe PA promotes health, they do not consider physical *inactivity* is a health-risk behaviour. Such a perception is typical of the ‘absent-exempt’ heuristic: young people who have engaged in risk behaviours without negative consequences tend to believe they are exempt from future risk (Weinstein, 1987, 1989). These perceptions have implications for the design of future interventions: it is important to understand whether to focus on absent-exempt thinking as part of an intervention targeting risk prototypes.

4.1.4 Daily average MVPA as an outcome measure

By considering only planned exercise, such as going to the gym, previous studies in this field (Ouellette et al., 2005; Ravis & Sheeran, 2003; Ravis, Sheeran, & Armitage, 2006) have failed to capture the impact of social reactive variables on the many impulsive decisions to be active or inactive that adolescents make every day in the social contexts of school and leisure time. In this study, therefore, the author chose the novel approach of measuring daily average MVPA, using accelerometry, to capture a full range of impulsive PA choices as well as planned exercise such as after-school sports, active commuting and community leisure activities. Choosing daily minutes of MVPA as an outcome measure could also shed light on the extent to which an intervention targeting PWM variables might encourage young adolescents to meet the government’s PA guidelines.

4.1.5 Aims of Study 2

Study 1 found initial qualitative indications that the PWM might more fully explain adolescent PA than behavioural models, such as the TPB, that consider reasoned decision-making alone. The overarching objective of Study 2 is to seek preliminary quantitative evidence that variables from the social reactive pathway of the PWM add to the variance explained by reasoned action variables. Specifically, the aims of this study are to:

- Measure the strength, valence and range of active and inactive prototype perceptions for boys and girls, and willingness to be active in a school setting
- Investigate daily average MVPA levels for boys and girls in relation to government guidelines, and their thoughts about the risk of inactivity

- Explore whether, and to what extent, active and inactive prototype perceptions, and willingness to be active, augment variance in daily average MVPA explained by reasoned TPB variables, including perceived control.

4.2 Method

4.2.1 Design

In this prospective study pupils completed a self-report questionnaire during morning tutor time, and physical activity data was collected for the following seven days.

This thesis is concerned with whether a dual-process model that accounts for impulsive decision-making is a more powerful predictor of adolescent PA than models based on rational processes alone. Therefore TPB variables were entered into a hierarchical linear regression model first, followed by social reactive variables from the PWM. Perceived control, which in the TPB is hypothesised to predict variance in reasoned intentions to engage in health-promoting behaviour such as PA, was included in the first stage of the regression, even though it does not appear in the PWM's 'reasoned action' path.

Statistical power and sample size are important considerations for any research testing the TPB (Hankins, French, & Horne, 2000) and other health behaviour models. There is relatively little research applying the PWM to PA behaviour, so no clear indication of an expected effect size exists in the literature. Assuming a relatively conservative effect size of 0.2, $\alpha = .05$, required power (1- β error probability) of 0.95 and nine predictors, G*Power calculated that the total sample size required was 127 (Faul, Erdfelder, Buchner, & Lang, 2009).

4.2.2 Participants

Recruitment was opportunistic. Three Oxfordshire secondary schools from the pilot phase of Fit to Study agreed to take part. In each school, Year 8 pupils (aged 12-13) from three classes, all with around 28 students, were invited to participate.

4.2.3 Procedure

Across all three schools, 207 paper questionnaires were distributed and 195 participants completed the measures. At the same time, 205 participants agreed to

wear a numbered AX3 accelerometer for the following week. Following instructions from their teacher, students wrote the number of the accelerometer on their questionnaire, fitted the device to their non-dominant wrist and then completed the survey. They were told to wear the accelerometer at all times, including while showering, swimming and sleeping. Questionnaires were collected immediately on completion. The devices were picked up a week later. All measures were completed in June-July 2016, during a typical week in school term.

4.2.4 Questionnaires

Intention, attitudes, norms, perceived behavioural control, active prototype favourability and similarity, inactive prototype favourability and similarity and willingness were measured using the items described in Chapter 2. The full survey is available at Appendix 2. Behavioural beliefs about incurring health risks by avoiding physical activity were measured with a single item, drawn from Weinstein et al. (2007), as described in Section 2.3.1. To control for order effects, there were four different versions of the questionnaire. Items were divided into three sections, about attitudes and beliefs concerning PA; other people; and images of active and inactive people. The order of questions within each block was randomised.

4.2.5 Physical activity measure

Daily average physical activity was measured over a full week using the Axivity AX3, a wrist-worn accelerometer. Full details of the procedure are in Chapter 2.

4.2.6 Data cleaning and preparation

Physical activity data. Of the 205 AX3s distributed, 16 were not returned and 14 failed, leaving 175 physical activity data sets for processing. Of these, 128 included data for the 12 hours from 08.00 to 20.00 for at least three weekdays and one weekend day, the threshold for inclusion in the analysis. Four of these participants did not complete the associated questionnaire, leaving 124 valid cases for analysis, of which 64 (52%) were male. More than 94% of cases had at least 6 days of valid data (see Table 4.1). The author processed the raw data and calculated daily average MVPA for each participant using the methods described in Chapter 2.

Table 4.1: Number (%) of cases with 7, 6, 5 and 4 days of valid data (N=124)

Valid Days	No. of Cases	% of Cases
7	84	67.7
6	33	26.6
5	5	4.0
4	2	1.7
TOTAL	124	100

Constructing the final data set. The author merged files containing 195 cases of questionnaire data and all cases of valid physical activity data using SPSS 23, creating 124 (male=64) complete cases. A missing data analysis found that none of the 124 cases had more than 2% of questionnaire item responses missing. The threshold for replacing missing data with the series mean without introducing unacceptable bias is 5% of cases; missing data were therefore replaced with the series mean in all cases (Tabachnick, Fidell, & Osterlind, 2001). Summary variables were the mean of scores on each subscale, calculated in SPSS 23.

4.3 Results

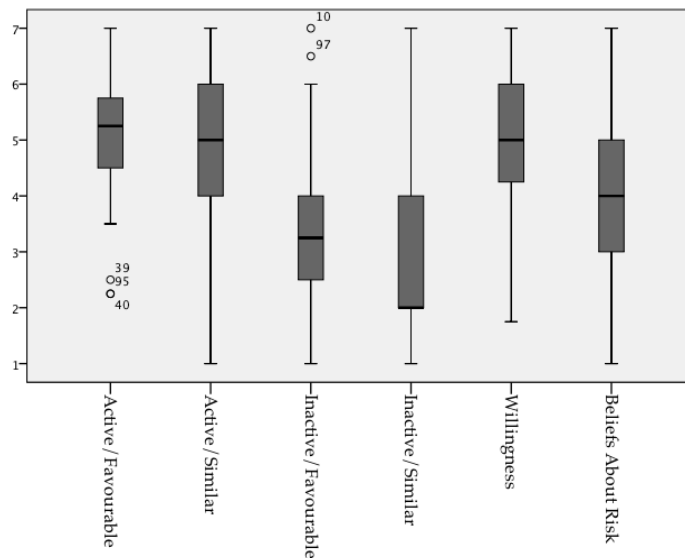
4.3.1 Descriptive Statistics

TPB and PWM variables. On a Likert scale of 1 = ‘strongly disagree’ to 7 = ‘strongly agree’, a score above 4 represents a positive endorsement. Median intentions, attitudes, norms, perceived control, and willingness to complete 60 minutes of MVPA daily were all positive (see Table 4.3). The median evaluation of physically-active prototypes was positive, while the median evaluation of inactive images was negative. Median similarity to active images was positive, while median similarity to inactive images was negative. Median willingness to engage in PA in a school setting was also positive. Scores were not normally distributed (see Fig. 4.3). for intentions, attitudes, norms, perceived control, willingness to complete 60 minutes of MVPA daily, favourability towards and similarity to active prototypes, scores were all negatively skewed. By contrast, the distribution of scores rating favourability and similarity towards, inactive prototypes were positively skewed.

Perceptions of inactivity as a health-risk behaviour. The median score for perceptions about the health risks of inactivity was 4, or neutral. The distribution of answers was negatively skewed.

Gender differences. Boys recorded higher median scores than girls on all TPB and PWM variables apart from inactive prototype favourability and similarity, where girl posted higher median scores. By contrast, girls were more likely than boys to believe that inactivity would cause their health to suffer. The Mann-Whitney U test for non-parametric data was used to explore differences between genders on all variables, including risk perception, and Bonferroni-adjusted alpha levels of .005 per test were applied to control for the elevated type I error. There were no significant differences between boys' and girls' mean scores on any TPB or PWM variables, or on risk beliefs.

Fig 4.1: Range of prototype perceptions, willingness & risk beliefs (N=124)

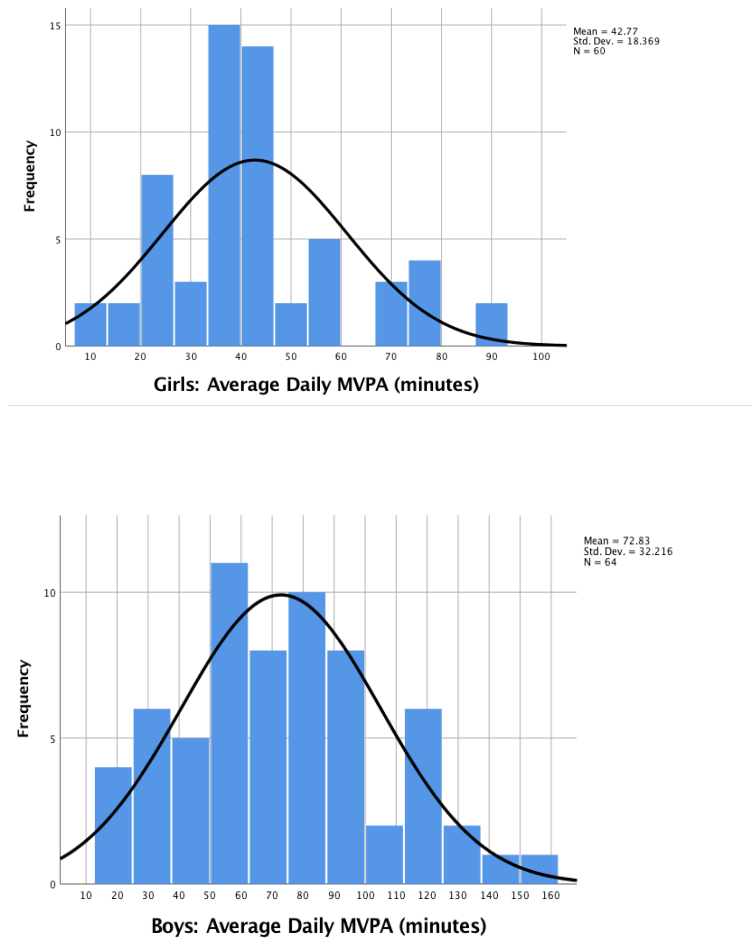


Physical activity. Mean average daily MVPA was just below the recommended target of 60 minutes per day, $M(SD) = 58.28 (30.3)$ minutes. Overall, 60.5% of participants recorded mean daily MVPA of less than 60 minutes and 16.1% recorded an average of less than 30 minutes per day (see Table 4.2). Among girls, 42% recorded less than 60 minutes per day, and among boys the figure was 37%.

Table 4.2: Mean and median daily average MVPA in minutes (N = 124)

Participants	N	Av MVPA	SD	Mdn MVPA
Male	64	72.83	32.21	70.42
Female	60	42.76	18.36	40.14
Total	124	58.28	30.34	52.53

Fig 4.2: Distribution of daily average MVPA scores, by gender (N = 124)



Physical activity by gender. Diagnostic tests revealed that the girls' physical activity data was not normally distributed, and that the assumption of homogeneity of variances had been violated. The Mann Whitney U test for non-parametric data revealed that boys recorded a significantly higher average daily MVPA (*Mdn* 70.4) than girls (*Mdn* 40.1), $U = 815$, $z = -5.52$, $p < .001$ (2-tailed), $r = .49$. There were 3 statistical outliers ± 2 SD from the mean: one male recorded daily average MVPA of 153 mins; while 2 females achieved 92 minutes and 89 minutes respectively. Despite these, the overall data distribution was positively skewed.

Fig 4.3: Distribution of prototype perception, willingness & risk belief scores

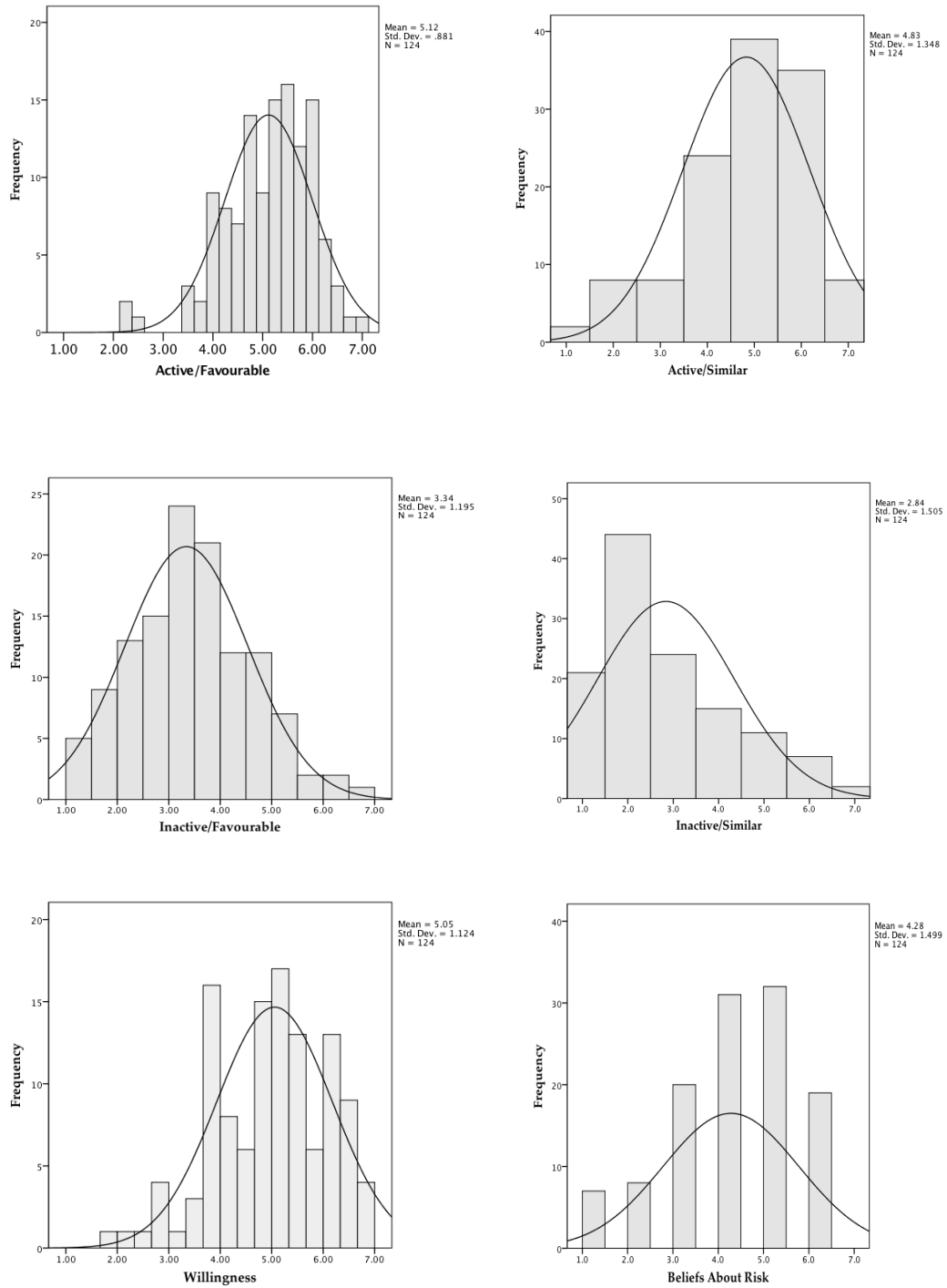


Table 4.3: Median (inter-quartile range) scores for TPB & PWM variables, with gender comparison (N = 124)

Variable	Overall			Male			Female			Gender Comparison	
	Mdn	Range	Skewness	Mdn	Range	Skewness	Mdn	Range	Skewness	U	p
Intention	6.0	2.0	-.75	6.0	2.0	-.75	5.0	2.0	-.75	1512	.036
Attitude	5.4	1.5	-.11	5.5	1.2	-.11	5.2	1.2	-.11	4117	.501
Subjective Norms	5.2	1.2	-.64	5.0	1.0	-.64	5.2	1.0	-.64	4106	.482
PBC	5.5	.88	-.68	5.9	.88	-.68	5.5	4.0	-.68	3923	.224
Active / Favourable	5.2	1.2	-.73	5.5	1.4	-.73	5.0	1.1	-.73	3500	.019
Active / Similar	5.0	2.0	-.74	5.0	2.0	-.74	5.0	1.8	-.74	1492	.028
Inactive / Favourable	3.2	1.5	.36	3.3	1.6	.36	3.2	1.2	.36	4139	.541
Inactive / Similar	2.0	2.0	.83	2.0	2.0	.83	3.0	2.0	.83	3722	.075
Willingness	5.0	1.7	-.33	5.0	1.7	-.33	5.0	1.0	-.33	4275	.807
Belief about health risk	4.0	2.0	-.33	4.0	2.0	-.33	5.0	2.0	-.33	1515	.039

4.3.2 Exploring Data Assumptions

Data distribution appeared to meet the necessary assumptions for linear regression analysis, although there were a number of potentially influential cases.

Multicollinearity. A correlation matrix, using Spearman's Rho for nonparametric data, revealed that there were no strong correlations ($p > .07$) between any of the predictor variables, suggesting that the assumption of multicollinearity had not been violated (see Table 4.4). Furthermore, no variance inflation factor statistics, which indicate the strength of variables' linear relationships with one another (Bowerman & O'Connell, 1990), were > 2 and no tolerance statistics were < 0.2 (Menard, 1995).

Independent Errors. The Durbin-Watson test for correlation between adjacent standardized residuals had a value of 1.45 suggesting that errors are independent and normally distributed.

Homoscedasticity. Plotting the standardized predicted values of the dependent variable against standardized residuals showed a random distribution of errors, suggesting the assumption of homoscedasticity was met.

Influential cases. Five cases (4% of the sample) had standardised residuals of either > 2 or < -2 , compared to the 5% we could expect assuming a normal distribution. But of these, 3 (or 2.4% of the sample) had values > 2.5 or < -2.5 , which is more than the 1% we should expect. Three cases had an unusually high average daily MVPA score, while two had an unusually low value. There were 22 cases with Mahalanobis Distances, an indicator of multivariate outliers, that were greater than 15 and therefore cause for concern. But since no cases had a Cook's Distance of > 1 , suggesting that none were exerting an undue influence on the model (Cook & Weisberg, 1982), no data was excluded from further analysis.

4.3.3 Testing the PWM's reasoned pathway: model 1

Three predictor variables from the reasoned pathway of the PWM – intention, attitudes and subjective norms - were entered into a hierarchical regression model. Perceived control was also included as a hypothesized predictor at this stage because there is empirical evidence that it predicts reasoned PA intention and behaviour (Hagger, Chatzisarantis, Biddle, & Orbell, 2001). Together reasoned action variables

Table 4.4: Correlation matrix of predictor variables and average daily MVPA (N = 124)

Variable	1	2	3	4	5	6	7	8	9	10
1. Av Daily MVPA	1									
2. Intention	.296**	1								
3. Attitude	.281**	.434**	1							
4. Subjective Norms	.106	.296**	.412**	1						
5. PBC	.280**	.282**	.356**	.126	1					
6. Active / Favourable	.159	.277**	.199*	.150	.339**	1				
7. Active / Similar	.392**	.403**	.445**	.317**	.294**	.343**	1			
8. Inactive / Favourable	-.150	-.037	.006	.082	.078	.064	.002	1		
9. Inactive / Similar	-.270**	-.241**	-.334**	-.106	-.116	-.103	-.385**	.521**	1	
10. Willingness	.373**	.331**	.552**	.252**	.296**	.250**	.431**	-.068	-.376**	1

** Correlation significant at the .01 level (2-tailed)

* Correlation significant at the .05 level (2-tailed)

explained 15.6% of the variance in daily average MVPA, $F(4,119) = 5.50, p < .001, R^2 = 0.156$. Intention was the only significant predictor in this model (see Table 4.5).

4.3.4 Testing the PWM's social reaction pathway: model 2

Next, eight predictor variables representing both pathways of the PWM – intention, attitudes, subjective norms, four prototype evaluation variables (active/favourable, active/similar, inactive/favourable, inactive/similar) and willingness were entered into a hierarchical regression model, along with perceived control. PWM variables, with perceived control, explained 27.2% of the variance in daily average MVPA, $R^2 = 0.272$; adjusted $R^2 = .214, F(9,114) = 4.72, p < .001$. The addition of social reactive variables – prototype evaluations and willingness – explained an extra 11.5% of the variance in MVPA, $FChange(5,114) = 3.61, p = .005, R^2 Change = .115$. Similarity to active images was a significant positive predictor of daily average MVPA, while a favourable evaluation of inactive images was a significant negative predictor (see Table 4.5).

Table 4.5: Regression models explaining MVPA: β coefficients & significance

Predictor Variables	B	β	t	Sig
Model 1				
Intention	4.96	.216	2.32	.022
Attitude	5.30	.155	1.53	.128
Subjective Norms	-.216	-.007	-.070	.944
Perceived Control	6.17	.162	1.78	.077
Model 2				
Intention	2.98	.130	1.42	.156
Attitude	-.753	-.022	-.197	.844
Subjective Norms	.105	.003	.035	.972
Perceived Control	5.67	.149	1.65	.101
Active /Favourable	-.333	-.010	-.108	.915
Active /Similar	5.93	.263	2.53	.013
Inactive / Favourable	-5.94	-.234	-2.28	.024
Inactive / Similar	1.10	.055	.498	.619
Willingness	4.84	.179	1.72	.087

4.4 Discussion

In this study, active prototype evaluations were, overall, positive, and inactive prototype evaluations were negative; the range of responses was larger for inactive types. Participants generally rated themselves as similar to active images and not similar to inactive images; the range of opinions was the same for both. Overall, participants were more willing than not to be active in a school setting, and they had no strong beliefs about the health risk of inactivity. There were no significant differences between girls and boys on any of these measures. Mean daily MVPA for the sample was below the recommended target of 60 minutes per day, although boys were significantly more active than girls and, on average, exceeded guideline activity levels. Perceptions of active and inactive images explained significant variance in daily average MVPA after variables in the PWM's reasoned pathway had been taken into account. Notably, neither intention nor willingness were significant predictors in the model. Overall, the study provides initial evidence that the addition of social reactive variables might more fully explain PA decision-making than a model based on rational intentions alone.

4.4.1 Prototype perceptions

Overall, young adolescents in this sample evaluated active images favourably. In general, respondents agreed that this type of image included the *positive* characteristics of confidence, attractiveness, determination and popularity (Mdn = 5.2). Yet the distribution of responses (inter-quartile range = 1.2) indicates individual differences in the strength of these appraisals, and in some cases participants disagreed that active images held these characteristics. These findings therefore extend the results of Study 1 by providing initial quantitative evidence that most (but not all) young people evaluate these active prototypes positively. The previous study found evidence that active prototypes were associated with both positive and negative social characteristics but it is important to note that in Study 2 participants were not asked to rate the extent to which active prototypes include *negative* social characteristics such as 'judgmental' or 'annoying'. Nevertheless, the findings from Study 2 indicate that active prototypes might be more nuanced than earlier work has suggested (Rivis & Sheeran, 2003) and that physically-active prototypes might not necessarily represent goal states or 'desired selves' (Blanton et al., 2001; Rivis et al.,

2006) for all young people.

By contrast, participants evaluated inactive types negatively. In general, they disagreed that this type of image was confident, attractive, determined and popular (Mdn = 3.2) although, again, the distribution of scores (inter-quartile range = 1.5) implies that perceptions of physically-inactive images may be complex. These results support the findings from Study 1, which suggested that inactive types have negative social characteristics and are unlikely to represent a ‘goal state’ or a ‘desired self’. After correcting for multiple comparisons, there was no significant difference between the extent to which girls and boys agreed that active prototypes included positive social characteristics, or disagreed that inactive types had these qualities.

Overall, participants agreed that they were similar to an active prototype (Mdn = 5.0, inter-quartile range = 2). The same participants more strongly *disagreed* that they were similar to an *inactive* type (Mdn = 2.0, inter-quartile range = 2). In line with negativity bias in social perception (Skowronski & Carlston, 1989), this finding suggests that young people are keener to dissociate themselves from *negative* social characteristics attached to inactive prototypes (unpopular, unattractive) than to associate themselves with the positive evaluations associated with active types (confident, determined).

Participants, on average, agreed that they would be willing to voluntarily take part in PA in a school setting (Mdn = 5.0, inter-quartile range = 1.7). This is a surprising result given the evidence of social anxiety concerning PA in a playground context that emerged from Study 1. Some researchers have questioned whether a self-report measure of willingness can capture a response that takes place at the edge of consciousness (Ajzen, 2011; Fishbein, 2008). This issue is addressed further in Section 5.1.

4.4.2 Daily average MVPA, and perceptions of inactivity as a health-risk

On average, and in line with previous research (Sallis, Prochaska, & Taylor, 2000), males were more active than females: boys met the recommended health target of 60 minutes of MVPA per day whereas girls did not, despite evidence from Study 1 that young people appear familiar with these government guidelines. These findings further support existing evidence (eg Inchley et al., 2016) that young adolescents do

not exercise for the time or at the intensity required to gain the health benefits of PA.

Strikingly, objectively-measured daily activity is at odds with participants' self-rated similarity to active and inactive images. The correlation between MVPA and active/similar is medium-sized, $r = .39$, $P < .001$, and between MVPA and inactive/similar it is small, $r = -.27$, $P < .001$. These findings suggest that some young adolescents could either be unaware of their relatively low activity levels, or unwilling to acknowledge them, even to themselves.

Furthermore, participants in this sample neither agreed nor disagreed with the proposition that their health would suffer as a consequence of avoiding PA, providing more evidence that while PA is considered a health-promoting behaviour, inactivity is *not* considered a health-*risk* behaviour. This implies that, for this age group, the social consequences of inactivity are more salient than the cost to health.

4.4.3 The PWM as an explanation adolescent physical activity

Previous research in the TPB framework has conceived of PA as a health-promoting behaviour guided by planned intentions to, for example, go the gym or take a walk (Hagger et al., 2002). But in this study, variables from the social reaction path of the PWM (prototype evaluations and willingness) explained 11.5% of the variance in MVPA over and above reasoned action variables (attitudes, norms and intentions, and perceived control). Intention itself was not a significant predictor of objectively-measured daily average MVPA. All PWM variables (and perceived control), predicted 27.2% of the variance in MVPA, higher than the 20.5% explained by the PWM in the meta-analysis. This result suggests that the PWM could be at least as effective at explaining adolescent PA as other health behaviours.

Notably, willingness was not a significant predictor in the model either. This finding extends previous research by Ravis and Sheeran (2003), which found a direct relationship between prototypes and subjectively-measured exercise behaviour among university students, and suggests that image evaluation may influence PA through processes other than willingness, such as self-identity.

Social reaction variables are significant predictors of MVPA. In Model 2, prototype perceptions were the only constructs to significantly account for variance in PA behaviour. Perceived similarity to active images positively predicted daily average MVPA while favourable evaluations of inactive types were a significant

negative predictor. This is a striking result, given that much of the previous research in the TPB/PWM framework has assumed that PA, like other health-protective behaviours, is goal oriented and guided more by reasoned intentions than by impulsive social reaction (van Lettow et al., 2016).

Active prototype similarity (but not favourability) predicts MVPA. Perceived similarity to an active type was a significant positive predictor of average daily activity, whereas a favourable evaluation of this image did not predict behaviour. This is in line with previous research showing that perceived similarity to health-protective images explains greater variance in behaviour than favourability (Rivis & Sheeran, 2003; van Lettow et al., 2016), discussed further in Chapter 6. One likely explanation is that adolescents are seeking self-consistency: they engage in physical activity because their self-image is active or sporty (Aloise-Young & Hennigan, 1996). In other words, as suggested by Rivis and Sheeran (2003), social identification appears to be an important determinant of PA behaviour.

Inactive prototype favourability (but not similarity) predicts MVPA. Favourable evaluations of inactive types were significant negative predictors of PA behaviour, although similarity to this image was not. Earlier research has shown that favourability exhibits a stronger relationship with health-risk than with health-protective behaviour (van Lettow et al., 2016) – although it is important to note that this sample did not perceive inactivity as a health-*risk* behavior. One possible interpretation of these results, then, is that the inactive image represents a possible future self that adolescents are keen to avoid by exercising (Ouellette et al., 2005). An additional explanation is that adolescents who view inactive types negatively in terms of attractiveness, confidence, popularity and determination wish to avoid the perceived social consequences associated with inactivity (Gibbons & Gerrard, 1995).

4.4.4 Limitations

As described in Chapter 2, Cronbach's alpha for the items measuring perceived behavioural control was poor, $\alpha = .37$. PBC was not a significant predictor in either model, but this finding may reflect the variable's lack of internal consistency. One possibility is that young adolescents rarely feel their actions are '*entirely up to me*' at school. When the individual PBC items were entered into the regression (Rivis et al., 2011), neither was a significant predictor of MVPA.

It is possible that the measures of willingness used in this study do not adequately capture impulsive behaviours and decision-making that takes place at the edge of consciousness. Willingness to be active in a social setting could therefore be lower than these self-report items suggest, and more influenced by the social anxiety reported in Study 1.

Overall, the results are likely to reflect the broader population, although if a very conservative effect size is assumed, the study is slightly underpowered as a consequence of compliance issues that led to a smaller-than-anticipated sample size. Several outliers were included in the analysis (see Fig. 4.1), which had potential to bias the results.

4.4.5 Conclusion

To the author's knowledge, this is the first study to provide prospective evidence that social-reactive variables explain variance in objectively-measured adolescent physical activity behaviour. The findings support the results of Study 1, add to the very limited research on non-active images and their potential influence on behavioural decision-making, and suggest that any intervention targeting PA prototypes might be equally applicable to either gender. Study 2 found that self-reported prototype perceptions explain variance in average daily MVPA over and above reasoned action variables, and that neither intention nor willingness are significant predictors of young adolescent PA. This supports the idea that prototype perceptions could make a suitable target for intervention to increase adolescent activity. Similarity to active images – or self-identifying as an active type of person – explained significant variance in PA, and participants more strongly *disagreed* they were similar to an *inactive* image than *agreed* they were similar to an active image. Unfavourable evaluations of inactive images also explained significant variance in PA in this study. Taken together, these results suggest that young people are keen to avoid the negative social consequences of an inactive identity, and that there is scope to encourage more young people to identify as active. Some young adolescents appear unaware of their relatively low activity levels, or unwilling to acknowledge them – and the risk inactivity poses to their health. Chapter 5 reports on a study that explored favourability, similarity and willingness in more depth by measuring both explicit and implicit perceptions of active and inactive images.

5

Chapter Five

Do Implicit Prototype Perceptions Improve Predictions of Physical Activity?

5.1 Introduction

The previous chapter described prospective evidence that social reactive constructs – perceptions of active and inactive prototypes - explain variance in young people’s daily average physical activity. Similarity to an active prototype positively predicted activity levels, while a favourable evaluation of an inactive type was a significant negative predictor. Like most other research using the Prototype Willingness Model (Blanton et al., 2001; Gerrard et al., 2002) Study 2 investigated prototype perceptions with self-report measures. In other words, even though the social reaction pathway is assumed to be outside conscious awareness, research in the PWM framework attempts to measure these variables using explicit measures. Self-report methodology assumes that participants are not only able to access their cognitions and emotions, but that they will answer honestly. Yet there are well-documented concerns that self-report data are subject to presentation bias or experimenter demand (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). For example, adolescents might be reluctant to self-report a favourable evaluation towards, or similarity to, the type of young person who drinks heavily or uses drugs. Study 3 explores whether measuring PA prototype evaluations that are unavailable to self-report could improve the PWM’s ability to explain variance in young adolescent PA.

5.1.1 Explicit and implicit associations and bias

Individuals are thought to have cognitive associations and biases that exist outside conscious awareness (Greenwald et al., 2009). These implicit attitudes have been defined as "introspectively unidentified (or inaccurately identified) traces of past experience that mediate favourable or unfavourable feeling, thought, or action toward social objects" (Greenwald & Banaji, 1995). Implicit cognitions are said to be less susceptible to social desirability concerns: for example, individuals might hold prejudices towards certain social groups that they are unable or unwilling to report, perhaps even to themselves. They also reflect older, more stable representations, based on long-term social experiences (Greenwald & Banaji, 1995). These cannot easily be captured with explicit measures.

Explicit and implicit preferences can deviate as individuals encounter new experiences and make fresh evaluations: typically, the correlation between explicit and implicit measures of attitude is low (Nosek, 2007; Payne, Burkley, & Stokes,

2008). One theoretical explanation for the divergence is given by the Associative Propositional Evaluation Model (Gawronski & Bodenhausen, 2006). In this dual-process account, explicit cognitions are derived from conscious processing of rational propositions based on available information (for example, physical activity is healthy). Implicit cognitions are shaped by associative conditioning, or the pairing of a stimulus (such as physical activity) with a positive or negative association (for example, enjoyment or frustration). Furthermore, implicit cognitions can influence behaviour (Strack & Deutsch, 2004). They can also, potentially, lend additional predictive power over and above explicit measures (Greenwald et al., 2009). There is evidence that explicit and implicit *attitudes* towards physical activity *behaviour* are independent, and that implicit attitudes can predict intentional PA (Conroy, Hyde, Doerksen, & Ribeiro, 2010). For example, a recent study among older adolescents measured implicit associations between stimuli representing physical activity, social/appearance outcomes of PA and health outcomes of PA using a Go/No Go Association Task (McFadden, Berry, McHugh, & Rodgers, 2018). The research found that this age group implicitly attends more to the social and appearance outcomes of PA than its health outcomes.

On this basis, a handful of recent studies have measured implicit prototype evaluation to capture participants' non-conscious attitudes and beliefs concerning socially undesirable prototypes including performance-enhancing drug-users (Whitaker et al., 2014) and individuals who practice risky tanning behaviour (Ratliff & Howell, 2015). These PWM studies are based on the theory that we develop self-schemas in given domains, based on our past experience: for example, a young person is likely to have a clear idea of whether they are 'good at maths' (Cross & Markus, 1994). These self-schemas are important because they increase sensitivity to self-related information and inform ideas about future (or possible) selves that might include, say, 'scientist' or 'mathematician' (Bandura, 1986). Prototypes are thought to represent our possible future selves in a given domain such as maths or physical activity (Ouellette, Hessling, Gibbons, Reis-Bergan, & Gerrard, 2005). These possible selves might embody either an ideal or attainable self – a goal state – or a feared state to be avoided, and therefore act as a motivation, to either act in a certain ways or abstain from certain behaviours. Furthermore, these idealised or feared states may not be available to self-report: for example, a young person might desire the future self represented by the active prototype, or fear the future self

embodied by inactive prototypes, more than they are willing to explicitly report. As a consequence, implicit prototype perceptions – in terms of similarity with self-schema and favourability of the future self they represent - might influence young people as they set goals and devise strategies to meet them, as well as short-term behavioural willingness and PA behaviour.

5.1.2 Measuring prototype evaluation with implicit association tests

The Implicit Association Test or IAT (Greenwald et al., 1998) is one measurement of non-conscious processes that has been used to explore bias concerning racial, gender and other social groups (Fazio & Olson, 2003). The test, a computer-based sorting task, assesses the relative strengths of associations between target concepts and target attributes: the faster (and, by implication, the more easily) participants can sort one pair of targets/attributes (such as *physically active/positive*) compared to another (*physically active/negative*) the greater is said to be the unconscious association between that pairing. (Chapter 2 contains a full description of IAT methodology).

Evidence from the PWM studies using IATs to explore prototype evaluations suggests that implicit evaluations might add to the model's ability to predict behaviour. Ratliff and Howell (2015) used explicit self-report measures and IATs in a sample of adult females to examine the extent to which explicit and implicit evaluations of 'tanned skin' and 'light skin' prototypes predicted harmful tanning behaviour such as using sunbeds and not using sunscreen. They found that explicit and implicit measures of favourability were only weakly correlated, suggesting that the self-report questionnaires and the IATs tapped different aspects of prototype evaluation. Furthermore, IAT *D* scores of implicit bias predicted a wider range of risky behaviours than the explicit measures. Whitaker et al. (2014) found that athletes who were contemplating the use of performance-enhancing drugs had a strong preference for good and doper on an IAT measure, in contrast to their self-reported preference.

Gray, LaPlante, Bannon, Ambady & Shaffer (2011) developed a drinker identity IAT to capture an implicit measure of the extent to which individuals perceive drinking alcohol to be a defining characteristic of their self-identity. The authors found that college students who had stronger implicit associations between 'alcohol' and 'me' at baseline were more likely to engage in risky drinking behaviour

both 3 and 6 months later. These results suggest that implicit measures of prototype *similarity* could also have predictive value.

Implicit physical activity prototype perceptions could also help identify adolescents who are vulnerable to inactivity. In the PWM, adolescents are said not only to have clear images of prototypes, but to be able to describe them (Gibbons et al., 1995). But Study 1 found evidence that some adolescents were unable, or unwilling, to define and evaluate active and inactive images. Understanding more about perceptions that are inaccessible to conscious deliberation – their valence, their strength and their correspondence with explicit perceptions - could help shed further light on the social reactive path to physical activity behaviour.

5.1.3 Age-related changes in implicit prototype perceptions

As individuals become older and more experienced, repeated exposure to stimuli can strengthen explicit associations (Hofmann, Friese, & Strack, 2009). Furthermore, evidence from cognitive neuroscience suggests that the brain systems involved in planning and self-regulations mature through adolescence (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001). As a consequence, health behaviours such as drinking alcohol are thought to become more planned and less reactive with age (Pomery, Gibbons, Reis-Bergan, & Gerrard, 2009), suggesting that implicit cognitions might explain less variance in behaviour among older samples. Davies, Paltoglou and Foxcroft (2016) found that implicit attitudes to alcohol (rather than to drinker prototypes) predicted drinking behaviour over and above explicit measures of intention and willingness among university students, but not younger school pupils, among whom willingness was the stronger predictor. More evidence concerning how implicit prototype perceptions change with age may help target interventions. Given that past experience informs unconscious bias, exploring the behavioural correlates of implicit prototype perceptions might improve understanding of how they form and how they might be manipulated.

5.1.4 The role of non-conscious processes in health behaviour

More generally, there is growing concern among health researchers that behaviour change theories based on rational, reflective processes alone might be too narrow (Marteau et al., 2012; Sheeran et al., 2016; Sheeran et al., 2017). There is increasing

evidence that implicit processes - unintentional habits, impulses and non-conscious goals not captured by self-report - can also influence health behaviour (Papies, 2016). There are indications that interventions that target only explicit attitudes and beliefs lead to modest and temporary changes in behaviour (Sheeran et al., 2016).

The PWM accounts for some of the heuristic processes that might influence health behaviour. The model's social reaction decision-making pathway explains "non-intentional" but "volitional" choices (Gerrard et al., 2008). Behavioural willingness, influenced by prototype perceptions, is said to be unplanned but not entirely unconscious. Some researchers have questioned the extent to which explicit measures, requiring conscious deliberation, can accurately capture impulsive willingness – behaviour that is neither planned nor entirely unconscious - to engage in an unintended behaviour (Fishbein, 2008). Implicit prototype measurements might more fully capture decision-making that takes place at the edge of consciousness than explicit measures alone.

5.1.5 Aims of Study 3

Study 3 is an exploratory investigation of implicit perceptions of active and inactive prototypes, their relationship with explicit prototype perceptions and whether implicit bias varies with age and activity level. Specifically, the aims are to:

- Measure the strength and valence of a) implicit PA prototype perceptions and b) explicit prototype perceptions measured against both positive and negative social characteristics
- Examine the correlations between implicit and explicit prototype perceptions
- Investigate mean differences in implicit perceptions by age and activity level
- Add to the evidence concerning daily average MVPA levels for boys and girls in relation to government guidelines
- Calculate the extent to which implicit perceptions of PA prototypes explain variance in objectively-measured daily average minutes of MVPA

5.2 Method

5.2.1 Experimental design, sample size and statistical analysis

Mann-Whitney tests for mean differences in non-parametric data measuring explicit

prototype evaluations, and Spearman's Rank correlations between explicit and implicit measures took place using SPSS 23. Implicit bias was calculated using Qualtrics (Qualtrics XM, Provo, UT). Regression analysis was used to measure variance explained by explicit and implicit measures. Study 2 found that social reactive variables explained an additional 11.5% of variance in in daily average MVPA over and above reasoned action variables, $R^2 \text{ Change} = .115$. Assuming this small effect size of 0.11, $\alpha = .05$, a required power (1- β error probability) of 0.95 and two predictors, G*Power calculated the sample size required =144 (Faul et al., 2009).

5.2.2 Participants and procedure

Recruitment and testing took place in two stages. Stage One was opportunistic: one Oxfordshire secondary school from the pilot phase of Fit to Study agreed to take part. Year 8 pupils (aged 12-13) from two mixed-ability PE classes – one male and one female – were invited to participate. Participants (n = 78) completed the questionnaire and the IATs online using school computers, under exam conditions. Following instructions from their teacher, pupils fitted the accelerometer to their non-dominant wrist. They were asked to wear the device at all times for a full week, after which it was collected from school. All measures were completed in July 2017, during a typical week in school term.

Stage Two, involving younger participants, took place during an opt-in brain imaging study that was part of the main Fit to Study trial. The recruitment process is described in detail in Chapter 2. A total of 61 Year 7 pupils (aged 11-12) from six schools in Oxfordshire and the South East of England completed the self-report questionnaire and IATs as part of a larger battery of tests, conducted in a laboratory outside school hours between July-September 2017. They were instructed to wear the accelerometer for a full week during the first full week of term following the summer holidays, and to return the device by post.

5.2.3 Questionnaire measures

The self-report measures were delivered online using Qualtrics software (Qualtrics XM, Provo, UT). To control for order effects, Qualtrics randomised questions within the blocks concerning prototype evaluation and willingness.

Prototype similarity. This measure was as described in Chapter 2.

Prototype favourability. In this study participants were asked to indicate ‘*how far the following words describe*’ an active type of person and an inactive type of person (1 = ‘not at all’ to 7 = ‘extremely’) using four positive adjectives as before (*confident, popular, determined, attractive*) and also four negative adjectives (*annoying, bossy, grumpy, judgmental*) drawn from the thematic analysis reported in Chapter 3. These items matched the positive and negative stimuli used in the IATs so results could be compared. Negative items were reverse scored using SPSS 23 and mean scores for items measuring active prototype evaluation and also inactive prototype evaluation were calculated. Cronbach’s alpha for active and inactive images was $\alpha = .51$ and $\alpha = .68$ respectively.

Behavioural willingness. Respondents were asked to imagine two situations in school where they could choose to be physically active or inactive in the presence of peers. Scenario One was as described in Chapter 2. Scenario Two was altered so willingness to be active was measured in a situation taking place on school premises:

‘It’s morning breaktime at school. Some people you know ask you to join in a game that involves running and jumping. People in your class are standing talking nearby.’

For each scenario, two items assessed whether participants would be willing to *be* physically active or *avoid* being physically active from 1 = ‘very unwilling’ to 7 = ‘very willing’. Negative items were reverse scored and SPSS 23 calculated a single summary variable for willingness. Cronbach’s alpha was good, $\alpha = .85$.

5.2.4 IAT measures

Participants completed two IATs, measuring implicit active/inactive prototype favourability and implicit active/inactive prototype similarity. These are described in detail in Chapter 2. Qualtrics randomised the order in which the favourability IAT and the similarity IAT were completed. Iatgen calculated the split-half reliability for each IAT using a Spearman-Brown correction. Both tests showed good internal consistency. For the favourability IAT, $r = .73$ and for the similarity IAT, $r = .79$. The measures, and the method of presentation, are described fully in Chapter 2.

5.2.5 Physical activity measure

Daily average physical activity was measured over a full week using the Axivity

AX3, a wrist-worn accelerometer. The procedure is fully described in Chapter 2.

5.2.6 Data cleaning and preparation

Physical activity data. In Stage One, the older classroom sample, of the 58 AX3s distributed, 4 either failed or were not returned, leaving 54 data sets. Of these, 50 included data for the 12 hours from 08.00 to 20.00 for at least 3 weekdays and 1 weekend day, the threshold for inclusion in the analysis. In Stage Two, the younger laboratory sample, 61 AX3s were distributed, 3 were not returned and 1 failed. One participant withdrew after completing the questionnaire, leaving 56 sets for processing. Of these, 50 included data for the designated time period. The author processed the raw data using the method described in Chapter 2, and calculated daily average MVPA for each participant.

IAT D scores. Iatgen software calculated single *D* scores for implicit bias towards, and similarity to, the active prototype, using the method outlined in Chapter 3, following procedures set out in Greenwald et al. (2003). Fourteen participants were removed from the Stage One sample because they recorded response times of < 300ms for more than 10% of individual trials on either or both IATs; a further five cases were removed from the Stage Two sample

Self-report questionnaires. In the Stage One sample, there was no missing data because the survey software was programmed so that participants were unable to skip questions. In the Stage Two sample, a missing value analysis revealed 3 cases with more than half of the 18 items measuring explicit prototype evaluation missing: these were deleted list-wise. A second analysis found that none of the remaining items had more than 5% of data missing; this was replaced by the series mean in all cases (Tabachnick et al., 2001). Where necessary, prototype evaluation and willingness items were reverse scored in SPSS 23 and summary variables were calculated.

The author merged files containing valid data from both stages using SPSS 23, creating a total of 78 (male=40) cases (see Table 5.1). Participants were coded as 'active' if they recorded a daily average MVPA on equal to or greater than 60 minutes, and 'inactive' if they scored less than 60 minutes.

Table 5.1: Participant characteristics (N= 78; Male = 40)

Characteristic	Stage One Age 12-13 (N)	Stage Two Age 11-12 (N)	Combined Sample (N)
Gender			
Male	20	20	40
Female	16	22	38
Days of PA Data			
7	28 (78%)	38 (90.5%)	66 (85%)
6	7 (19%)	3 (7.1%)	10 (13%)
5	1 (3%)	1 (2.4%)	2 (2%)
Activity Level			
Inactive	20	29	49
Active	16	13	29
TOTAL	36	42	78

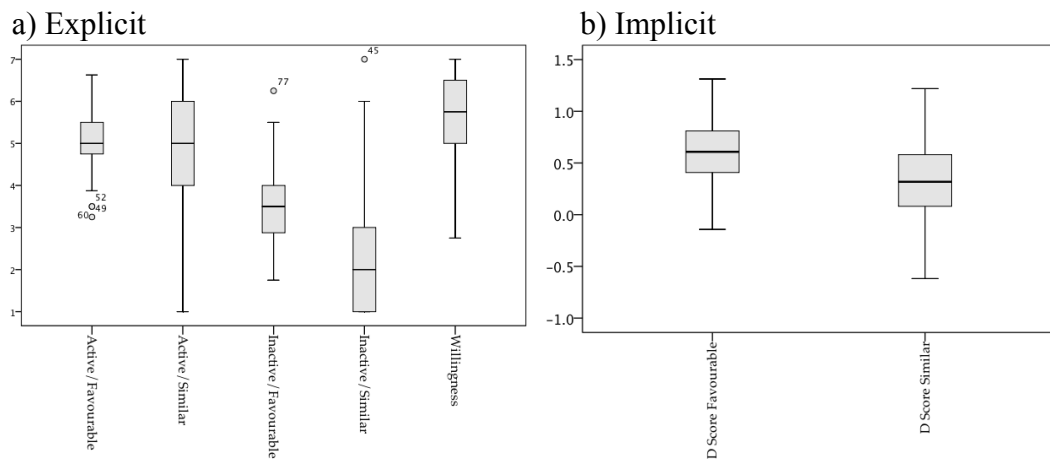
5.3 Results

5.3.1 Strength and valence of explicit and implicit PA prototypes

On a Likert scale of 1 = ‘strongly disagree’ to 7 = ‘strongly agree’, a score above 4 represents a positive endorsement. The median explicit evaluation of active prototypes measured with both positive and negative social characteristics was positive, while the median evaluation of inactive images using the same positive and negative characteristics was negative. Median explicit similarity to active images was positive, while median similarity to inactive images was negative. Median willingness to engage in PA in a school setting was also positive (see Table 5.3).

Iatgen calculated *D* scores for prototype favourability and similarity (see Table 5.3). The mean *D* scores for both favourability and similarity were positive, indicating that participants had relatively stronger associations between ‘physically active’ and ‘positive’ (or ‘me’) than between ‘physically active’ and ‘negative’ (or ‘not me’). *D* scores of .15 to .35 indicate ‘slight’ bias; scores of .35 to .65 denote ‘moderate’ bias and scores above .65 signify ‘strong’ bias (Greenwald, Nosek, & Banaji, 2003). There was moderate-to-strong implicit bias in favour of active types relative to inactive types, $M(SD) = .60(.30)$, which significantly differed from zero, $t(77) = 17.9, p < .0001, 95\% \text{ CI } 0.546, 0.683$. Participants also recorded slight-to-moderate implicit similarity with the active image, $M(SD) = .32(.39)$, which significantly differed from zero, $t(77) = 7.03, p < .0001, 95\% \text{ CI } .227, .407$.

Fig 5.1: Range of explicit and implicit prototype perceptions, (N = 78).



Using the Mann-Whitney test for non-parametric data, and applying Bonferroni-adjusted alpha levels of .00625 per test to control for the elevated type I error, participants rated active prototypes significantly more attractive, confident, popular and determined than inactive prototypes ($p < .0001$); and significantly less annoying and grumpy ($p < .0001$). There were no significant differences between how active and inactive types were rated on ‘bossy’ and ‘judgmental characteristics’ (see Table 5.2).

Table 5.2: Mdn (range) social characteristic scores for active and inactive prototypes

Characteristic	Active	Inactive	U	Z	p
Attractive	4.0 (2.0)	3.0 (2.0)	1417.5	-5.95	<.0001
Confident	6.0 (1.0)	3.0 (2.0)	502.5	-9.11	<.0001
Popular	5.0 (2.0)	3.0 (2.0)	1248	-6.47	<.0001
Determined	6.0 (2.0)	2.0 (1.0)	422.5	-9.41	<.0001
Annoying*	5.0 (2.0)	4.0 (2.0)	1883.5	-4.17	<.0001
Bossy*	5.0 (2.0)	4.2 (3.0)	2730	-1.12	0.25
Judgmental*	4.0 (2.0)	4.0 (3.0)	2873.5	-0.60	0.54
Grumpy*	6.0 (2.0)	3.2 (3.0)	1756	-4.62	<.0001

*Reported scores for negative social characteristic have been reversed

5.3.2 Correlations between explicit and implicit prototype evaluations.

Using Spearman’s Rho for nonparametric data, there was a small significant positive correlation between explicit and implicit active prototype similarity, $r = .24$, $p = .037$.

There were no significant correlations between any other explicit and implicit prototype measures (see Table 5.6).

5.3.3 Differences in implicit perceptions by age and activity level

Non-parametric tests were used where appropriate. Bonferroni-adjusted alpha levels of .007 per test were applied to control for the elevated type I error. There were four outliers with scores $< 2SD >$ from the mean: a female scored unusually low for explicit similarity, at -4; two males recorded low scores on willingness, at 2.25 and 3 respectively; a male participant recorded an unusually high *D* score of 1.31 for implicit favourability while a female scored an unusually low score, at -.14.

Differences between age groups. Participants aged 12-13 recorded significantly higher *D* scores (*Mdn* .76) on the favourability IAT than those aged 11-12 (*Mdn* .56), indicating greater *implicit* bias towards the active image, $U = 444$, $Z = -3.12$, $p = .002$ (2-tailed). The effect size was moderate, $r = .35$. Older participants (*Mdn* .55) also scored significantly higher on the similarity IAT than the younger group (*Mdn* .21), indicating greater implicit similarity to the active image $U = 381$, $Z = -3.75$, $p < .001$ (2-tailed). The effect size was moderate, $r = .42$. There were no significant differences in *explicit* prototype evaluation scores between age groups (see Table 5.5)

Differences between active and inactive participants. There were no significant differences in mean scores any of the implicit or explicit measures between active and inactive participants (see Table 5.5).

5.3.4 Daily average MVPA levels for boys and girls.

Mean daily average MVPA for the sample was below the recommended target of 60 minutes per day, $M(SD) = 53.2 (34.9)$ minutes. Both boys, $M(SD) = 57.9(41.9)$ minutes, and girls $M(SD) = 48.3(25.3)$ minutes, failed to meet the guidelines. Overall, 63% of participants recorded mean daily MVPA of less than 60 minutes and 27% recorded less than 30 minutes per day (see Table 5.3). Among boys, 52.5% failed to meet the target and for girls the figure was 74%.

Diagnostic tests revealed that daily average MVPA was not normally distributed either within gender or within age group, although variances between genders and between age groups were approximately equal.

The Mann-Whitney U test for non-parametric data found no significant difference in daily average MVPA between boys (*Mdn* 46.3) and girls (*Mdn* 42.7), $U = 689$, $z = -.705$, $p = .48$ (2-tailed), or between the older adolescents (*Mdn* 48.8) and the younger adolescents (*Mdn* 45.9), $U = 656$, $z = -.808$, $p = .41$ (2-tailed).

There were two statistical outliers with scores >2 SDs from the mean: a male from Stage One recorded a daily average MVPA of 239 minutes, while a male from Stage Two achieved 135 minutes per day on average.

Table 5.3: Mean(SD) daily average MVPA in minutes (N = 78)

Participants	N	M Daily MVPA	SD	Mdn Daily MVPA
Male	40	57.9	41.9	46.3
Female	38	48.3	25.3	42.7
Stage One	36	56.8	40.9	42.5
Stage Two	42	50.1	29.0	45.9
Active	29	86.9	35.3	80.7
Inactive	49	33.2	11.7	34.2
Total	78	53.2	34.9	45.6

5.3.5 Do implicit prototype perceptions explain variance in daily MVPA?

Exploring Data Assumptions. Data distribution appeared to meet the necessary assumptions for linear regression analysis with either willingness or activity as the dependent variable, although there were a number of potentially influential cases.

Multicollinearity. Using Spearman's Rho for nonparametric data as described above, there were no very strong correlations ($>.8$) between the predictor variables, suggesting that the assumption of multicollinearity had not been broken (see Table 5.5). Furthermore, no variance inflation factor statistics, which indicate the strength of variables' linear relationships with one another (Bowerman & O'connell, 1990) were >2 and no tolerance statistics were <0.2 (Menard, 1995).

Independent Errors. The Durbin-Watson test for correlation between adjacent standardized residuals had a value of 1.97, suggesting errors are independent and normally distributed.

Influential cases. There were 2 cases (2.5% of the sample) with standardised residuals of >2 or <-2 , compared to the 5% we could expect assuming a normal distribution. Both cases had an unusually high average daily MVPA score. There

was 4 cases with a Malahanobis Distance, an indicator of multivariate outliers, >11 and therefore cause for concern. But since no cases had a Cook's Distance of >1, suggesting that none are exerting an undue influence on the model (Cook & Weisberg, 1982), no data was excluded from further analysis.

Homoscedasticity. Plotting the standardized predicted values of the dependent variable against standardized residuals showed a random distribution of errors, suggesting that the assumption of homoscedasticity has been met.

Implicit measures of prototype favourability and similarity were entered into a linear regression model with daily activity as the outcome variable. The model was not a significant predictor of physical activity, $F(2,75) = .622, p = .570$. It explained 1.2% of the variance in activity, $R^2 = 0.012$ (see Table 5.6).

Table 5.4: Implicit prototype evaluations predicting daily MVPA

Predictor Variables	B	□	t	Sig
Implicit/Favourable	-1.280	-.011	-.093	.926
Implicit/Similar	10.883	.125	1.041	.301

Table 5.5: Median (range) scores for explicit and implicit variables (N = 78, Male = 40)

Variable	Overall		Age 11-12		Age 12-13		Mean Difference		Inactive		Active		Mean Difference	
	Mdn(IR)		Mdn(IR)		Mdn(IR)		U	p	Mdn(IR)		Mdn(IR)		U	p
Explicit Active Favourable	5.0(.69)		4.9(1.1)		5.1(.75)		723	.740	4.9(1.0)		5.1(.75)		687	.808
Explicit Active Similar	5.0(1.5)		5.0(3.0)		5.0(2.0)		639	.233	5.0(2.0)		6.0(2.0)		611	.298
Explicit Inactive Favourable	3.5(.86)		3.5(1.2)		3.5(1.1)		742	.888	3.5(1.1)		3.5(1.1)		648	.521
Explicit Inactive Similar	2.0(1.5)		2.0(2.0)		2.0(1.0)		639	.233	2.0(2.0)		2.0(1.5)		708	.978
Willingness	5.7(1.1)		5.5(1.9)		6.0(1.4)		666	.365	5.5(2.2)		5.7(1.2)		678	.736
Implicit Favourable	.60(.30)		.56(.32)		.76(.47)		444	.002	.62(.38)		.60(.38)		688	.816
Implicit Similar	.32(.40)		.21(.44)		.55(.63)		381	<.001	.36(.42)		.22(.62)		695	.873

Table 5.6: Spearman's Rho correlation matrix showing relationships between explicit and implicit prototype evaluations (N = 78)

Variable	1	2	3	4	5	6	7	8
1. Daily MVPA	1							
2. Explicit Active/Favourable	.072	1						
3. Explicit Active/Similar	.246*	.186	1					
4. Explicit Inactive/Favourable	-.106	-.241*	-.181	1				
5. Explicit Inactive/Similar	-.117	-.015	-.334**	.483**	1			
6. Implicit Favourable	.089	-.060	.160	.028	-.085	1		
7. Implicit Similar	-.037	.001	.237*	.048	-.014	.304**	1	
8. Willingness	.143	.242*	.421**	.025	-.225	-.050	.049	1

** Correlation significant at the .01 level (2-tailed)

* Correlation significant at the .05 level (2-tailed)

5.4 Discussion

Overall, the sample explicitly evaluated active types favourably and inactive types unfavourably, and, on average, they explicitly rated themselves as similar to active prototypes and dissimilar to inactive prototypes. Participants demonstrated implicit favourability towards, and similarity to, active prototypes compared to inactive images. Implicit and explicit perceptions were therefore aligned, but the only significant correlation was between explicit and implicit similarity. The *older* group recorded significantly stronger implicit bias towards, and similarity to, active images than the younger group. Surprisingly, *active* participants who met recommended PA guidelines did not show significantly stronger implicit bias towards, or similarity to, active prototypes than inactive young people. Implicit prototype perceptions did not explain significant variance in daily average MVPA.

5.4.1 Strength and valence of explicit and implicit PA prototypes

In this study, explicit prototypes were evaluated against both desirable and undesirable social characteristics: participants rated active and inactive types using four negative adjectives (*annoying, bossy, grumpy, judgmental*) as well as the four positive adjectives used in Study 2 (*confident, popular, determined, attractive*). On average, active prototypes were rated favourably (Mdn 5.0, interquartile range .69). These results extend findings from Study 2 that active prototypes have *positive* social characteristics by providing initial evidence that an active prototype's balance of desirable and undesirable qualities is positive. The distribution of responses was narrower than in Study 2, in which Mdn = 5.2 and interquartile range = 1.2. By contrast, participants rated inactive types unfavourably (Mdn 3.5, interquartile range .86). These findings also support results from the previous study, which found that inactive types are rated low on desirable attributes. Active prototypes were rated significantly more confident, popular, determined and attractive than inactive types, and significantly less annoying and grumpy, which emphasises the existence of a nuanced inactive prototype, distinct from active types. In Study 1, participants described how active types judge their inactive peers harshly, and in this study judgmental is the negative characteristic on which active types are given the highest rating, at a neutral Mdn = 4.0. Participants, on average, showed moderate-to-strong

implicit bias in favour of active types, and slight-to-moderate implicit similarity with the active image. This is encouraging because it suggests that there are unlikely to be unconscious negative evaluations of active types or positive evaluations of inactive types representing hidden or unreported goal states that could make young people vulnerable to inactivity. Taken together, these results demonstrate that active prototypes are, overall, perceived positively and inactive types are viewed negatively, both explicitly and implicitly.

5.4.2 Correlations between explicit and implicit prototype evaluations

There was a small but significant correlation between explicit and implicit measures of similarity ($r = .24$), while measures of favourability were uncorrelated. This aligns with the results of the study by Ratliff and Howell (2015) which found that explicit and implicit measures of favourability towards tanning prototypes were only weakly correlated ($r = .19$). Dual-process theories such as the APE model (Gawronski & Bodenhausen, 2006) suggest that explicit and implicit perceptions can diverge because explicit perceptions are shaped by rational propositions based on available information, while implicit cognitions are based on associative conditioning. As a consequence of their distinct antecedents, explicit and implicit evaluations can differ in both strength and valence.

One potential explanation for the findings of this study is that PA prototype favourability, which is linked to others and the social context (Gerrard et al., 2008), can be subject to social anxiety and interpretation bias (Amir, Beard, & Bower, 2005). As a consequence, young people might develop an implicit bias linking certain prototypes and social characteristics – active people may appear relatively confident, for example – which might diverge from their more rational observations that active people are not necessarily confident. By contrast, similarity is associated with the self and the relevance of the image to self-perception, concepts which individuals can typically access, if not always explicitly report (Rivis et al., 2011). One potential explanation is that as self-knowledge and self-acceptance grows through adolescence, explicit and implicit similarity measures will become more closely aligned.

An alternative interpretation is that methodological considerations might be responsible for the low correspondence between explicit and implicit measures.

Payne et al. (2008) suggest that the very different cognitive demands that explicit and implicit measurements place upon participants could explain the weak relationship between them.

5.4.3 Differences in implicit perceptions by age and activity level

Year 8 participants, with greater knowledge and experience of active and inactive prototypes after two years in secondary school, showed greater implicit bias towards, and similarity to, active images than those in Year 7, although there was no significant difference in explicit evaluations. Stronger implicit favourability suggests that additional experience might have strengthened their unconscious bias linking active types with positive attributes, which is not reflected in their explicit evaluations. It is therefore possible that relatively strong implicit bias in favour of active prototypes could become more influential as adolescents become older. This interpretation corresponds with research by Davies et al. (2016) which found that implicit attitudes to alcohol were stronger predictors of drinking *behaviour* among university students than among school children.

Stronger implicit similarity to active images among the older age group is harder to explain and it is possible that this is linked not to age but to other variables, as discussed in the section on limitations.

5.4.4 Implicit perceptions do not explain significant variance in activity

Implicit PA prototype favourability and similarity did not explain variance in objectively-measured daily average MVPA in this study. As a consequence, there is no evidence that implicit prototypes might predict additional variance over and above explicit, self-report measures.

5.4.5 Limitations

5.4.5.1 Study limitations

Study 3 was limited by several flaws that arose as a consequence of constraints on time and resources. First, two groups of participants were sampled using different approaches and tested at different times and in different settings, biasing the data. As described, the Stage One group was drawn from two mixed-ability classes in a single school using an opt-out approach, whereas Stage Two participants, drawn from ten

local schools, opted in to testing. It is likely that the samples had different socio-economic and fitness profiles.

Unsurprisingly, given classroom distractions, data collected in the laboratory setting was of a better quality: 14 sets of IAT data were discarded from the Stage One group due to careless responding, compared to just five from Stage Two. The high proportion of data discarded led to a reduction in the study's power to detect the hypothesised effects. When recruiting, future studies should take account of the high level of data loss caused by both careless responding in reaction-time tasks and non-compliance with accelerometer wear-time protocols in this age group.

Physical activity among Stage One participants was measured before the school summer holiday while in the Stage Two group it was measured during the first week of the autumn term. The long break from school PE and other school-related sporting activities may have reduced fitness and overall activity levels in this group relative to Stage One participants.

Had a larger sample size been available for recruitment, the author would have also explored the extent to which implicit measures explain variance in daily average MVPA over and above explicit measures.

5.4.5.2 Critical analysis of the approach taken

The methodology used in Study 3 was also adversely impacted by limited time. Crucially, a longitudinal design, measuring explicit and implicit prototype evaluations in the same participants at Time 1 and Time 2 (one year later), would have controlled for key confounding variables and improved the study's power to detect an effect of age. This approach has been used in previous studies: for example, (Teachman & Woody, 2003) used a repeated-measures design to explore implicit fear of spiders among arachnophobes before and after anxiety therapy. In this study, a significant within-group difference in implicit bias was detected after three months of therapy. It is possible that in Study 3 the two groups were too close in age to have developed a difference in implicit favourability and/or similarity.

Initially, dichotomising participants into active and inactive group based on recognised health guidelines (rather than using a median split, for example) is appealing. Indeed, many clinical studies define an 'overweight' group based on the accepted definition of a body mass index of $>25\text{kg/m}^2$ (Royston, Altman, & Sauerbrei, 2006). Yet such grouping leads to a loss of information and power.

Furthermore, in this study, activity levels were confounded with both age and gender. A more robust approach might have been to pre-select active and inactive groups using a questionnaire examining habitual physical activity behaviour. Further, partial correlation could have been used to explore associations between implicit and explicit scores while controlling for age, group or activity level.

Finally, it is possible that the IAT itself did not adequately capture implicit prototype evaluations. For example, participants might have confused prototype evaluations with attitudes towards physical activity. Alternatively, their evaluation might have been confounded with mere familiarity with the idea that ‘active is positive’. An alternative approach, used by Ratliff and Howell (2015) and Teachman and Woody (2003), would have been to deliver a series of IATs with different attributes representing a number of different prototype characteristics such as popular/unpopular, confident/insecure or attractive/unattractive.

5.4.6 Conclusion

To the author’s knowledge this exploratory study is the first to investigate relationships between explicit and implicit PA prototype perceptions. Overall, this study did not find evidence that implicit prototype evaluations predicted variance in objectively-measured physical activity. But the research did find that explicit and implicit PA prototype perceptions share a valence: active types are evaluated positively and inactive types are judged negatively both consciously and unconsciously. This in turn suggests that unconscious bias is unlikely to represent a hidden or unreported goal state that could make young people even more vulnerable to inactivity. The following chapter returns to explicit prototype perceptions and examines the dimensions of favourability and similarity in more detail.

6

Chapter Six

Testing the Predictive Validity of the Prototype Willingness Model in a Large Sample

6.1 Introduction

The Prototype Willingness Model was conceived to explain variance in adolescent health risk behaviours such as drinking or smoking (Gibbons & Gerrard, 1995). Research in this framework has therefore focused on risk prototypes that are thought to be salient for this age group, such as binge drinkers and smokers, and on willingness to engage in associated behaviours (Todd et al., 2014; van Lettow et al., 2016). But Study 1 found evidence that young people were able to describe prototypes of physically active and inactive young people, and that there appeared to be both reasoned and social reactive pathways to PA decision-making, especially in a school setting. Study 2 found initial evidence that, on average, active, *health-promoting* prototypes were evaluated favourably while inactive, *health-abstaining* (not *health-risk*) prototypes were judged negatively. Participants generally rated themselves as similar to active images and not similar to inactive images. Overall, PWM variables, and perceived control, explained 27.2% of the variance in daily average MVPA, comparable with variance explained in health-risk behaviours (Todd et al., 2016). Crucially, similarity to active images, and evaluation of inactive images, predicted significant variance in objectively-measured daily average MVPA after variables in the PWM's reasoned pathway had been taken into account, providing initial evidence that a dual-process approach could provide a useful framework for future young adolescent PA interventions. Surprisingly, intention was not a significant predictor. Study 3 found further evidence that active images are perceived positively (and inactive images negatively) even when they are evaluated against both positive and negative social characteristics (for example '*confident*', '*judgmental*'). Overall, findings support a recent suggestion by the model's authors, Gibbons and Gerrard, that not only are health-promoting images such as "fitness buff, healthy eater, condom user" as salient as health-risk images, but that "there is no reason why positive behaviours could not come within the purview of this model" (Gibbons & Gerrard, 2016).

The two recent reviews and meta-analyses of studies in the PWM framework (Todd, Kothe, Mullan, & Monds, 2016; van Lettow et al., 2016) have, for the first time, quantified associations between prototype perceptions, willingness and health behaviour. These reviews, and subsequent commentaries (Gibbons & Gerrard, 2016; Todd & van Lettow, 2016), suggested further avenues

for research using the PWM to describe and explain variance in health behaviour: these are described in more detail in the following sections. The evidence set out in the preceding experimental chapters offers a basis for investigating relationships between active and inactive prototypes and PA behaviour in greater depth, and for considering the issues raised by Todd et al. (2016) and van Lettow et al. (2016) in relation to adolescent PA and interventions. This chapter therefore describes a large cross-sectional study exploring relationships between constructs in the PWM and testing the extent to which they explain variance in the number of days per week on which adolescents achieve the recommended 60 minutes' MVPA per day.

6.1.1 The PWM as an explanation of adolescent PA behaviour

Overall, Study 2 found that PWM variables, and perceived control, explained 27.2% of the variance in daily average MVPA, using accelerometry to capture both spontaneous and planned PA. This figure compares well with the results of the meta-analysis of the PWM (Todd, Kothe, Mullan, & Monds, 2014), which found the model explained 20.5% of variance in behaviour. Previously, a meta-analysis of 72 TPB studies in the PA domain (Hagger et al., 2002) found that attitude, subjective norms and perceived control together explained 45% of the variance in PA *intention*, while perceived control and intention together explained 27% of variance in *behaviour*. Many studies included in this TPB meta-analysis examined the extent to which reasoned action variables predicted *self-reported* PA. As described in Chapter 2, the cognitive challenges associated with seven-day PA recall can lead participants to over- or under-report activity (Adams et al., 2005). Adolescents tend to over-estimate their PA levels, and inactive young people appear to inflate their estimates by more than their active counterparts (LeBlanc & Janssen, 2010). Given that many studies in the PWM and TPB framework have used self-reported measures (Hagger et al., 2002; Todd et al., 2016), it is important to examine whether the PWM, and the social reactive pathway, significantly predicts variance in self-reported as well as objectively-measured PA to enable comparisons with previous studies. Understanding the extent to which the PWM explains variance in self-reported PA among a large sample of young adolescents, as well as objectively-measured activity, will shed light on whether the model could inform future interventions in this age group.

6.1.2 Favourability v similarity as predictors of PA behaviour

Favourability and similarity are independent predictors of health behaviour that work through distinct mechanisms, according to evidence from numerous studies (Lettow, de Vries, Burdorf, Norman, & Van Empelen, 2013; Todd et al., 2016; van Lettow et al., 2016). Favourability is linked to social context; it is said to reflect the perceived social consequences of the behaviour (Gerrard et al., 2008). Similarity is thought to be associated with self-identity and the relevance of the image to self-perception (Rivis et al., 2011). The recent meta-analysis concluded that similarity, rather than favourability, tends to be the stronger predictor of *behaviour*. In line with this, Study 2 found that similarity to active prototypes was a significant predictor of daily average MVPA, although evaluation of inactive images also explained significant variance. Further understanding the extent to which the different components of prototype perception predict PA behaviour will help design future interventions, so a second aim of this study is therefore to measure the extent to which similarity, compared with favourability, predicts days per week of activity.

6.1.3 Health-promoting and health-abstaining prototypes.

So far, relatively little is known about whether and to what extent health-promoting and health-abstaining prototypes, including active and inactive young people, explain variance in health protective behaviour. Healthy actor images (fit, strong, slim) might serve as goal states (Rivis et al., 2006), while health-abstainer images (unfit, weak, obese) might represent a possible future self that adolescents wish to avoid by exercising (Ouellette et al., 2005). Understanding the extent to which competing active and inactive prototypes influence decision-making and behaviour could shed further light on whether image perception should be a target.

Gibbons and Gerrard (2016) suggest that health-promoting behaviour is linked with variance in similarity while *risky* or health-abstaining behaviour is allied with variance in favourability. They argue this is because positive images (such as a condom-user or a physically-active person) are widely rated as favourable, whereas negative images (for example a reckless driver or an inactive person) can be perceived more or less unfavourably since they might include an element of 'cool' or 'relaxed'. Meanwhile, adolescents are unlikely to report

similarity to risky images (such as drug-user or binge-drinker), regardless of their actual behaviour, although they might identify with a positive image (such as a physically active person or social drinker). On this basis, we might expect *similarity* to be a stronger predictor of PA behaviour and *favourability* to be more closely aligned with inactivity. Studies 1 and 2 found evidence that young people regard inactivity not as a risky behaviour but as a health-abstaining behaviour, yet Study 2 also found that favourability towards an inactive image predicted inactive behaviour. This study will therefore further explore the extent to which active versus inactive prototype perceptions explain variance in days per week of MVPA.

6.1.4 The interaction terms of prototype favourability and similarity

Because prototype favourability and similarity are separate constructs, they do not necessarily share a valence. For example, in Study 1, inactive participants (low similarity to an active image) reported that active prototypes had positive characteristics (high favourability of an active image) while in Study 3 participants who recorded less than 60 minutes per day of MVPA (and so categorised as inactive) also evaluated active types favourably, on average. These individuals - low in similarity and high in favourability - might be 'contemplating' whether to adopt the behaviour (Prochaska & DiClemente, 1982). Those who are high in similarity and low in favourability might be aiming to give the behaviour up (Gibbons et al., 1991).

Gibbons and Gerrard (2016) proposed that the interaction term between favourability and similarity should be included in future analyses, particularly when - as in the case of adolescent PA - there is evidence that they do not necessarily share a valence. There is some evidence that the effect of prototype favourability might be greater if individuals rate themselves as similar to the prototype, although the evidence concerning this interaction is not conclusive (Rivis et al., 2011; Rivis et al., 2006): measuring whether similarity levels moderate the effect of favourability on PA behaviour would aid the design of interventions. A key aim of this study is therefore to explore the extent to which the interaction terms between active prototype favourability x similarity, and inactive prototype favourability x similarity, explain variance in the number of days per week of activity, and the moderating effect of similarity on favourability.

6.1.5 Prototype perceptions as predictors of willingness *and* intention

Prototype perception is part of the PWM's social reactive pathway yet there is evidence that *similarity* could be more closely associated with reasoned behavioural *intention* than with social reactive *willingness*. Surprisingly, neither willingness nor intention were significant predictors in Study 2. Similarity and intention are thought to be linked because self-consistency is an important motivator and young people engage in a behaviour because their self-image is similar to that of the prototype (Aloise-Young, Hennigan, & Graham, 1996; Norman, Armitage, & Quigley, 2007). Understanding whether PA prototype perceptions influence reasoned or social reactive decision-making (or both) is relevant for PA interventions: if similarity influences intention then any intervention targeting this construct might be less likely to impact spontaneous decisions to be active in the playground, for example. An aim of this study is therefore to explore whether prototype perceptions more fully explain variance in willingness or intention.

6.1.6 The role of past behaviour

Prototype similarity is closely linked to past behaviour, itself a significant behavioural predictor (Ajzen, 2011) and a PWM variable said to predict attitudes, norms and prototype perceptions, as described in Fig. 1.1 (page 26) (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008). Put simply, individuals perceive themselves as similar to an active prototype because they themselves have been active in the past. Given that the 'past behaviour' construct cannot itself be manipulated via interventions (Ajzen, 1987), investigating whether prototype similarity explains variance in PA over and above past behaviour is particularly important. Studies have found that prototype similarity explains drinking behaviour even after past actions have been accounted for (Lettow, Vries, Burdorf, Conner, & Empelen, 2015). Evidence that similarity mediates the relationship between past and future PA behaviour would strengthen any case for targeting prototype similarity via an intervention.

6.1.7 Aims of Study 4

The overarching aim of this study is to further investigate the extent to which PWM variables explain self-reported PA in a large sample of young adolescents by:

1. Measuring the extent to which PWM variables predict days per week of self-reported PA, and the extent to which variables from the social reactive pathway explain variance in PA over and above variables in the reasoned action pathway.
2. Calculating the extent to which prototype favourability and similarity explain variance in days per weeks of MVPA, and whether health-promoting (active) or health-abstaining (inactive) prototype perceptions better predict PA
3. Testing whether the interaction terms of active prototype favourability and similarity, and inactive image favourability and similarity, predict variance in PA behavior, and, if so, the extent to which similarity moderates the relationship between favourability and activity behaviour.
4. Measuring whether prototype perceptions more fully explain variance in willingness or intention.
5. Seeking evidence that image similarity predicts days per week of MVPA over and above past behaviour alone by calculating the extent to which active (and inactive) prototype similarity mediates the relationship between habitual PA behavior and PA in the past week.

A secondary aim is to investigate the proportion of adolescents meeting the target for daily average MVPA, by gender.

6.2 Method

6.2.1 Sample size

Data for Study 4 was collected using a computer-based questionnaire during the main Fit to Study baseline tests, which determined the size of the sample.

Assuming an effect size of 0.11 as before, $\alpha = .05$, a required power ($1-\beta$ error probability) of 0.95 and 11 predictors, G*Power calculated that the total sample size required is 239 (Faul et al., 2009). The actual sample is considerably larger, allowing the detection of statistically significant, but very small, effect sizes

(Sullivan & Feinn, 2012). It is therefore important to consider the practical significance of the detected effects.

6.2.2 Participants

As described in Chapter 2, 104 state secondary schools in the Midlands, the South and the South East of England started Fit to Study baseline tests, of which six were all-girls schools and one was all-boys. A total of 9,304 Year 7 pupils aged 11-12 (male = 3,744 or 40.2%) from 81 schools completed the questionnaire between June and July 2017. Of these, 1,347 pupils (14.5%) were eligible for free school meals, an income-related measure of socio-economic disadvantage (Taylor, 2017), compared to 13.2% of secondary school students nationally (Department of Education, 2016). Of those claiming free meals, 36.9% were male, and of those not in receipt of free meals, 40.8% were male.

6.2.3 Procedure

Participants completed the survey online using school computers. The questionnaire was presented on a bespoke software platform, which uploaded participants' responses to a secure database and calculated summary variables. Data was then downloaded into SPSS 23 for further analysis.

6.2.4 Measures

PWM Measures. Intention, subjective norms, perceived behavioural control, prototype favourability and prototype similarity were measured using the items described in Chapter 2. Attitudes and behavioural willingness were measured using items described in Chapter 5.

Physical activity. Government health guidelines suggest that young people should complete 60 minutes per day of MVPA. The aim of this thesis is to explore the extent to which PWM constructs explain variance in an outcome variable that captures daily levels of MVPA. Studies 2 and 3 used accelerometry to prospectively measure daily average minutes of MVPA as a continuous variable using a seven-day protocol (five weekdays and 2 weekend days), sufficient to obtain a reliability coefficient of 0.8 or above when assessing adolescent physical activity (Troost, Pate, Freedson, Sallis, & Taylor, 2000). Accelerometry was

impractical in this large study, and it was also important to compare variance explained with previous studies using self-reported measures. So, as described in Chapter 2, PA was measured using a single retrospective item on an 8-point scale (0-7 days): *“In the past week, on how many days have you done a total of 60 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for fun, or to get to and from places.”* (Scott et al., 2015).

Past physical activity behaviour. Habitual PA over the past six months was measured using a single item, from 1 = Never to 7 = Always: *“Thinking about the past six months, how often have you been physically active for an hour every day during a typical week in term?”* The item was drawn from Hagger et al. (2001).

6.2.5 Data Analyses

Linear Regression 1 explored the extent to which PWM variables predict days per week of self-reported PA; how far social reactive constructs predict variance in PA over and above reasoned action variables; and the extent to which active and inactive prototype favourability and similarity – and their interaction terms – explain variance in days per weeks of MVPA. Two further linear regressions (Linear Regression 2 & 3) were used to measure whether prototype perceptions more fully explained variance in willingness or intention.

In line with Aiken and West (1991), interaction terms between active and inactive prototype similarity and favourability were derived by mean-centring the predictor variables to avoid issues with multi-collinearity, and then calculating their products using SPSS 23. Where interactions were found, simple slopes analysis was used to understand their pattern (Aiken, West, & Reno, 1991) with graphs derived using the PROCESS V3 macro for SPSS (Hayes, 2012, 2017).

The Baron and Kenny (1986) four-step approach to mediation analysis was used to test whether prototype similarity mediates the relationship between habitual past behavior and daily PA. In Step 1 of this approach, the total effect (c) of the predictor variable (X) on outcome variable (Y) is calculated to establish whether there is an effect that may be mediated. In Step 2, the effect of the predictor variable (X) on the hypothesized mediator (M) is calculated to establish whether there is a relationship (path a). Step 3 calculates the effect of M on Y controlling

for X (path *b*) to find whether the hypothesized mediator affects the outcome variable. In Step 4, full mediation is established when the effect of X on Y controlling for M (path *c'*) is zero. Partial mediation is indicated when the first three steps are met. The size of partial mediation, or the indirect effect, is the product of (*a*)(*b*). Mediation analyses were carried out using the PROCESS V3 macro for SPSS (Hayes, 2012, 2017) and the strength and significance of the indirect effects were tested using the product-of-coefficients strategy with bootstrapping, suitable for non-parametric data (Preacher & Hayes, 2004).

6.3 Results

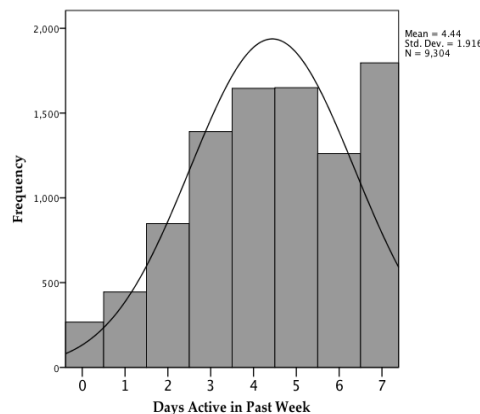
6.3.1 Descriptive Statistics

Physical Activity. Overall, 19.3% or 1,796 participants reported completing an hour's MVPA every day for the past week (see Table 6.1 and Fig. 6.1). Some 24.6% of the boys and 15.8% of the girls reported 60 minutes of activity on all seven days. A total of 7.7%, or 712 participants, reached the PA target on only one day, or not at all. Using the Mann-Whitney U test, (see Table 6.1), boys were significantly more active during a typical week, $U = 9013622$, $z = -11.06$, $p < .0001$). The effect size was small, $r = .12$.

Table 6.1: Number of days active for ≥ 60 minutes in the past week (N = 9,304)

Group	Mean (SD) Days	Median (Range)
Male	4.7 (1.9)	5.0 (3.0)
Female	4.3 (1.9)	4.0 (3.0)
Overall	4.4 (1.9)	5.0 (3.0)

Fig 6.1: Distribution of days per week of reported activity (N = 9,304)



PWM Variables. Median scores for intention, attitude, subjective norms, perceived behavioural control, perceptions of active prototypes, and willingness were all positive (above neutral, 4) as described in Table 6.2. Median scores for perceptions of inactive prototypes were negative. Using the Mann-Whitney U test for non-parametric data, and applying Bonferroni-adjusted alpha levels of .005 per test to control for the elevated type I error, there were significant differences ($p < .0001$) between boys and girls on all PWM variables, but in all cases the effect sizes were very small (see Table 6.2). Boys had significantly stronger intentions, attitudes, norms, perceived control and willingness to be active, and more positive evaluations of active images, than girls. Girls reported significantly more positive evaluations of inactive images.

Table 6.2: Median (Range) for PWM variables by gender (N=9,304, male=3,744)

Variable	Male	Female	Gender Difference				Overall
			U	Z	p	r	
Past Behaviour	5.0 (2.0)	5.0 (2.0)	9397757	-6.81	<.0001	.07	5.0 (1.4)
Intention	6.0 (3.0)	5.0 (3.0)	9435800	-7.81	<.0001	.08	6.0 (1.6)
Attitude	5.0 (2.0)	5.0 (1.0)	9032203	-11.09	<.0001	.11	5.0 (1.3)
Subjective Norms	5.0 (1.7)	4.7 (1.5)	9440563	-7.58	<.0001	.08	4.7 (1.2)
Perceived Control	6.0 (1.5)	5.5 (1.5)	9729465	-5.34	<.0001	.05	6.0 (1.1)
Active/Favourable	5.2(1.5)	5.2 (1.5)	1011244	-2.28	<.0001	.02	5.2 (1.1)
Active/Similar	5.0 (2.0)	5.0 (2.0)	9766605	-5.09	<.0001	.05	5.0 (1.5)
Inactive/Favourable	3.0 (2.0)	3.0 (2.0)	9781239	-4.99	<.0001	.05	3.0 (1.4)
Inactive/Similar	3.0 (3.0)	3.0 (2.0)	9988175	-3.31	<.0001	.03	3.0 (1.7)
Willingness	5.5 (2.2)	5.0 (2.0)	9130472	-10.03	<.0001	.10	5.2 (1.3)

6.3.2 Exploring data assumptions for regression

Data distribution appeared to meet the necessary assumptions for linear regression analysis after influential cases were removed.

Influential cases. There were 62 cases (male = 40) with standardised residuals of >3 or <-3 . These were deleted listwise from the analysis. There were a further 12 cases (male = 4) with a Malahanobis Distance of >31.264 , the value of χ^2 when $p = .001$ with 11 degrees of freedom, and in this model the threshold for

suggesting a multivariate outlier. These cases were also deleted listwise, leaving 9,230 cases (male = 3,710) for analysis.

Multicollinearity. The correlation matrix, using Spearman's Rho for nonparametric data, revealed that there were no very strong correlations ($>.8$) between any of the predictor variables, suggesting that the assumption of multicollinearity had not been broken (see Table 6.3). Furthermore, no variance inflation factor statistics, which indicate the strength of variables' linear relationships with one another (Bowerman & O'Connell, 1990) were >10 , which would give cause for concern (Myers, 1990) and no tolerance statistics were <0.2 (Menard, 1995).

Independent Errors. The Durbin-Watson test for correlation between adjacent standardized residuals had a value of 1.79, suggesting that errors are independent and normally distributed.

Homoscedasticity. Plotting the standardized predicted values of the dependent variable (days per week of target MVPA) against standardized residuals showed a random distribution of errors, suggesting the assumption of homoscedasticity has been met.

No cases had a Cook's Distance of >1 , suggesting that none were exerting an undue influence on the model (Cook & Weisberg, 1982), so no further data was excluded from analysis.

Table 6.3: Spearman's Rho correlation matrix showing relationships between variables (N = 9,230)

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Days Active	1										
2. Past Behaviour	.612**	1									
3. Intention	.540**	.644**	1								
4. Attitude	.458**	.535**	.597**	1							
5. Subjective Norms	.367**	.412**	.481**	.412**	1						
6. Perceived Control	.352**	.416**	.458**	.434**	.434**	1					
7. Active/Favourable	.203**	.234**	.269**	.258**	.276**	.686	1				
8. Active/Similar	.485**	.581**	.553**	.506**	.383**	.381**	.273**	1			
9. Inactive/Favourable	-.063**	-.070**	-.064**	-.033**	-.019	-.026**	.019	-.003	1		
10. Inactive/Similar	-.316**	-.355**	-.328**	-.308**	-.182**	-.216**	-.122**	-.312**	.402**	1	
11. Willingness	.394**	.447**	.481**	.498**	.304**	.380**	.232**	.445**	-.130**	-.387**	1

** Correlation significant at the .01 level (2-tailed)

* Correlation significant at the .05 level (2-tailed)

6.3.3 Linear regression 1

A linear regression model explored the extent to which PWM variables (and PBC) predicted PA; how far social reactive constructs predicted variance in PA over and above reasoned action variables; the extent to which prototype favourability and similarity explained variance in PA; and the significance of active and inactive prototype perceptions.

Three predictor variables from the PWM's reasoned pathway - attitude, subjective norms and intention - were entered at Step 1. Perceived control was also included because there is strong empirical evidence that it predicts reasoned intentions and PA behaviour (Hagger et al., 2002). Reasoned action variables explained 36.1% of the variance in days per week of target MVPA in a typical week during the school term, $R^2 = 0.361$, $F(4,9225) = 1304.2$, $p < .0001$. All variables were significant predictors, but only intention, $\beta = .358$, and attitude, $\beta = 1.87$, had an effect size $> .1$ (see Table 6.4).

Table 6.4: Reasoned action and social reaction variables as predictors of MVPA

Predictor Variables	B	β	t	Sig
Step 1				
Intention	.429	.358	31.754	<.001
Attitude	.275	.187	17.307	<.001
Subjective Norms	.156	.096	9.795	<.001
Perceived Control	.153	.092	9.440	<.001
Step 2				
Intention	.317	.265	22.924	<.001
Attitude	.160	.109	9.852	<.001
Subjective Norms	.124	.076	7.945	<.001
Perceived Control	.102	.061	6.346	<.001
Active/Favourable	.003	.002	.187	.852
Active /Similar	.238	.190	18.351	<.001
Inactive/Favourable	.010	.007	.777	.437
Inactive/Similar	-.100	-.091	-9.346	<.001
Active Fav x Sim	.005	.005	.644	.520
Inactive Fav x Sim	.024	.033	4.004	<.001
Willingness	.094	.064	6.321	<.001

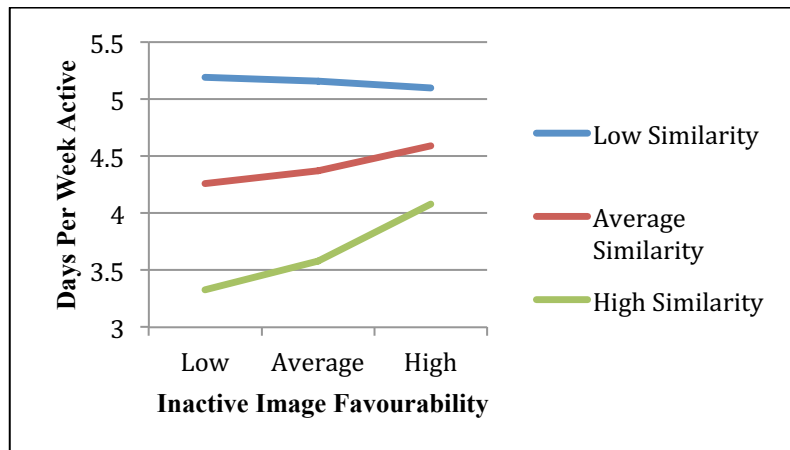
To test whether social reaction variables predict activity over and above reasoned action variables and perceived control, four prototype evaluation variables (active/favourable, active/similar, inactive/favourable, inactive/similar) and willingness were added at Step 2. The interaction terms active (similar x favourable) and inactive (similar x favourable) were also entered. Reasoned action and social reaction variables together explained 40.4% of the variance in days per week of target MVPA, $R^2 = 0.404$, $F(11, 9218) = 567.47$, $p < .001$. The addition of social reaction variables explained an additional 4.3% of the variance in activity, $\Delta R^2 = .043$; $\Delta F(7, 9218) = 93.9$, $p < .001$. Similarity to active and inactive images, and the interaction term of inactive (favourable x similar) significantly predicted self-reported days per week of target MVPA (see Table 6.4). Favourable evaluations of active and inactive images, and the interaction term active (favourable x similar) did not significantly predict activity. All other variables were also significant predictors (see Table 6.4). Only intention, $\beta = .26$, attitude $\beta = .11$ and similarity to active images $\beta = .19$ had effect sizes $> .1$.

6.3.4 Moderation analysis.

Moderation analysis was used to further investigate the interaction term of inactive (favourable x similar) because it significantly predicted self-reported days per week of target MVPA. Inactive prototype similarity and favourability, and their interaction term, were entered into a regression model, with activity as the dependent variable. The model explained 10.6% of variance in physical activity, $R^2 = .106$, $F(3, 9226) = 367.2$, $p < .0001$. The interaction term was a significant predictor in the model, $b = .071$, $t(9227) = 9.62$, $p < .0001$. This indicated that similarity to inactive prototypes does moderate the relationship between favourability and behaviour.

The author decomposed the interaction using simple slope analysis (Aiken et al., 1991) and produced a graph showing regression lines for prototype similarity at three different levels of favourability: the mean level, one standard deviation above the mean and one standard deviation below it (Fig 6.2). The graph showed that, for those who have a low favourability rating towards inactive prototypes, higher perceived similarity to that image is associated with inactivity.

Fig 6.2: Interaction between inactive similarity & favourability on days of PA



6.3.5 Linear Regressions 2 & 3

Dependent variable: intention. To test whether prototype perceptions explain more variance in intention or willingness, four prototype evaluation variables, and the interaction terms active (favourable x similar) and inactive (favourable x similar) were entered into a regression model with intention as the dependent variable. Social reactive variables explained 34% of variance in intention to be active during in a typical week, $R^2 = 0.340$, $F(6, 9223) = 793.1$, $p < .0001$ (see Table 6.5).

Dependent variable: willingness. To compare their ability to predict willingness, the same variables were entered into a regression model with willingness to be physically active as the dependent variable. Social reactive variables accounted for 27.6% of the variance in willingness to be active, $R^2 = .276$, $F(6, 9223) = 586.6$, $p < .001$ (see Table 6.5).

Table 6.5: Regression 2 -Social reactive variables as predictors of intention

Predictor Variables	B	β	t	Sig
DV: Intention				
Active/Favourable	.188	.125	13.727	<.001
Active /Similar	.482	.461	49.770	<.001
Inactive/Favourable	.001	.001	.116	.907
Inactive/Similar	-.153	-.167	-17.001	<.001
Active Fav x Sim	-.034	-.041	-4.622	<.001
Inactive Fav x Sim	.007	.011	1.267	.205

Table 6.6: Regression 3- Social reactive variables as predictors of willingness

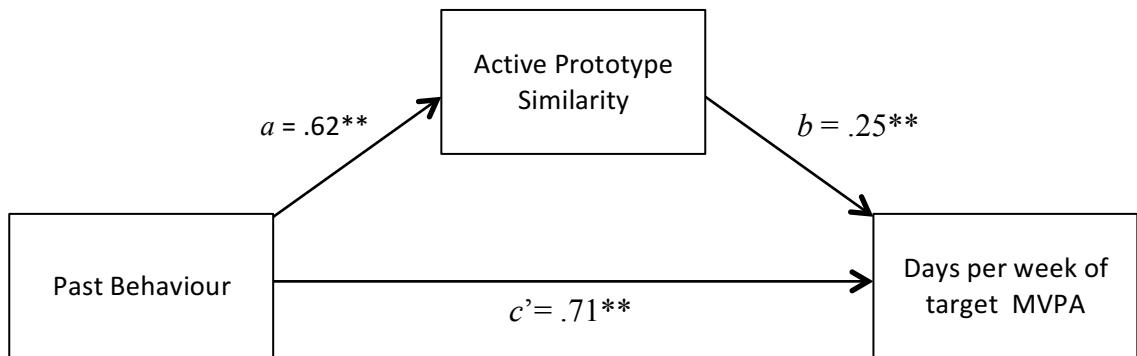
Predictor Variables	B	β	t	Sig
DV: Willingness				
Active/Favourable	.132	.108	11.321	<.001
Active /Similar	.298	.349	35.995	<.001
Inactive/Favourable	-.029	-.030	-3.085	.002
Inactive/Similar	-.184	-.246	-23.959	<.001
Active Fav x Sim	-.002	-.003	-.352	.725
Inactive Fav x Sim	.006	.011	1.254	.210

6.3.6 Mediation analyses

Similarity to active prototypes: Following the four steps set out by Baron and Kenny (1986) the author used regression analysis to investigate whether active prototype similarity mediates the relationship between past PA behaviour and days per week of PA (see Fig. 6.3). At Step 1, past behavior was a significant direct predictor of activity, $c = .87$, $t(9228) = 79.71$, $p < .0001$. Step 2 showed that past behaviour was a significant predictor of the mediator variable, active prototype similarity, $a = .62$, $t(9228) = 67.25$, $p < .0001$. In Step 3 prototype similarity, controlling for past behaviour, was a significant predictor of daily activity, $b = .25$, $t(9227) = 20.82$, $p < .0001$. Step 4 found that, controlling for prototype similarity, past behaviour still significantly predicted daily activity, $c' = .71$, $t(9227) = 54.86$, $p < .0001$. These results supported partial mediation.

The significance of the indirect effect was tested using a bootstrap estimation approach suitable for non-parametric data, with 5,000 samples. These results indicated that the standardised indirect effect of past behaviour on daily activity through active/similarity was significant, $b = .11$, 95% CI .102, .127. Past behaviour was associated with an additional .11 day of PA as mediated by active prototype similarity.

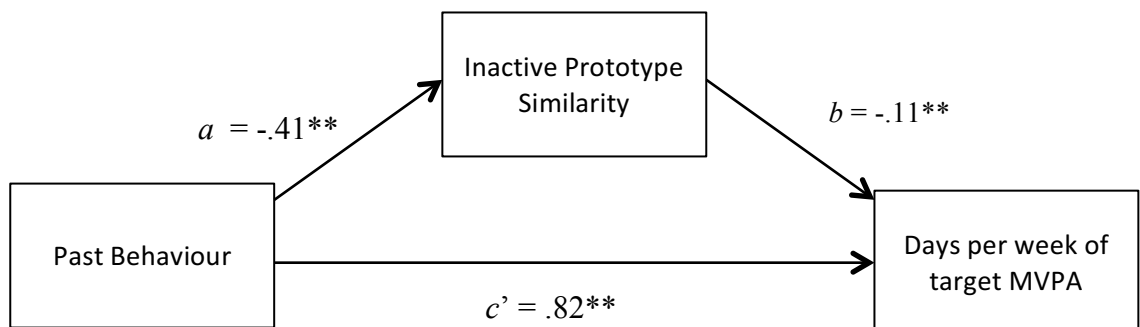
Fig. 6.3: Effect of past behaviour and active prototype similarity on PA



** Correlation significant at the .0001 level (2-tailed)

Similarity to inactive prototypes: Following the Baron and Kenny (1986) four-step approach (see Fig. 6.4), Step 1 established a relationship between past behavior and daily activity. Step 2 showed that past behaviour was a significant negative predictor of the mediator variable, active prototype similarity, $a = -.41$, $t(9228) = 79.62$, $p < .0001$. In Step 3, prototype similarity, controlling for past behaviour, was a significant predictor of daily activity, $b = -.11$, $t(9227) = -12.2$, $p < .0001$. Step 4 found that, controlling for inactive prototype similarity, past behaviour still significantly predicted daily activity, $c' = .82$, $t(9227) = 71.74$, $p < .0001$. These results supported partial mediation. The unstandardized indirect effect was $(-.41)(-.11) = .045$, and bootstrapping was used to test the indirect effect as before. The standardised indirect effect of past behaviour on activity through inactive/similarity was significant, $b = .03$, 95% CI .027, .041. Past behaviour was associated with .03 days' less PA as mediated by inactive prototype similarity.

Figure 6.4: Effect of past behaviour and inactive/similarity on daily activity



** Correlation significant at the .0001 level (2-tailed)

6.4 Discussion

All PWM variables, and perceived control, explained 40.4% of variance in the number of days per week on which young adolescents achieved the recommended target of an hour's MVPA. Intention to be active, attitudes to PA and self-rated similarity to active images were the only variables to show a standardised effect size $> .1$. Social reactive variables, and the interaction terms of prototype perceptions, explained an additional 4.3% of the variance in activity over and above reasoned action variables. Similarity to active and inactive prototypes significantly predicted of days per week of PA, while prototype evaluations did not. Similarity to active images had a larger standardised effect size than similarity to inactive images in the model. Of the interaction terms, only inactive (favourable x similar) significantly predicted PA. Similarity to inactive prototypes moderated the relationship between inactive prototype favourability and PA: strong self-rated similarity to inactive images, combined with an unfavourable rating of this image, is significantly associated with low levels of activity. Prototype perceptions are more closely linked to reasoned intentions than impulsive willingness: they explained 34% of the variance in intention and 27.6% of variance in willingness. Similarity to active images had the largest standardised effect size in both cases. Furthermore, when regressing these variables on PA with other PWM variables, intentions have a greater standardized effect size than willingness. Past activity levels are closely associated with PA behaviour, but this study found evidence that prototype similarity mediates the relationship between historical and current weekly PA levels. Overall, only 19.3% of participants reported completing 60 minutes of MVPA on all seven days in the previous week.

6.4.1 The PWM, and social reaction variables, explain variance in PA

To the author's knowledge, this is the first study to explore how far PWM variables explain self-reported physical activity behaviour at scale among young adolescents. Previous studies using the PWM to explore health-promoting exercise behaviour have focused on university students (Ouellette et al., 2005; Ravis & Sheeran, 2003; Ravis, Sheeran, & Armitage, 2011). Overall, with the addition of perceived control, the model accounted for 40.4% of variance in activity, supporting the contention that

the PWM is well-suited to explaining health-protective behaviour as well as health-risk behaviour, and providing a theoretical basis for adolescent PA interventions. The variance explained compares favourably with findings from a meta-analysis of PWM studies which found that the model explained, on average, just 20.5% of variance in health behaviour (Todd et al., 2016). One possible reason for the discrepancy is that reasoned action variables as described in the TPB (attitudes, norms, perceived control and intention) are known to be effective predictors of PA, accounting for 27.4% of variance in behaviour (Hagger et al., 2002). Yet the variance explained in the present study is also almost double the 21.4% reported in Study 2. This inconsistency could be explained by the fact that, like most research in the PWM framework, the present study used self-report measures of behaviour, whereas Study 2 used objective measures. Not only are self-report PA surveys subject to recall and presentation bias (Adams et al., 2005), they also deliver an ordinal measure, whereas accelerometry generates a continuous measure. Recent studies have highlighted the importance of investigating how relationships between psychosocial variables and PA differ depending on how PA is measured (Kavanaugh, Moore, Hibbett, & Kaczynski, 2015).

Another possible explanation has to do with the prospective design of Study 2, in which intention, which *did not* significantly explain PA variance, was measured *before* PA. In the present study, intention *did* significantly explain variance, but it was measured *at the same time* as PA. This suggests that measures of forward-looking intention are more closely linked with behaviour in cross-sectional studies than in prospective designs, - a finding which is worthy of further investigation.

Nevertheless, the present study demonstrates that PWM variables significantly predict both objectively and subjectively-measured PA, which strengthens the case for using the model to inform adolescent PA interventions.

Social reactive variables explained an additional 4.3% of the variance in activity. This percentage is comparable with other variables that have been hypothesised to close the ‘intention-behaviour gap’ such as anticipated regret (Sheeran, 2002). The result provides further evidence that a dual-process approach could provide a useful framework describing adolescent PA decision-making.

6.4.2 Favourability v similarity and health-promoting v health-abstaining prototypes as predictors of PA behaviour

Strikingly, *similarity* to active and inactive prototypes were both significant predictors of days per week of PA, while *favourability* towards these prototypes were not significant, even in a large sample that will allow the detection of statistically significant, but very small, effect sizes (Sullivan & Feinn, 2012). This result is in line with the recent meta-analysis which concluded that similarity, rather than favourability, tends to be the stronger predictor of *behaviour* (Todd et al., 2016). Study 2 also found that similarity to active prototypes was a significant predictor of daily average MVPA, although evaluation of inactive images also explained significant variance in objectively-measured activity. The significance of similarity as a PA predictor is supported by previous research (Ouellette et al., 2005) and suggests that self-identifying as a physically-active person, and considering PA as an important part of the self, are potentially important determinants of overall levels of PA among adolescents (Rivis et al., 2011). Although Study 1 found evidence that adolescents have clear evaluations of active and inactive prototypes and could describe PA decision-making that took place in a social context, and the perceived social consequences of activity, neither active nor inactive prototype *favourability* explained variance in PA. One possible explanation is that young people consider it unlikely they will acquire the social characteristics of an active prototype by performing the behaviour. Unlike other health behaviours explained by this model, such as smoking, drinking or eating healthily, there is perhaps an element of competence required to acquire the perceived social consequences of PA behaviour. Taken together, then, these results suggest that similarity rather than favourability would make a suitable intervention target.

Similarity to both health-promoting (active) and health-abstaining (inactive) images significantly predicted behaviour, although similarity to the health-promoting behaviour had the bigger (and positive) effect size. These findings are relevant for intervention design, although it is possible that young people are more likely to report a strong similarity to a positive (active) image than a negative (inactive) image. Another caveat is that, as previous research indicates (Adams et al., 2005) inactive participants might have indicated higher levels of PA than they in fact achieved, so that the association between inactivity and similarity to inactive prototypes appears weaker than it is. Overall, these results suggest that interventions

to reduce perceived similarity to inactive images and to increase similarity to active types could be effective.

6.4.3 The interaction terms of similarity and favourability

Only the interaction term between *inactive* prototype favourability and similarity was a significant predictor of activity; the interaction of *active* favourability and similarity was not significant. Furthermore, moderation analysis revealed that, for those who have a low favourability rating towards inactive prototypes, higher perceived similarity to that image is associated with inactivity. In other words, young adolescents who not only see themselves as inactive, but who are also alive to the unfavourable social consequences of this image, are especially likely to be inactive – perhaps to avoid being judged by their peers. This is an important conclusion, which appears to tie in to the evidence from Study 1, which found that some inactive participants judged inactive prototypes negatively. Together, these findings suggest that strategies to frame inactive young people’s self-perceptions as more active could ultimately boost physical activity levels.

6.4.4 Image perception explains variance in intention *and* willingness

Although the PWM hypothesises that prototype perceptions predict willingness in the social reactive pathway (Gerrard et al., 2008), recent research has suggested that prototype similarity is more closely linked with intentions and health-promoting behaviour through a reasoned pathway (Todd & van Lettow, 2016). In this interpretation, similarity to physically active images is associated with self-identity and self-perception (Rivis et al., 2011); active prototypes are seen as goal states that facilitate reasoned intentions to engage in PA behaviour. This study found that prototype perceptions predicted intention better than they predicted willingness (34% of variance in intention explained, compared with 27.6% of variance in willingness). This offers some support for the idea that, for adolescent PA, the social reaction pathway from image favourability via willingness to behaviour may be less influential than more reasoned considerations of self-identity and goal-based decisions about PA. It is important to note that the standardised effect size of intention in Linear Regression 1 ($\beta = .26$) is larger than that of willingness

($\beta = .06$), offering further support for the model's reasoned pathway as a predictor of health-promoting PA behaviour.

6.4.5 Past behaviour, prototype similarity and adolescent physical activity

Establishing that active and inactive prototype similarity account for activity over and above past behaviour is important, given that past behaviour in itself cannot be targeted by intervention. Prototype similarity mediated the relationship between past behaviour and days per week of physical activity, suggesting that this construct could be a key target in future interventions based on the PWM. When mediated by similarity to active images, past behaviour was associated with an additional .11 days of physical activity: assuming a day of activity is 60 minutes, this is equivalent to 6.6 minutes of MVPA per week. When mediated by similarity to inactive images it was associated with .03 fewer days, equivalent to 1.8 fewer minutes per week. The issue of past behaviour is discussed in more depth in Section 7.7, covering theoretical insights. Overall, then, it might be more effective to encourage perceptions of similarity to active images, rather than dissimilarity to inactive images, in future interventions.

6.4.6 Adolescent physical activity levels

Effective interventions are crucial, given that fewer than one in five adolescents in this study met physical activity guidelines for health. In line with previous findings (Brodersen, Steptoe, Boniface, & Wardle, 2007; Trost et al., 2002), boys were more active than girls, although the mean difference was small. Some 16% of girls and 25% of boys reported a hour of activity every day, comparable to the figures in the most recent Health Behaviour in School Aged Children Survey (Inchley et al., 2016), which used a very similar self-report measure and found that, in England, 20% of girls and 25% of boys achieved the target.

6.4.7 Limitations

This was a large-scale study but its design was correlational so the results do not indicate causality. The sample included 81 schools, but the analysis plan did not account for school clusters, which could have explained some of the variance in PA behaviour. Due to the large scale of this study which ruled out the use of

accelerometers, and because of the requirement for a brief survey, physical activity was measured using a single item that asked on how many days during the *past week* the respondent had completed 60 minutes of MVPA. In other words, past activity was used as a proxy for prospective activity. Given that the alternative would have been a second survey the following week, this was judged to be a practical solution.

With a sufficiently large sample, statistical tests will almost always find a significant difference or relationship (Sullivan & Feinn, 2012). In this study, with over 9,000 participants, most p values were $<.0001$, making it difficult to interpret the true significance of the results. As a consequence it became particularly important to consider the effect size, most of which were small or even trivial, despite a highly significant p value. Perceived control was among the variables with a very small effect size, which may have been affected by the measure's poor internal consistency.

6.4.8 Conclusion

This study offers strong evidence that The Prototype Willingness Model can shed light on adolescents' physical activity, and that prototype evaluations explain variance over and above reasoned action variables in this young age group. By extension, this suggests that the model could be used to predict other health-protective behaviours, such healthy eating or sleeping, as well as risky behavioural choices. As expected, prototype similarity is a strong predictor of days per week of physical activity, and it explains variance over and above past behaviour. In this study, intention was also an important predictor. This suggests that more conscious evaluations of self-identity in the physical activity domain may ultimately be the key influence on healthy behavioural-decision making. The perceived negative social consequences of activity are particularly salient for self-rated inactive types, which might be related to social anxiety concerning peer evaluations.

The final chapter in this thesis briefly considers the broader implications of this work and offers some suggestions for future research.

7

Chapter Seven

Conclusions and Future Directions

7.1 Introduction

The research question this thesis addressed was whether constructs in the social reactive path of the Prototype Willingness Model could explain additional variance in young adolescents' daily PA levels over and above the reasoned action variables that have been used extensively to predict exercise behaviour. To the author's knowledge, this is the first exploration of young British adolescents' PA using the PWM, a dual-process framework that accounts for reasoned decision-making and the social reactive responses that are characteristic of this age group. Evidence that prototype perceptions significantly predict young people's PA could support the use of interventions involving prototype manipulation. A secondary aim was to measure the proportion of young people in this age group who meet PA guidelines.

Four individual studies, using qualitative and quantitative methods, were conducted. This chapter draws together the study findings, acknowledges their limitations and describes their novel contribution to the literature. It provides an overall discussion of the theoretical and methodological insights from the work as a whole, addressing how the findings contribute to the overall conclusions from the work and to knowledge in the field. Finally, it considers the implications for interventions and future research.

7.2. A focus group study of constructs in the PWM

7.2.1 Summary of evidence and strengths

Study 1 conducted eight mixed-gender focus groups, with participants aged 12-13, exploring common thoughts about, and experiences of, PA in a school setting. Thematic analysis found preliminary indications that young adolescents make both reasoned and more impulsive decisions about PA in the presence of peers, indicating that the PWM's dual-process framework might be appropriate for exploring their PA behavioural decision-making. Participants were able to describe widely-held and agreed-upon active and inactive prototypes, which included social characteristics. Active prototypes were described as having both positive and negative characteristics, while inactive types were evaluated negatively. There was evidence that participants did not regard inactivity as a risky health behaviour. Focus groups stimulate peer-led responses and reflections, and this study's key strength is that it

generated culturally-relevant and age-appropriate prototype descriptions for use in future studies.

7.2.2 Limitations

Although data was collected and reported with reference to the COREQ checklist (Tong, Sainsbury, & Craig, 2007), the study has a number of specific limitations, discussed in Section 3.4.1. More broadly, because participants came from two English counties, and from schools with relatively low percentages of pupils receiving free school meals, it is possible that their prototype perceptions, and the prototype descriptions they generated, might not generalise to other areas of the UK or to regions with higher levels of economic deprivation. Holding additional single-sex focus groups might have generated further evidence of more nuanced prototypes, although this may not have changed the study's overall conclusions.

7.2.3 Contribution to the literature

This published study, presented at Appendix A (Wheatley, Davies, & Dawes, 2018) is the first qualitative exploration of young British adolescents' perceptions of physically-active and inactive prototypes and extends the current literature by applying the PWM beyond older adolescents and university students. Overall, the study found initial evidence that the PWM could provide a suitable theoretical framework for exploring PA during a developmental stage characterised by spontaneous decision-making and sensitivity to the social environment.

7.3 Prototype perceptions predict objectively-measured PA

7.3.1 Summary of evidence and strengths

Study 2 used questionnaires developed according to established guidelines, and a seven-day accelerometry protocol, to gather initial evidence that prototype perceptions from the PWM's social reaction pathway accounted for significant variance in objectively-measured daily average MVPA over and above reasoned action variables.

Similarity to active images was a significant positive predictor of adolescent PA while the evaluation of inactive images was a significant negative predictor.

Neither intention nor behavioural willingness were significant in the model.

One key strength of this study is the novel approach of using accelerometry to capture a full range of impulsive activity choices as well as planned exercise when measuring PA behaviour. Previous studies in this framework have used self-report PA measures as outcome variables, but the cognitive challenges associated with seven-day PA recall can lead participants to over- or under-report activity (Adams et al., 2005), which potentially biases results. Further, the measures of prototype favourability were specifically designed for use in this age group: this issue is considered further in section 7.7. Although a correlational study, the prospective design, in which pupils reported prototype perceptions before activity was measured, ranks above retrospective designs in the evidence hierarchy (Vandenbroucke, 2008).

7.3.2 Limitations

The study has a number of limitations beyond the specific issues discussed in Section 4.4.5. Most importantly, compliance with the PA measurement protocol was poor, as expected in this age group (Cain, Sallis, Conway, Van Dyck, & Calhoun, 2013). Around a quarter of the accelerometers distributed were worn for less than three weekdays and one weekend day, the threshold for inclusion in the analysis, and it is possible that these belonged to relatively inactive or disadvantaged participants, for example. Although more than 94% of cases included in the analysis recorded at least six days of PA data, another potential source of bias is the standardisation of five- or four-day data sets. Future work could repeat the study with a larger, more representative sample.

7.3.3 Contribution to the literature

Previous experimental studies in the PWM framework have measured the extent to which prototype perceptions predict self-reported exercise behaviour among older adolescents and students (Ouellette et al., 2005; Amanda Ravis & Sheeran, 2003; Amanda Ravis et al., 2011). This study extends current knowledge with evidence that the model has explanatory potential among younger adolescents. The PWM was conceived to explain variance in health-*risk* behaviours (Gibbons & Gerrard, 1995), but the results strengthen the evidence base for using the model to describe health-*promoting* behaviour more generally as well as PA specifically in this age group.

7.4 Do implicit prototype perceptions improve PA prediction?

7.4.1 Summary of evidence and strengths

Study 3 explored image perception in more depth, testing the hypothesis that implicit bias towards, and similarity to, active or inactive images explains unique variance in PA using two novel IATs. On average, participants showed non-conscious bias towards, and similarity to active prototypes, and there was a weak but significant correlation between implicit and explicit measures of prototype similarity. The study was underpowered to detect other hypothesised associations.

Only a handful of previous studies (e.g. Ratliff & Howell, 2015; Redford, Howell, Meijs, & Ratliff, 2018; Whitaker, Long, Petróczy, & Backhouse, 2014) have used IATs to investigate the explanatory potential of implicit prototype perceptions. This study was intended to explore the feasibility of using IATs to measure implicit PA prototypes and to examine their predictive potential in the PWM framework. The project demonstrated that the IAT, and the platform on which it was presented, were straightforward to use in school and well-understood by participants. The study's methodological implications are considered further in section 7.8.

7.4.2 Limitations

This study's limitations have been considered extensively in Section 5.4.3, which also includes a critical analysis of the approach taken. When planning recruitment, future studies might consider the risk of missing data posed by a methodology that includes both a response time task and an objective measure of PA, both of which are well-known for poor compliance with their associated protocols in this age group (Cain et al., 2013; Nosek, Greenwald, & Banaji, 2005).

7.5.3 Contribution to the literature

Unconscious bias concerning PA prototypes might potentially represent a hidden or unreported goal state which, because it is unknown, could make young people all the more vulnerable to inactivity. Although the study is underpowered, the correlational evidence that explicit and implicit prototype favourability and similarity share valence offers some evidence that young people are unlikely to be concealing negative bias behind explicitly positive evaluations.

7.5 Testing the PWM's predictive validity in a large sample

7.5.1 Summary of evidence and strengths

Study 4 used an online questionnaire and associated secure database, developed in collaboration with colleagues, to test the extent to which the PWM explained variance in self-reported days per week of PA among over 9,000 young adolescents, and how far social reaction variables explained PA variance over and above constructs in the reasoned action pathway. The sample was sufficiently large to explore the interactions of favourability and similarity and the mediating effect of prototype similarity on the relationship between past behaviour and PA.

Overall the PWM explained 40.4% of variance in self-reported days per week of target physical activity. Prototype perceptions, their interaction terms, and willingness, together explained an additional 4.3% of variance over and above reasoned action variables. Given the large sample size, there were significant relationships between almost all of the variables, so effect size was an important statistic in this study. In the test of the model, intention explained most variance, with a standardised effect size equivalent to .26 days of MVPA per week (or 15 minutes, assuming 60 minutes per day). This contrasted with the results of Study 2. Prototype similarity had an effect size equivalent to .19 days (or 11.4 minutes). These were the only PWM variables with a standardised effect size $>.1$. Active and inactive prototype similarity mediated the effect of habitual physical activity on PA behaviour, and moderation analysis showed evidence that young adolescents who not only see themselves as inactive, but who are also concerned about the unfavourable social consequences of this image, are especially likely to be inactive. Notably, neither active nor inactive prototype favourability were significant predictors of days per week of activity. Willingness, although a significant predictor in the model, had a very small effect size.

The Fit to Study trial presented an opportunity to test the application of the PWM to a health-promoting behavior in a large and representative sample of young adolescents in which the overall percentage of free school meals – an indicator of deprivation – was close to the national average. An online questionnaire that did not allow students to skip answers removed the issue of bias caused by missing data at the individual level.

7.5.2 Limitations

In addition to the issues described in Section 6.4.7, the sample selection is responsible for a number of additional limitations. Of the 104 schools recruited, 20 withdrew before testing took place, which had potential to bias the results. Earlier studies in this thesis found no significant differences in prototype perceptions between genders, so gender was not included as a covariate in the model test. Nevertheless, only 40.2% of the sample was male, which might also have biased the results. The use of a self-report measure of PA is both a limitation and a strength of this study: poor recall can lead participants to over- or under-report activity but the results can more easily be compared with those of other studies. Comparisons with previous research are discussed in section 7.7.

7.5.3 Contribution to the literature

This study is one of only a limited number using the PWM to investigate health-promoting behaviour (J Todd et al., 2016). The results indicate that social reactive variables explain additional variance in days per week of MVPA, and may contribute to closing the ‘intention behaviour gap’ (Sheeran, 2002). These findings also add to the evidence that prototype similarity is a critical predictor of PA: this is important because previous PA interventions have attempted to manipulate variables including attitudes and norms which, in this test of the PWM, had smaller standardised effect sizes on PA (Hardeman et al., 2002). The study’s theoretical contributions to the literature are considered in more detail in the following section.

7.6 Measuring young adolescents’ MVPA

Finally, this thesis used a seven-day accelerometry protocol and a single-item self-report question to explore the proportion of secondary school students aged 11-13 meeting the recommended target of 60 minutes per day of MVPA. In Study 2, which used an objective measure, activity levels in the sample (aged 11-12) were higher than expected: 60.5% of participants recorded mean daily MVPA above 60 minutes. Among girls, 58% met the target, compared to 62.5% of boys. Study 3 participants, (aged 11-13), were less active: overall, 37% of the sample met the target. Of the girls, 26% achieved 60 minutes per day on average, against 47.5 % of boys. Study 4 measured self-reported PA among 11-12-year-olds and the results aligned closely

with data reported in the most recent HBSC survey (Inchley et al., 2016), which uses a very similar measurement item: 19.3% reported completing an hour's MVPA every day for the past week. Of the boys, 24.6% achieved the target, and of the girls, 15.8% reported 60 minutes of activity on all seven days. The lower proportion of active adolescents in Study 4 suggests that, if anything, self-report might *under*-estimate adolescent PA. One potential explanation is that the protocol used for analysing objective PA included every minute of MVPA, a relatively short bout of exercise that participants might not recall. For closer comparisons, future accelerometry studies might use a protocol that also identifies ten-minute blocks of exercise.

7.7 Theoretical insights

The most compelling conclusions from the four studies presented here are that young adolescents hold physical activity prototypes, and that self-reported similarity to these images directly predicts PA variance in a typical week during school term. Previous research (eg Ravis & Sheeran, 2003) has found evidence that the PWM explains exercise behaviour among university students, but the research in this thesis extends the model's utility to a younger age group. Although the PWM was developed to account for risky adolescent health behaviours such as smoking and drinking in the presence of peers, these studies support the contention (Gibbons & Gerrard, 2016; Ravis, Sheeran, & Armitage, 2006) that it can also predict health-promoting behaviour. There was mixed evidence concerning the role of prototype favourability, while willingness did not appear to be significant. Overall, the theoretical insights support the use of PA interventions involving prototype similarity manipulation. This section considers the implications of these findings.

The evidence that similarity to active prototypes explains variance in both objectively-measured and self-reported adolescent PA extends previous work by indicating that young people can have strong reactions to non-risk images, and that similarity to these images, rather than favourability, predicts healthy behaviours (Gerrard et al., 2002; A Ravis et al., 2006). Researchers have suggested that similarity facilitates behaviour when the prototype represents a self-image, linked to internal (rather than social) processes and reflecting self-perception (Hertel & Mermelstein, 2012; Ravis et al., 2011). Where PA is concerned, young adolescents may consider themselves as an active type of person, and to maintain that self-

perception requires them to be active. For example, Ravis and Sheeran (2003) reported that prototype similarity and descriptive norms accounted for an additional 5% of variance in university students' exercise over and above TPB variables and past behaviour, where exercise was measured with a single item, '*How often did you engage in exercise over the past two weeks?*'

Critics of this interpretation have suggested that measures of similarity are essentially the same as self-reported behavior (Ajzen, 2011). As Ajzen notes (p1122): "*The question employed, 'In general, how similar are you to the type of person your age who (performs behaviour x)?' is likely to produce much the same information as asking, 'Are you the kind of person who performs behaviour x?'; i.e. 'do you perform behaviour x?'*"

Whether or not this is the case, the mediation analyses in Study 4 indicated that both active and inactive prototype similarity had an effect on behaviour even after controlling for past behaviour, suggesting that similarity is indeed measuring something different from behaviour itself. This is an important finding because, as Ajzen himself conceded (Ajzen, 2011, p1123), such evidence would go some way to demonstrating the PWM's utility. Furthermore, the correlation between active prototype similarity and behaviour in Study 4, although significant, was only moderate, $r = .48$. In Study 2, $r = .39$ and in Study 3, $r = .25$.

Understanding more about active and inactive prototype similarity is important if they are to be targeted in interventions. In this thesis, young people generally rated themselves as similar to active types and dissimilar to inactive types using both explicit and implicit measures, although the range of responses was broad, as shown in Studies 2 and 3. Overall, this suggests there is scope for increasing perceptions of similarity to active images (and decreasing similarity to inactive prototypes) using interventions, as discussed in Section 7.9.

Image favourability did not explain significant PA variance in Study 4, a notable finding given that all other variables were highly significant in the model. Evidence from Study 1 suggested that this age group perceives active types positively (although with some negative qualities), and as a healthy-behaviour actor rather than a risk-behaviour abstainer. Study 2 found there were individual differences in the strength of these appraisals and Study 3, in which participants were asked to evaluate prototypes against both positive and negative qualities, found

similar results. Notably, implicit bias, representing evaluations that young people might be unable or unwilling to self-report, was moderate-to-strongly in favour of active rather than inactive images.

Together, these findings are consistent with PWM theory: favourability, said to reflect the perceived social consequences of the behaviour (Gerrard et al., 2008), is more usually related to *risky* behaviour (Gibbons & Gerrard, 2016). This is because positive images (such as a condom-user or a physically-active person) are widely rated as favourable, whereas negative images (for example a reckless driver or an inactive person) can be perceived more or less unfavourably since they might include an element of ‘cool’ or ‘relaxed’.

Surprisingly, in the light of Study 4 results, inactive prototype favourability was a significant negative predictor of PA in Study 2. One possibility is that this finding is caused by the inclusion of outliers in the data analysis (see Fig. 4.1, p82). Yet the interaction term of inactive (favourability x similarity) was also significant in Study 4: strong self-rated similarity to inactive images, combined with an unfavourable rating of this image, is significantly associated with lower levels of activity. This suggests that young people who are not only aware of the negative social consequences attached to inactive prototypes, but who also think of themselves in this way, are especially likely to be inactive – perhaps to avoid behaving in a way that will be judged harshly by their peers.

Intentions were the largest significant predictor of health-promoting PA in Study 4, while willingness, although also significant, had an effect size of $<.1$. The PWM proposes that willingness is a better predictor than intention of certain types of spontaneous behaviors that take place in social contexts: favourable evaluations of risky prototypes are thought to prompt willingness to engage in risky health behavior (Gibbons & Gerrard, 2016; Todd & van Lettow, 2016). The evidence presented in this thesis supports the additional contention that, for health-promoting behaviours, intention, aligned with the self - rather than willingness, aligned with social goals - could be more closely linked with PA behavior. This does not, however, imply that adolescent PA decisions are all carefully and systematically reviewed: as Ajzen (2011) noted, the TPB recognizes that most everyday behaviours are performed without much cognitive effort, consistent with the notion that perceived similarity, rather than rationality, guide PA behavior.

7.8 Methodological Insights

The research presented in this thesis involved developing novel self-report scales and implicit association tests to measure explicit and implicit prototype perceptions. Their designs were based on established theoretical guidelines (Davies, Martin, & Foxcroft, 2013; Gibbons, Gerrard, & McCoy, 1995; Greenwald, McGhee, & Schwartz, 1998; Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Nosek et al., 2005; Rivis et al., 2006) and informed by qualitative research presented in Study 1. This section considers the methodological insights gained from developing and implementing these and other self-report measures.

7.8.1 Explicit measures of prototype favourability.

Overall, four items were developed to capture participants' evaluation of active and inactive prototypes, which are defined as clear and distinct images, widely recognised and agreed upon, that include social characteristics (Gerrard et al., 2008). Participants were asked to "*Think of someone **your age** who is physically active for an hour every day in a typical week during school term*" and indicate "*how far the following words describe*" this type of person (1 = 'not at all' to 7 = 'extremely') using four adjectives (*confident, popular, determined, attractive*). They were then asked to evaluate an *inactive* prototype using the same descriptors. Study 3 posed the same question but participants were also asked to evaluate prototypes against four negative adjectives (*annoying, bossy, grumpy, judgmental*).

Notably, Cronbach's alpha was higher when participants evaluated inactive images than when they rated active types. Using only the four positive items, $\alpha = .80$ for inactive evaluations, compared to $\alpha = .71$ active evaluations. With four positive and four negative items, $\alpha = .68$ and $\alpha = .51$ respectively.

One implication of these findings is that participants appear to view inactive types in a more uniformly negative way across all dimensions, whereas they are more selective about the extent to which they ascribe positive terms to active types. This is supported by evidence from Study 1, which found that young adolescents feel negative towards inactive prototypes but they do not view active types in a universally positive light. Another implication is that the use of both positive and negative terms might introduce confusion to the evaluation process if participants rate their strength as well as their valence differently. For example, if participants

think that active types are *slightly confident* and *not at all grumpy* or *extremely determined* and *slightly annoying* then the measure will lose internal consistency. Alternatively, one recent study (Elliott et al., 2017) treated positive and negative ratings as separate constructs after factor analysis showed that that positive and negative items loaded onto two distinct factors.

The strength of the favourability measure used in this thesis is that it draws from descriptions suggested and agreed upon by young adolescents themselves. Piloting, as reported in Section 2.3.2, showed that the terms were well understood by this age group. For this age group, it improves upon other established research methods piloted during the research programme, in which participants reflect privately on prototype images and whose favourability is measured using the ‘evaluation thermometer’ (Haddock & Zanna, 1994).

7.8.2 Implicit measures of prototype favourability and similarity

Two exploratory IATs were developed to capture implicit prototype favourability and similarity. In the favourability IAT, participants were presented with eight active and inactive ‘stick people’ and eight positive and negative adjectives (*confident, popular, determined, attractive, annoying, bossy, grumpy, judgmental*). The IATs were delivered on iatgen, a validated online tool (Carpenter et al., 2017) that runs in Qualtrics and which cleans data and calculates scores using the algorithm recommended by Greenwald et al. (2003).

Both IATs found implicit bias in the expected direction: there was moderate-to-strong bias in favour of active types relative to inactive types, and slight-to-moderate similarity with active compared to inactive images. Yet this does not necessarily confirm that the IATs were measuring implicit prototype evaluations, as intended. Ultimately, the IAT is a sorting task that infers information about the strength of associations from participants’ response times. But these can be confounded with other factors including mere familiarity with the concepts (Ottaway, Hayden, & Oakes, 2001): it is possible for example, that the image of the running stick person was more familiar than that of the stick person lying on their bed and therefore easier to pair with an attribute. It is also conceivable that, despite being presented with instructions that “*in this game you will see pictures that represent people your age who are physically active*”, participants might have

confounded prototype perceptions with attitudes towards the activity presented. If, for example, a participant felt very negative about swimming, they might have been slower to pair the swimming image with a positive social characteristic. As noted by Westfall, Judd, and Kenny (2015), it might be that the IATs measured participants' bias as elicited only by the particular set of activities presented – cycling, swimming, weightlifting, running – rather than their bias concerning active and inactive types more generally.

It is important to note that the test gives an indication of the *relative* strength of associations between active/inactive prototypes and positive/negative social characteristics. In other words, the IAT is based on an underlying assumption that participants' evaluations of the different categories (in this case active and inactive types) have different valences (Blanton, Jaccard, Gonzales, & Christie, 2006). Although the studies in this thesis have found evidence supporting this contention, some participants in Study 1 appeared more ambivalent.

One disadvantage of iatgen is its relative lack of flexibility: for example there is no option to deliver an IAT format with fewer block or trials than the standard seven-block format, which might have been a more suitable approach for young participants with short attention spans. But a major advantage of this online tool is that it runs on school computers without needing to download a plug-in, which schools are reluctant to permit, piloting revealed. Overall, this exploratory instrument proved straightforward to use and well-understood by participants.

7.8.3 Self-report measures of willingness

Using evidence from Study 1, and in line with previous research (Davies, Martin, & Foxcroft, 2016; Gibbons et al., 1998) scenarios were designed to measure how willing participants might be to take part in PA with peers in school and two items per scenario assessed whether participants would be willing to *be* active or *avoid* being active (1 = 'very unwilling' to 7 = 'very willing'):

Scenario 1: '*It's lunchtime at school and the teachers have organised an obstacle race on the playing field for a challenge. Some students are taking part and others are watching*'.

Scenario 2: *'It's morning breaktime at school. Some people you know ask you to join in a game that involves running and jumping. People in your class are standing talking nearby.'*

The measures have good face validity and internal reliability was good ($\alpha = .85$), yet there is debate about the extent to which explicit measures, requiring conscious deliberation, can accurately capture impulsive willingness to engage in behaviour that is neither planned nor entirely unconscious (Fishbein, 2008). The model's authors suggest that willingness involves *heuristic* rather than *automatic* processing: the primary heuristic is the social image (cool, stupid, attractive) that the individual associates with the behaviour (Gibbons, Kingsbury, Gerrard, & Wills, 2011). An alternative approach for the future might be to use a reaction-time task, in which participants are required to quickly provide yes/no answers to willingness (Comello & Slater, 2011).

7.8.4 Self-report measures of perceived behavioural control

Two PBC items were designed to capture participants' confidence that they could meet the daily MVPA target by measuring self-efficacy and the extent to which performing the behaviour is within their control (Francis et al., 2004): Participants were asked (1 = 'strongly disagree to 7 = 'strongly agree') whether *'If I wanted to, I am confident that I could be physically active for an hour every day in a typical week during term'* and *'Whether or not I am physically active for an hour every day in a typical week during term is completely up to me.'*

These items showed poor internal consistency, suggesting that there is no strong association between self-efficacy and controllability among young adolescents, in line with some previous findings (Armitage & Conner, 2001; Norman & Hoyle, 2004). This might perhaps reflect the important role that parents or teachers play in organising adolescents' schedules. A more internally-consistent measure of perceived control might have explained greater variance in PA, a limitation of the research presented in this thesis. One option for Study 4 might have been to develop a series of items for measuring self-efficacy and controllability separately, and to use factor analysis (Bornstedt, 1977; Ratray & Jones, 2007) to test their construct validity. However, these discrete constructs are not themselves part of the model. Overall, the findings concerning this measure suggest that established frameworks for developing self-report measures might not be suitable for younger

populations and that controllability might be better captured with a term other than ‘*entirely up to me*’.

7.8.5 Reflections on opt-out consent in secondary schools

Data presented in this thesis was collected during the pilot and main trial phases of Fit to Study, a cluster-randomised trial for which the University of Oxford’s Central University Research Ethics Committee approved the use of opt-out parental consent. School head teachers opted in after an initial approach, and parents had the opportunity to opt out of participation and/or data storage on behalf of their children after receiving information sheets. Participants tested in school for Studies 1, 2 and 3 gave verbal assent on the day and could withdraw at any time. For Study 4, testing took place as part of normal school activities, so pupils did not have the option to withdraw on the day, in line with ethical approval. A total of 65 students – fewer than 0.05% of those recruited – opted out of the main trial.

Recruiting a large and representative sample to participate in the Fit to Study intervention was important: there is evidence that young people from disadvantaged backgrounds are both less physically-active (Humbert, 2006) and underperform at school relative to socio-economically advantaged peers (Paterson, 1991). An *opt-out* approach was therefore justifiable given that *opt-in* approaches tend to generate smaller samples that are less representative of disadvantaged groups (Hewison & Haines, 2006). Opt-out consent for smaller pilot studies might be more problematic, although all participants were aware that they could withdraw at any time and indeed several students did opt not to participate in the Study 1 focus groups on the day.

One potential issue for future consideration when recruiting at the school level is that while head-teachers gave opt-in consent on behalf of the school, PE teachers were responsible for ensuring that baseline questionnaire data was collected. This placed a burden on teaching staff, whose views on this additional workload might not have been sought or considered. A total of 20 schools withdrew from the trial between recruitment and baseline testing when Study 4 data was collected, the result, perhaps, of teachers subsequently declining to take part. Had teachers’ consent been sought during recruitment, this relatively high withdrawal rate, which has the potential to bias results, might potentially have been avoided.

Finally, ethical approval and recruitment for the studies reported in this thesis

took place shortly before General Data Protection Regulation (GDPR) came into effect in May 2018. Under the new legislation, researchers must have a ‘lawful basis’ for holding and using personal data. For many projects, this lawful basis is likely to be that the research is a ‘task in the public interest’ but, if this is deemed not to be the case, then participants’ consent to store and use data must be sought. Although GDPR does not explicitly ban opt-out consent, the Information Commissioner’s Office says that opt-outs are ‘essentially the same as pre-ticked boxes, which are banned’. In practical terms, this has significant implications for future opt-out trials such as Fit to Study.

7.9 Implications for interventions

From an applied perspective, the PWM offers a promising explanation for health-promoting behaviours, and, although interventions using this framework to encourage physical activity are very limited, evidence from this thesis suggests that strategies to help young people create a more active (or less inactive) self-perception could boost physical activity levels. Study 4 highlighted one specific group that might particularly benefit: young people who are not only aware of the negative social consequences attached to inactive prototypes, but who also think of themselves in this way, are especially likely to be inactive.

Given that the PWM was developed to explain risky health behaviour, interventions in this framework typically consider how to curtail health-*negative* behaviours such as excessive alcohol consumption (Davies et al., 2016), often with interventions that encourage *social* comparison. For example, a study that prompted young adults to compare themselves with drinkers found that participants who perceived a dissimilarity between themselves and heavy drinkers in terms of social characteristics became less willing to drink (Lane et al., 2011).

Interventions that manipulate similarity are less common. In the physical activity domain, Ouellette et al. (2005) found that systematic contemplation of exercise images could produce changes in PA behaviour. Participants were asked to consider, and write down their thoughts about, their own and other people’s health and appearance 10-20 years in the future, thinking about whether, over that period, they exercised regularly or not. In other words, they contemplated a hoped-for or feared future self-image – which has components of both similarity *and*

favourability. Asking young people to spend time thinking about their future self in this way could potentially be fruitful.

A Delphi study to elicit expert feedback on suitable behaviour change techniques to reduce adolescent alcohol misuse identified potential strategies linked to the PWM that were drawn together into the Alcohol Smart Quiz (Davies, Martin, & Foxcroft, 2016). One suggestion was the creation, or provision, of a positive (or negative) group identity to help change prototype perception. In schools, one possibility might be a whole-school intervention to encourage an active group identity including, for example, active commuting and active lesson breaks. A supportive environment might be particularly useful for young people who are not only inactive, but fear being judged harshly for the associated perceived characteristics.

Another strategy might be to encourage *risk* comparisons between participants and target images. Studies 1 and 2 found evidence that young adolescents, and especially boys, do not perceive inactivity as a long-term health risk. This perception is typical of the ‘absent-exempt’ heuristic: young people who have engaged in risk behaviours without negative consequences tend to believe they are exempt from future risk (Weinstein, 1987, 1989). For example, the more young adults engage in drunk-driving without accidents, the less likely they are to believe they will have an accident or get arrested (Gibbons, Lane, Gerrard, Pomery, & Lautrup, 2002).

Another study involving adult female participants found that, although many women consider themselves invulnerable, perceived similarity to individuals with breast cancer or heart disease lowered absent-exempt thinking (Gerend, Aiken, West, & Erchull, 2004). A recent study found that absent-exempt thinking could be manipulated with text suggesting that it is illogical, for example, for individuals to believe that they are not at risk of a sexually-transmitted disease after engaging in unprotected sex: in other words, by encouraging reasoned rather than heuristic decision-making (Stock, Gibbons, Beekman, & Gerrard, 2015). The study also found that participants who receive such a manipulation, and then compare themselves to a target who is similar in terms of risk behaviour but who has caught a sexually transmitted disease, reported fewer feelings of being exempt from future risk. A PA intervention targeting young people might perhaps manipulate absent-exempt thinking and then ask adolescents to contemplate people who have

jeopardised their health through inactivity, or, more positively, protected their health through activity.

7.10 Future directions

Adolescence is a period of rapid growth, learning and neurobiological development during which young lives can change rapidly, for better or worse: it is crucial to improve our understanding of this age group and develop interventions to keep young lives on track in terms of long-term health and wellbeing (Dahl, Allen, Wilbrecht, & Suleiman, 2018). This thesis has concluded that contemplative assessments of prototype similarity guide adolescent decisions about physical activity rather than more impulsive willingness to participate driven by a favourable assessment of prototypes and their social consequences. Yet impulsive decision-making about health behaviours remains an important avenue for exploration. Developing a measure of willingness that captures adolescent spontaneity, perhaps with a protocol involving virtual reality headsets, may be a useful next step. The large data set collected in Study 4 opens a number of interesting possibilities. Path analysis would provide a clearer picture of the relationships between past behaviour, prototype similarity, intention and physical activity among young adolescents. Finally, developing an intervention that manipulates inactive adolescents' perceptions of prototype similarity has potential to address the inactivity crisis now threatening young peoples' futures.

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Appendices