Habit, Cognition and the Environment: The Influence of Psychosocial and Perceived Environmental Factors on Children's Physical Activity

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Declarations

I hereby declare that this thesis is a presentation of my own original work. Where I have consulted the published work of others, every effort is made to indicate this clearly with due reference to the literature. This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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Acknowledgements

Abstract

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Physical activity determinant studies now often include both environmental and socio-cognitive factors but few of them acknowledge and explore the mechanisms underlying relevant environmental influences. This thesis addressed the gap in current knowledge by exploring pathways linking the environment and physical activity in children beyond the limits of models such as the Theory of Planned Behaviour (Ajzen, 1991), by examining the more complex automatic and habitual mechanisms underlying this behaviour.

First, a TPB questionnaire was developed to assess physical activity cognitions in children (study 1). This was followed by a psychometric evaluation of the Physical Activity Questionnaire for Older Children (PAQ-C) (Crocker, Bailey, Faulkner, Kowlaski & McGrath, 1997) (study 2). Building on the first two studies, study 3 utilized these measures to delineate the mechanisms linking the environment and physical activity in children. Results showed that nearly 43% of the association between convenient facilities and physical activity intentions could be explained by subjective norms (16.7%) and habit strength (26.2%), while 15% of the association between convenient facilities and physical activity could be explained by habit strength alone.

Study 3 provided the impetus for the development, implementation and evaluation of a theory based cluster randomised control trail to increase physical activity in children (study 4). Results revealed a significant increase in PAQ-C scores for those in the intervention group, however perceived access to convenient facilities and habit strength did not significantly increase as a result of the intervention and did

not mediate the intervention effect. There was however some evidence that the intervention increased intention – behaviour consistency.

The results demonstrate the importance of concepts such as environmental accessibility and habit strength in the prediction of children's physical activity, however further research is required to elucidate the role of these factors in producing intervention effects.

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Chapter 1

Introduction

"Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it" (Plato 428 – 348 B.C).

1.1   Introduction

Physical inactivity is the fourth leading risk factor for global mortality accounting for 6% of deaths globally. This follows high blood pressure (13%), tobacco use (9%) and high blood glucose (6%). Physical inactivity is the main cause for approximately 21–25% of breast and colon cancers, 27% of diabetes and 30% of ischaemic heart disease burden. Increasing physical activity brings health benefits and reduces mortality from non-communicable diseases like heart disease and stroke, diabetes, cancer and chronic lung disease. Physical activity is also a key determinant of energy expenditure, and thus fundamental to energy balance and weight control (World Health Organisation [WHO], 2011). Although the ill effects of ischaemic heart disease and other chronic diseases manifest in adulthood, it is increasingly understood that their development starts in childhood and adolescence. Therefore promoting physical activity must start early in life.

There is evidence that children do not engage in sufficient levels of physical activity for good health (Craig, Mindell & Hirani, 2009). Such evidence has compelled psychologists to adopt models of social cognition to identify the psychological antecedents of physical activity behaviour in children and to map the processes by which these antecedents lead to action (Maddux, 1993). Prominent among these is the Theory of Planned Behaviour (TPB) (Ajzen, 1991). A great number of studies have applied the TPB to physical activity behaviour and supported the major premises of the model. However the model has been criticised because it places undue emphasis on the individual (Giles-Corti & Donovan, 2002) and has led to a

strong focus on cognitive determinants such as attitudes, subjective norms (SNs) and perceived behavioural control (PBC) (Brug, van Lenthe & Kremers, 2006). A further criticism of the TPB is its inability to account for repetitive or habitual behaviours. As such the field has been shaped by assumptions that choices to be active are conscious and deliberate, i.e. consequent upon attitudes, SNs and PBC.

Attributes of the physical environment as correlates of physical activity have begun to be identified. This interest reflects a growing recognition of the influence that environmental factors may have on physical activity. The ANGELO (analysis grid for environments linked to obesity) framework (Swinburn, Egger & Raza, 1999) in particular has been informative in guiding some of our newer ways of thinking about the environment and provides a practical tool for prioritizing environmental elements for research and intervention. Ecological models, the Environmental Research Framework for Weight Gain Prevention (EnRG) (Kremers et al., 2006) for example, are now helping to integrate this new data into 'mainstream' research on physical activity and health (Owen, Spathonis & Leslie, 2005). As a result, physical activity determinant studies now often include both environmental and socio-cognitive factors, however only a few of them acknowledge and explore the potential mechanisms underlying relevant environmental influences.

This thesis will address the gap in current knowledge by exploring the pathways linking the environment and physical activity in children beyond the limits of models such as the TPB and the ANGELO framework by exploring the more complex automatic and habitual mechanisms underlying behaviour. Studies that explore the mediating pathways between the environment and physical activity are largely lacking (Brug et al., 2010). It is important to investigate such associations in order to develop well planned interventions to encourage physical activity.

1.2 Research aims

This project seeks to:

1. Examine associations between habit, cognition and the environment and moderate to vigorous physical activity (MVPA) in children.

2. Examine whether associations between the environment and MVPA are mediated by the TPB and by habit strength.

3. Develop a model of children's MVPA.

4. Design, implement and evaluate a theory driven physical activity intervention for children, with the purpose of testing and refining the above mentioned model.

1.3   Structure of the thesis

The behavioural epidemiological model advocated by Sallis and Owen (1999) has provided a framework for the structure of this thesis. The framework proposes five main phases of research, as they may be applied to physical activity and health:

1. Establish the links between physical activity and health
2. Accurately measure physical activity
3. Identify factors that influence physical activity
4. Develop and evaluate interventions to promote physical activity
5. Translate research into policy and practice

Phases 3 investigates the types of behaviours that are identified as most closely associated with health in phase 1; Phase 2 considers the measurement of physical activity as well as population prevalence and trends. Phase 4 aims to change the influences identified in phase 3; while knowledge gained from phases 3 and 4 help to formulate relevant public health policies and practice in phase 5.

Consistent with the behavioural epidemiological framework, this report is organised into 5 phases, containing 14 chapters in total. Chapter 1 serves as a brief introduction to the research study and its aims. Chapter 2 defines and differentiates between key terms before considering the importance of physical activity to health. Next, government recommendations concerning the appropriate frequency, intensity, type and duration of physical activity necessary for good health are discussed. Survey data is then presented to show the extent to which children across the UK meet current recommended activity targets, before considering UK

policy on physical activity and the role of health psychology in physical activity research and promotion.

Chapters 3 to 8 present the background literature and origins of the project. Chapter 3 provides an introduction to SCMs. It introduces and compares several key theories, before concluding with a general critique of the social cognition approach. Chapter 4 considers one model in particular, the TPB, and places it within the context of children's physical activity. The strengths and limitations of the model are also discussed. Chapter 5 explores the impact of environmental factors on children's physical activity. It discusses the numerous different ways in which the environment has been conceptualised and measured. It critically examines environmental research and considers the general limitations of the environmental approach. Chapter 6 describes and critically evaluates the ecological approach and presents several key, physical activity specific models, while chapter 7 introduces the concept of habit and contrasts the notion of automaticity with planned behaviour.

Chapter 7 states the case for a clear and unambiguous distinction between physical activity habit and behavioural frequency and the implications of this distinction for the measurement of habit strength are discussed. Several models describing the basic mechanisms underlying habit performance are examined and a model of physical exercise habit formation is presented. Because the basic mechanism of implementation intentions and habits seem very similar, chapter 8 examines the role that implementations may play in creating future physical activity habits.

Chapter 9 pulls together research on habit, cognition and the environment which leads logically into a formal statement of the study aims and specific objectives. Chapters 10 and 11, present two preliminary studies. Chapter 10 describes the development and validation of brief TPB questionnaire to assess physical activity cognition in children, while chapter 11 presents a psychometric evaluation of the Physical activity questionnaire for older children (PAQ-C) (Crocker, Bailey, Faulkner, Kowlaski & McGrath, 1997).

Chapter 12 describes a study which utilizes the TPB and the PAQ-C to delineate the causal mechanisms linking the environment and MVPA in children. Specifically this study sought address aims 1, 2 and 3 stated above; in short it sought to determine whether associations between perceived accessibility of convenient facilities and resources in the home and school environment and MVPA are mediated by the TPB and/or by habit strength. Chapter 13 describes the development, implementation and evaluation of a school based teacher led intervention to increase MVPA in children. The purpose of this study was to test and refine the model developed in chapter 12. Finally, chapter 14 sets out the conclusions of this project, considers the limitations of the research designs and methodologies and discusses implications for future research.

The diagram below maps the thesis according to the five phases of research identified by Sallis and Owen's (1999) behavioural epidemiological framework.
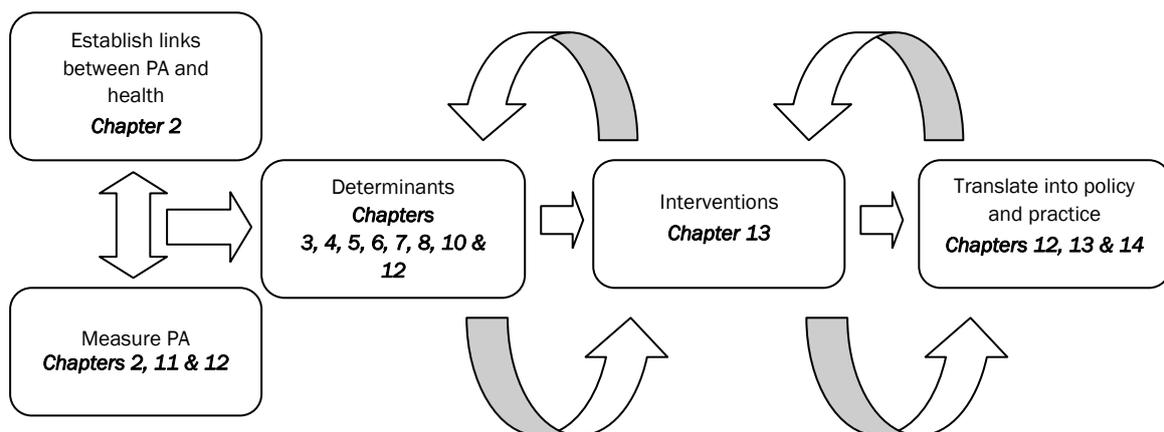
Figure 1.1 Behavioural epidemiological framework (Sallis & Owen, 1999 adapted from Biddle & Mutrie, 2008)

Chapter 2

Physical activity and health

"Movement is a medicine for creating change in a person's physical, emotional and mental states" (Carol Welch)

2.1   Introduction

Physical activity, exercise and sport are all terms that describe different concepts; however they are often confused with one another and the terms are sometimes used interchangeably (Casperson, Powell & Christenson, 1985). It is therefore essential that these (and associated) terms are formally defined before considering the importance of physical activity to health.

2.2   Defining key terms

Physical (in)activity and energy expenditure

Casperson et al. (1985, p.126) define physical activity as "any bodily movement produced by skeletal muscles that results in energy expenditure". This definition of physical activity is undisputed in the literature and while broad is at least objective (Thirlaway & Upton, 2009). A further area of confusion centres on the distinction between the terms physical activity and energy expenditure. This is evident from the widespread practice of expressing physical activity as energy expenditure. However it should be noted that these terms are distinct constructs. Physical activity is movement; energy expenditure on the other hand is physiological consequence of physical activity and is a reflection of age, sex and body mass in addition to movement and efficiency of movement (Tudor-Lock & Myers, 2001).

Physical inactivity has been defined as a "state in which bodily movement is minimal" (Dietz, 1996). Behaviours that are considered physically inactive include;

standing still, sitting, watching television, working on a computer and passive commuting, i.e. driving a car, sitting on a bus (Dietz, 1996; Ainsworth et al., 1993).

Physical activity is a complex, multi-dimensional behaviour. Many different modes of activity contribute to total physical activity including; occupational, transport, household and leisure time activities (Miles, 2007). Physical activity can be further categorised in terms of frequency, duration and intensity. Frequency and duration refer to how often and how long an activity is performed, while intensity refers to how hard a person is working or the rate of energy expenditure an activity demands (Miles, 2007).

Moderate intensity physical activity

Biddle, Sallis and Cavill (1998, p.2) define moderate intensity physical activity as "activity usually equivalent to brisk walking, which might be expected to leave the participant feeling warm or slightly out of breath".

Vigorous intensity physical activity

Biddle, Sallis and Cavill (1998, p.2) define vigorous intensity physical activity as "activity usually equivalent to at least slow jogging, which might be expected to leave the participant feeling out of breath and sweaty.

Under the umbrella term 'physical activity' are the subcategories of exercise and sport.

Exercise

Caspersen et al. (1985, p.128) define exercise as "physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective". Exercise may also have the objective of enhancing health or improving performance (Bouchard & Shephard, 1994). Examples of this type of activity might include, walking, cycling, jogging or swimming.

Sport

According to Biddle and Mutrie (2008, p.10) sport is a "subcomponent of exercise whereby the activity is rule governed, structured, competitive and involves gross motor movement characterized by physical strategy, prowess and chance". Thus for Biddle and Mutrie sport is required to involve significant physical exertion; in practice however many activities that are understood to be a sport fail to meet this criteria. For example, both snooker and darts maybe rule governed, structured and competitive, but require little in the way of gross motor movement.

Discrepancies in the way the term 'sport' is understood make the relationship between exercise and sport problematic. Consequently a linear relationship between these levels of activity (where sport is a subset of exercise and exercise is a subset of physical activity) although appealing, cannot model the relationship effectively. A better model of the relationship is provided by Upton and Thirlaway (2009) (see figure 2.1). In this model both exercise and sport are subsets of physical activity, however the overlap between the two is dependent on the definition of the term 'sport'.
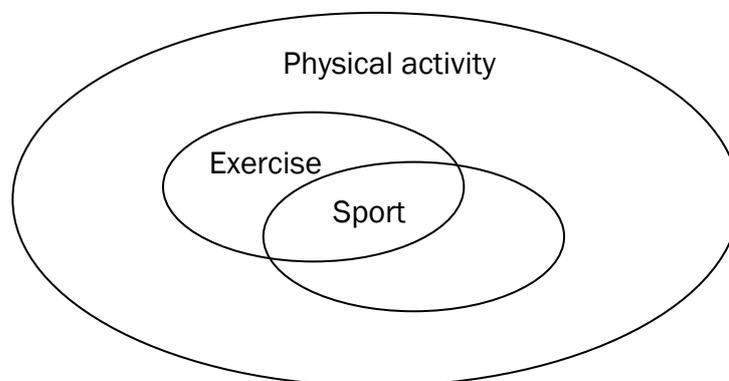
Figure 2.1 The relationship between physical activity, exercise and sport (Thirlaway & Upton, 2009)

Health

The WHO (1948 in WHO, 1998) define health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

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Health may, according to this definition, seem idealistic and impossible to achieve. However it does draw attention to the multifaceted and socially conscious definition of health which is favoured in contemporary western society (Blaxter, 2004). More recent statements from the WHO emphasize the dynamic nature of health and its many social and environmental correlates;

"Health is the extent to which an individual or group is able to realize aspirations, to satisfy needs, and to change or cope with the environment. Health is therefore a resource for everyday life, not the objective of living... a positive concept emphasizing social and personal resources, as well as physical capacities" (WHO, 1986 cited in WHO 1998).

2.3   The relationship between physical activity and health

A strong body of evidence suggests that regular physical activity is associated with numerous health benefits for children and young people. This includes most notably, the enhancement of skeletal health (e.g. Hind and Burrows, 2007; MacKelvie, Khan & McKay, 2002; Clark, Tobias & Ness, 2006) but also the prevention of obesity (e.g. Trost, Kerr, Ward & Pate, 2001; Ekelund et al., 2002; Trost, Sirard, Dowda, Pfeiffer & Pate, 2003; Bassett et al., 2007) and type 2 diabetes (e.g. Sinha et al., 2002; Khan et al., 2003; Viner, Segal, Lichtarowicz-Krynska & Hindmarsh, 2005). There is also some evidence to suggest that physical activity provides psychological health benefits for children, in particular for self-esteem (e.g. Ekelund, Heian, Hagen, Abbott & Nordheim, 2004) and depression (e.g. Motl, Birnbaum, Kubik & Dishman, 2004; Larun, Nordhiem, Ekelund, Hagen & Heian, 2006). Although cardiovascular disease is not a disease of childhood there is evidence to suggest that less active children are more likely to have risk factors associated with the disease (Andersen et al., 2006; Gutin & Owens, 2011).

Physical activity is not only important for children's current health; it can also provide a strong platform for the maintenance of good health throughout the life course. For example, Yang et al. (2007) followed 1,319 boys and girls aged 9-18 over a period of 21 years and found that adult obesity was linked to adult activity

and adolescent obesity. Importantly however, adult obesity showed only an indirect effect for adolescent activity acting through adolescent obesity. Although there is limited evidence that childhood activity directly affects adult health, research suggests that it may exert an indirect influence via childhood health and adult activity (Biddle & Cavill, 2007) (see figure 2.2).

Establishing physical activity habits at an early age can also help lead to a physically active lifestyle in adulthood, thus extending its benefits across the life course. Research varies as to whether the relationship between childhood and adult activity is small or small to moderate, however correlations are generally stronger between adolescence and adulthood (Hallal, Victoria, Azevedo & Wells, 2006), among the more active (Telama, Yang, Hirvensalo & Raitakari, 2006) and when the quality of the physical activity experience in childhood is improved (Taylor, Blair, Cummings, Wun & Malina, 1999). The potential tracking of physical activity from childhood to adulthood is important as there is comprehensive evidence that an active lifestyle in adulthood has direct health benefits.
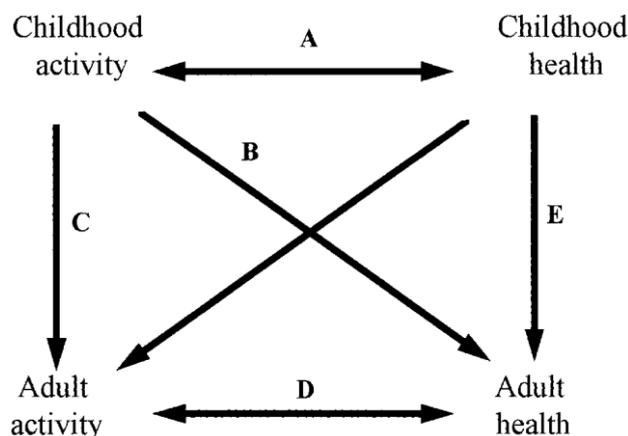
Figure 2.2 Hypothetical relationships between physical activity in childhood and health in both children and adults (Blair, Clark, Cureton & Powell, 1989)

In adults, physical activity is a major independent protective factor against coronary heart disease (Kohl, 2001) and stroke (Lee, Folsom & Blair, 2003) and also helps to

improve several associated risk factors including raised blood pressure (Whelton, Chin, Xin & He, 2002), adverse blood lipid profiles (Durstine, Grandjean, Davis, Ferguson, Alderson & DuBose, 2001), and insulin resistance (Wallace, Mills & Browning, 1997). Physical activity also has a clear protective effect on colon, breast (among post menopausal women) and lung cancer; although the evidence for lung cancer is less consistent (Thune & Furberg, 2001). Low levels of physical activity are a major risk factor in the development of type 2 diabetes (Kelley & Goodpaster, 2001) and obesity (Wenche, Holmen, Kruger & Midthjell, 2004). Evidence suggests that adults who lead an active lifestyle have a reduced risk of clinical depression (Dunn, Trivedi & O'Neal, 2001) and reduced anxiety (O'Connor, Raglin & Martinsen, 2000). Physical activity can also help people to function better through the alleviation of stress (Iwasaki, Zuzanek, & Mannell, 2001) and improved sleep (Sherrill, Kotchou and Quan, 1998). A recent review conducted by the Physical Activity Guidelines Advisory Committee (PAGAC) (2008) concluded that there is very strong evidence, based on well conducted studies which demonstrate that physically active people are at lower risk of developing a number of disabling medical conditions and have lower rates of various chronic diseases than inactive people.

There is a clear dose-response relationship between physical activity and diseases such as CHD and type II diabetes, in that greater benefits occur with greater participation, i.e. curvilinear relationship. Curves for their diseases will become more apparent as the volume of evidence increases. For instance the prevention of different disease may require different doses of activity – it may be that more activity is required to reduce the risk of colon cancer than is needed to reduce the risk of CHD (Department of Health [DoH], 2011). According to the PAGAC (2008), few studies have provided data on the dose response for various health outcomes in children and youth. However, substantial data indicate that important health benefits can be expected to accrue in most children who participate in at least 60 minutes of moderate to vigorous physical activity daily.

As well as its effect on morbidity, large studies in Finland (e.g. Salonen, Puska, Kottke, Tuomilehto & Nissinen, 1983) and the USA (e.g. Paffenbarger, Hyde, Wing & Hsieh, 1986) have shown that those who are physically active are less likely to suffer from premature death. For example, Lee and Skerrett (2001) conducted a review assessing the dose-repose relationship between physical activity and all cause mortality. Forty four studies satisfied their inclusion criteria and were included in the review. Researchers reported evidence of a clear linear inverse dose-response relationship between volume of physical activity and all cause mortality in both men and women. They found that minimal adherence to physical activity guidelines, yielding an energy expenditure of around 1000Kcal a week, was associated with a 20 – 30% reduction in risk of all cause mortality with further reductions at higher volumes of energy expenditure. Researchers suggested that additional research is needed to clarify the contributions of intensity, duration and frequency of physical activity to decrease all cause mortality rates.

In summary then, evidence of a health benefit for physical activity is seen throughout the life course. In children, effects are predominantly seen in the amelioration of risk factors for disease, avoidance of weight gain, achieving a high peak bone mass, and mental health. In adults, protection is conferred against the diseases themselves including CVD, cancer, type 2 diabetes, obesity and all cause mortality. It is generally agreed that greater health benefits occur with greater participation.

2.4   Measuring physical activity

The measurement of physical activity is typically complex; however these complexities are exacerbated when assessing activity in children. It is beyond the scope of this review to evaluate the full range of methods available, (Buckworth & Dishman, 2002 for example identified over 30 different methods); however it would be inappropriate to ignore the fact that different methodologies for measuring physical activity exist. Broadly, the various techniques can be grouped as self-report, observation, heart rate telemetry and motion sensors (Rowlands & Eston, 2007) or

primary measures, secondary measures and subjective measures (Sirard & Pate, 2001, see figure 2.3).

Primary measures

According to Sirard and Pate (2001) direct observation of the individuals' movement is the most practical and comprehensive criterion measure of physical activity and should be used as the gold standard for physical activity research. Evidence supporting the use of observational systems comes from studies correlating observation scores with heart rate or oxygen consumption. Correlations between observed physical activity and heart rate and/or oxygen consumption in these studies typically range from 0.61 to 0.91 (Sirard & Pate, 2001). Drawbacks of direct observation include the relatively high experimenter burden and potential reactivity of participants. What's more the total observation time required to obtain accurate day-to-day stability is not clear from most observational instruments (Sirard & Pate, 2001). Despite these drawbacks, direct observation has the advantage of being able to accurately describe what took place in the physical activity setting, thus providing both quantitative and qualitative information. Providing information on the environmental setting is becoming increasingly important in physical activity research.

Doubly labelled water (DLW) is a biochemical procedure that assesses total caloric expenditure by estimating carbon dioxide production and is well recognized as a criterion measure in field evaluations of energy expenditure (EE) (Sirard & Pate, 2001). The procedure involves ingesting two stable isotopes of water, then after a 5 to 14 day period, the difference in the rate of loss between the two isotopes from the body (i.e. urine, sweat, evaporation) is analysed. This way a direct measure of carbon dioxide production can be obtained (Dale, Welk & Matthews, 2002). The precision and non-invasive nature of this method is a major advantage for many research applications (Dale et al., 2002); unfortunately however DLW has several limitations. For example, it is very expensive, the isotope can be difficult to get hold of, measurements must be taken over at least three days and accurate dietary records must be obtained during the measurement period. For these reasons it is

not particularly suitable for large studies. Furthermore, DLW only assesses total energy expenditure; however it may be just as important to evaluate other parameters such as duration, intensity and frequency (Sirard & Pate, 2001).

Indirect calorimetry is another method of assessing energy expenditure. Using this method EE is estimated from the respiratory exchange ratio (the ratio of the volume of carbon dioxide eliminated from the lungs per minute to the volume of oxygen taken into the lungs during the same time) and total oxygen consumption during progressive exercise tests. For short time intervals, participants typically wear a mouth piece or a canopy during exercise. Over longer intervals, i.e. 24 hours, participants are confined to a metabolic chamber. The advantage of this approach is its ability to accurately measure EE; however it is limited by the financial cost of the equipment, the invasiveness of the measure and the inability to simulate free living situations (Dale et al., 2002) as the equipment is too cumbersome to use under long term free living conditions, especially in children (Sirard & Pate, 2001).

Both DLW and indirect calorimetry measure EE and should not be considered direct measures of physical activity. Despite this, we are witnessing an increased use of these methods (especially doubly labelled water) to quantify physical activity and to validate other measures of the construct (Tudor-Lock & Myers, 2001; Westerkerp, 1999).

Secondary measures
Several objective techniques are now widely available for the measurement of physical activity. Heart rate monitors for example, provide an indirect indicator of the physiological response associated with physical activity under free living or controlled conditions. Most heart rate monitors can be programmed to record data at specified intervals therefore allowing a good description of the intensity, duration and frequency of activity. This data can then be downloaded onto a computer for analysis (Dale et al., 2002). Although heart rate monitors provide an objective assessment of physical activity, they present some unique challenges for researchers. First, during sedentary or light intensity activities an individual's heart

rate can be effected by factors other than body movement for instance; psychological and environmental stress, caffeine and some medications (Emons, Groenenboom, Westerterp & Saris, 1992). The second challenge for researchers is the temporal lag of the heart rate in response to the initiation or cessation of activity (Dale et al., 2002). For example, Strath et al. (2000) report that it takes 2 – 3 minutes for heart rate to increase to a level representative of the activity being performed and a similar amount of time to decrease to resting levels. A final challenge posed by this approach is deciding how to analyse the data. A variety of outcome measures have been suggested which each lead to different results and interpretation (Welk, Corbin & Dale, 2000).

Pedometers are a simple electronic device used to estimate the total number of steps taken over a period of time. They are relatively cheap, reusable and unobtrusive. For this reason pedometers are ideal for use in large studies (Rowlands & Eston, 2007). On the downside, because they measure total steps over a specified period, they cannot assess the intensity or pattern of activities, and they are unable to detect the movements involved in activities such as cycling or swimming (Sirard & Pate, 2001). There is also the possibility that wearing a pedometer will cause the individual to engage in reactive behaviour (Rowlands & Eston, 2007). Accelerometers on the other hand are more sophisticated electronic devices that measure accelerations produced by body movement. Critically, however accelerometers also have a time sampling capability allowing assessment of the temporal pattern and intensity of activity as well as total accumulated activity (Rowlands & Eston, 2007). Like pedometers, accelerometers provide an objective and reusable tool for assessing physical activity; however they have a limited ability to assess cycling, locomotion on a gradient and other activities with limited torso movement (Sirard & Pate, 2001).

Subjective measures
Survey methods such as self-report questionnaires, interviewer administered questionnaires, diaries and proxy-reports are all considered subjective because they rely on the response of the individual or proxy. Self-report questionnaires in

particular are inexpensive and offer researchers a means of estimating physical activity in large numbers of individuals while maintaining relatively low investigator and respondent burden. The greatest limitation of self-report measures is the subjectivity inherent when individuals are asked to respond to questions about their behaviour. Recall errors, social desirability bias and deliberate misrepresentations are particular concerns when dealing with children.

Interviewer administered measures have many of the same strengths and limitations as self-report questionnaires. Although providing a trained administrator may improve a child's cognition and accuracy (Sirard & Pate, 2001). Any potential benefit of this method must be weighted against the increased cost and burden to the researcher, as well as the potential bias introduced by the presence of the interviewer. The diary method is considered one of the most accurate subjective methods of assessing physical activity. However, because of the participant burden required to maintain an accurate diary, this technique has limited use in children and reports should be viewed with caution (Sirard & Pate, 2001). There is limited information on proxy-reports as a measure of physical activity in children and although it might be tempting to think that parents would provide an accurate assessment of their child's activity this is not always the case (Noland, Danner, DeWalt, McFadden & Kotchen, 1990). One of the advantages of using a proxy-report is that researchers can avoid recall errors caused by children's cognitive limitations, at the same time though, the characteristics and perceptions of the proxy may introduce an additional source of bias (Sirard & Pate, 2001).

Criterion standards
1. Direct observation
2. Doubly labelled water
3. Indirect calorimetry

Secondary measures
1. Heart rate
2. Pedometers
3. Accelerometers

Subjective measures
1. Self-report
2. Interview
3. Proxy-report
4. Diary
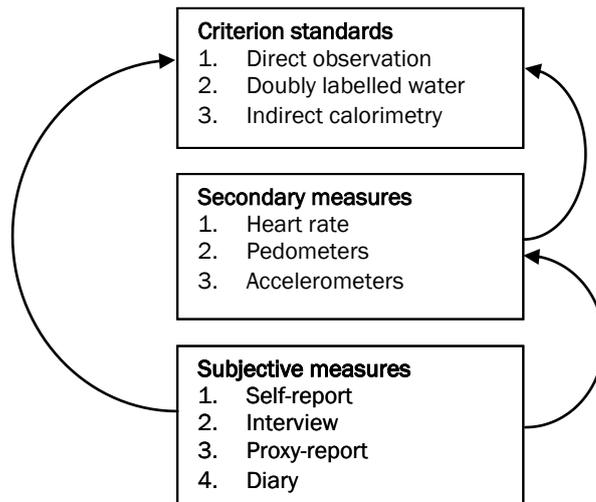
Figure 2.3 Three levels of physical activity measures. Arrows indicate acceptable criterion standards for the validation of tertiary and secondary methods (Sirard & pate, 2001)

An ideal method of assessing physical activity remains elusive (Sirard & Pate, 2001); indeed, no single measure is without its limitations. However the ultimate choice of measure will depend on the question to be studied, the size of the cohort and resources available (Hussey, Bell & Gormley, 2007).

Due to the sporadic short-burst nature of physical activity (Baquet, Stratton, Van Praagh & Berthoin, 2007) and children's limited ability for recall, objective techniques such as heart rate telemetry and accelerometry are recommended, however the costs associated with these methods can vary. For example Tudor-Lock and Myers (2001) reported the associated costs of accelerometry to be between $50 – $400 (£32 - £236) per unit, plus the cost of calibration, hardware, software and expertise. While pedometers provide a relatively inexpensive objective assessment of total physical activity ($10 - $50 [£6.40 - £32] per unit, Tudor-Lock & Myers, 2001) they are only suited to ambulatory activities and are limited by their inability to detect the movements involved in activities such as cycling or swimming. Observational studies are time consuming and labour intensive, while the costs and/or increased participant burden associated with DLW and indirect calorimetry render these methods prohibitive in large scale investigations. Assessing physical

activity through the use of subjective measures also has several limitations. However, when time, money and/or manpower are limited subjective measures, especially self-report questionnaires, seem to be the most practical way of quantifying or categorising physical activity behaviours.

2.5   Recommendations for physical activity

Evidence highlighting the link between physical activity and health has forced exercise scientists to propose guidelines for physical activity. Numerous recommendations across the U.K have been issued stating the appropriate frequency, intensity, type and duration of physical activity necessary for good health, however new physical activity guidelines have recently been published to help ensure consistent messaging across the four countries. The new UK wide guidelines cover early years (under fives), children and young people (5 – 18 years old), adults (19 – 64 years) and older adults (65+). This is the first time UK-wide physical activity guidelines have been produced and the first time guidelines have been produced in the UK for under fives as well as for sedentary behaviour, for which there is now evidence that this is an independent risk factor for disease (DoH, 2011).

The new guidelines offer more flexibility for achieving the recommended levels of activity than previous guidelines, however they still focus on being active everyday and spell out the recommended minimum levels of activity for each group.

The new guidelines for early years recommend that 1) physical activity should be encouraged from birth, particularly through floor based play and water-based activities in safe environments; 2) children of pre-school age who are capable of walking unaided should be physically active daily for at least 3 hours, spread throughout the day and 3) All under fives should minimise the amount of time spent being still for extended periods.

The new guidelines for children and young people state that 1) all children and young people should engage in moderate to vigorous intensity of physical activity for at least 60 minutes and up to several hours every day; 2) vigorous intensity activities, including those that strengthen muscle and bone, should be incorporated

at least three times a week and 3) All children and young people should minimise the amount of time spent being sedentary for extended periods.

The guidelines also recommend that 1) adults should be active daily. Over a week, activity should add up to at least 2 ½ hours of moderate intensity activity in bouts of 10 minutes or more; 2) Alternatively comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous intensity activity; 3) adults should also under take physical activity to improve muscle strength on at least two days a week and 4) all adults should minimise the amount of time spent being sedentary for extended periods. The recommendations for older adults are similar to that of adults except for the additional recommendation that those at risk of falls should incorporate physical activity to improve balance and co-ordination on at least two days a week.

2.6   How active are children in the UK?

Levels of activity are regularly measured throughout the UK, although there are some differences in the methods used to collect the data (DoH 2011). The health survey for England (HSE) 2008 (Craig et al. 2009) provides the most recent data on levels of physical activity among children aged 2-15 years. The HSE gathers information on the participation of formal and informal physical activity as well as travelling to and from school and sedentary behaviours. Children aged 13 – 15 were asked questions directly about their physical activity, while the parents of those aged 2 – 12 were asked questions on the child's behalf. In addition a subsample was selected for accelerometry, so that physical activity could be objectively measured.

Based on self report data 32% of boys and 24% of girls were classified as meeting the CMO's recommendation for physical activity, i.e. 60 minutes or more of moderate intensity activity on each day of the week. Forty four percent of boys and 47% of girls reported some activity, i.e. 30 – 59 minutes, while 24% of boys and 29% of girls reported that they had participated in less than 30 minutes of moderate intensity activity on each day. Among girls the proportion meeting the CMO's recommendation generally declined with age ranging from 35% among girls

aged 2 to 12% among those aged 14. There was a less consistent age pattern among boys (Craig et al. 2009).

Based on accelerometry during the week after the survey the proportions of boys and girls classified as meeting the CMO's recommendations were similar to the self report data – 33% and 21% for boys and girls respectively. Nonetheless, the accelerometry data identified larger differences between younger and older children than is apparent from the self report data. For example, for children aged 4 – 10, 51% of boys and 34% of girls had met the recommendations compared with 7% of boys and 0% of girls aged 11 – 15 (Craig et al. 2009).

Despite the health gains associated with physical activity there are still high levels of inactivity across the UK. The percentage of children meeting activity guidelines in Northern Ireland, Wales and Scotland are presented in the table below. Figures for England and Northern Ireland are based on 60 minutes or more of moderate intensity activity on each day, while those for Wales and Scotland are based on 60 minutes or more of moderate intensity activity on five days a week. Across the UK boys are more likely than girls to be active at almost every age. Physical activity declines with age in both sexes, but more steeply in girls (DoH, 2011).

Table 2.1 The percentage of children meeting previous physical activity guidelines in England, Scotland, Northern Ireland, Wales and Scotland (DoH, 2011)

Country	Boys	Girls
England (aged 2 – 15)	32%	24%
Northern Ireland (aged 8 – 12)	19%	10%
Wales (aged 4 – 15)	63%	45%
Scotland (aged 2 – 15)	76%	67%

2.7   UK policy on physical activity and the role of health psychology

Strategies for the promotion of physical activity vary across the UK. Nevertheless, all four nations have shown a commitment to increasing physical activity by placing it high on their list of priorities for government campaigns aiming to improve health. For example, in 1993 the DoH published the 'Health of the Nation initiative' (HON); the first explicit attempt by the British government to provide a strategic approach to improving the overall health of the population in England. The main objectives of the proposal were to reduce premature mortality, increase life expectancy and improve quality of life. Physical activity was identified as an important element to combat CHD and stroke, one of the five priority areas of the HON initiative. Subsequently, a number of campaigns have been launched to promote and enhance physical activity.

In 2002 a highly ambitious target for physical activity in England was proposed by the Government's strategy unit to increase the proportion of adults who participate in 30 minutes of MVPA on five or more days a week to 70% by 2020 (an interim target of 50% of individuals by 2011 was also set) (Strategy Unit, 2002). This target represents an approximate 40% increase or a 2% year-on-year rise. The more recent English document 'Choosing Activity: a physical activity action plan (DoH, 2005) has since suggested that the Government's target is unachievable. This was echoed by the Walness Report (Walness, 2004) which recommended that this 'aspirational' target should be replaced with something more realistic. In 2004 the HM Treasury proposed to increase the proportion of children who spend a minimum of two hours a week on high quality sport and PE from 25% in 2002 to 85% by 2008. Results of the School Sport Survey suggest that in 2007/08, 90% of pupils across 21,745 schools participated in at least two hours of high quality PE and school sport in a typical week; thus exceeding government targets. However, only 66% of children achieved this target through school curriculum time alone (Department for children, schools and families, 2008). There are now plans to give all children aged 5 – 16 the opportunity to take part in 5 hours of P.E or sport during the school week (DoH and Department for Children, Schools and Families, 2008).

In order to tackle physical activity out of school, initiatives such as the change for life campaign have been launched, the aim of which is to encourage families and individuals to 'eat better' and 'move more'. Since its launch a number of additional sub-brands have been launched with a specific focus on physical activity including; Swim4Life, Bike4Life, Play4life and Walk4Life (Change4Life, 2010). Swim4Life, for example, was launched early in 2009 and by September had led to more than 200 councils offering free swimming to all those aged 16 and under (HSE, 2008).

Similar initiatives have been launched across the UK. In 2006 the Welsh Assembly Government introduced the 'Food and Fitness Implementation Plan'; a five year plan for promoting physical activity and healthy eating for children and young people (Welsh Assembly Government, 2006). This was followed in 2009 by 'Creating an Active Wales; a programme designed to support children to live active lives and ensure access physical activity opportunities (Welsh Assembly Government, 2009b). In the 'Healthy Eating, Active living' paper the Scottish Government outlined its plans to tackle diet and physical activity from 2008 to 2011 (Scottish Government, 2008). Consequently a number of projects were developed to encourage and enable physical activity; including 'Girls on the Move' and the 'Play@Home' scheme (British Heart Foundation, 2010). In 2009, the Scottish Health Committee's report 'Pathways into Sport and Physical Activity' made a number of recommendations to improve levels of physical activity including a renewed commitment to providing a minimum of two hours of PE in schools each week (Scottish Parliament Health and Sport Committee, 2009). In 2009, the Northern Ireland Public Health Agency launched 'Physical Activity: It all Adds Up'; a campaign specifically highlighting that activity can be spread throughout the day in order to achieve the 60 minute target (Public Health Agency, 2009).

So government organisations across the UK have supported the promotion of physical activity as an important health protective behaviour through the publication of policy, position statements and campaigns. But how do government and other national organisations go about influencing physical activity? One way to promote participation is to consult theories of social behaviour often used in the field of

health psychology. Health psychology is both a theoretical and an applied field and is concerned with understanding how biology, behaviour and contextual factors including economic, cultural, community, social and lifestyle factors influence health. A major aim of health psychology is to investigate causal links between psychosocial factors and health at the population level. In this way health psychologists can help to discriminate between the health promotion practices which do and do not effectively promote health behaviours, quality of life and longevity. Health psychologists then, have the potential to make an important contribution to health care policy and campaigns to promote physical activity. One way that health psychologists promote physical activity is through the use of SCMs. These models or theories can provide a useful insight into the salient antecedent variables and mechanisms that underpin motivation and behaviour and can provide a general guide as to how physical activity behaviour can be promoted. Chapter 3 therefore, will review some of the key theories used to explain and predict physical activity behaviour from a health psychology perspective.

Chapter 3

Introduction to Social Cognition Models

"A theory that denies that thoughts can regulate actions does not lend itself readily to the explanation of complex human behaviour" (Bandura, 1986).

3.1   Introduction

For many years SCMs have been at the forefront of psychological research into behavioural choices and behaviour change. The social cognition approach argues that social behaviour is best understood as "a function of people's perception of reality, rather than as a function of an objective description of the stimulus environment (Conner & Norman, 2005, p. 5). Social cognition thus tends to focus on intra-individual functioning, i.e. how social knowledge is processed, as opposed to how these processes interface with society. The social cognition approach considers individual cognitions as processes which intervene between stimuli and response (Fiske & Taylor, 1991) and stems from information processing theory which argues that people actively process external information. The distinction between perception of reality and objective reality provides the basis for social cognitive theorising regarding behavioural change. In short it suggests that talking based interventions that challenge perceptions people hold about their environment or themselves; for instance it's too dangerous to cycle to school, may be at least as, if not more effective, at changing behaviour than a physical change to the objective environment such as building a cycle path (Thirlaway & Upton, 2010).

3.2   Social cognition models and health behaviour

A great number of SCMs have been developed over the years and widely applied to a variety of health behaviours, however some of the most popular models of exercise behaviour include; the Health Belief Model (HBM) (Rosenstock, 1974), Protection Motivation Theory (PMT) (Rogers, 1983), Social Cognition Theory (SCT)

(Bandura, 1982), the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and the Model of Goal Directed Behaviour (MGDB) (Perugini & Conner, 2000). All of these SCMs provide a basis for understanding human behaviour and behaviour change. They also provide a list of important targets which health behaviour interventions might focus upon (see table 3.1)

Broadly, three different kinds of SCM can be distinguished: motivational, multi-stage and volitional, however they all share the common view that human behaviour is based upon an elaborate, but subjective, cost benefit analysis of the pros and cons associated with that behaviour. In this way, each of these models emphasise the rationality of human behaviour. The mainSCMs listed above are primarily concerned with peoples' motivation to perform or not to perform a particular action. These theories share the view that intentions are the most immediate determinant of human behaviour; however they do not explain the process by which intentions are translated into action (Hagger & Chazisarantis, 2005a). More recently researchers have sought to redress this balance by developing volitional models which focus on action control strategies such as action planning (e.g. Gollwitzer, 1993 – see chapter 8) and coping planning (Sniehotta, Schwarzer, Scholz & Schüz, 2005). Multi-stage models on the other and differ from both motivational and volitional models in that they encapsulate several discrete stages. They also assume that the variables important in producing movement toward action vary from one stage to the next (Armitage & Conner, 2000). Stage theories of health behaviour include the Transtheoretical Model (TTM) (Prochaska & DiClemente, 1982) The Precaution Adoption Process Model (Weinstein, 1988; Weinstein & Sandman, 2002) and the Health Action Process Approach (Schwarzer, 1992). A summary outlining the key determinants and major criticisms of SCMs of motivation most often applied to exercise behaviours are provided in table 3.1.

3.3   Comparison of key social cognition models

A number of authors have commented on the considerable overlap between the key constructs contained in the main SCMs; indeed where differences do appear they tend to represent differences in labelling rather than differences in underlying

constructs (Cummings, Becker & Maile, 1981). For example, models such as the HBM and the PMT, which have been specifically developed to predict health behaviours, explicitly focus on the notion of threat, i.e. perceived severity and perceived susceptibility. Models such as the SCT and TPB on the other hand tap the notion of threat more implicitly by focusing on expectancies about environmental cues (i.e. risk perception) or beliefs people hold about physical inactivity and its consequences for health (i.e. the evaluative component of behavioural beliefs and belief strength). Most SCMs also tend to focus on the perceived consequences of performing a behaviour. For example, the SCT focuses on outcome expectancies, the TPB on behavioural beliefs and the PMT on response efficacy (Conner and Norman, 2005).

A number of models also focus on issues of control or barriers to performance. For instance there is considerable overlap between control beliefs in the TPB (i.e. Perceived Behavioural Control) (PBC) and self-efficacy (SCT). Similarity can also be noted with the perceived barriers dimension of the HBM and response costs in the PMT. With the exception of the TPB and the MGDB, normative influences on behaviour are not explicitly covered by the main SCMs. Most SCMs, the TPB, SCT, PMT and MGDB for example, all include an intervening variable which is seen to mediate the relationship between the other socio cognitive variables and behaviour, e.g. intention in the TPB and MGDB, goals in the SCT and protection motivation in the PMT. What's more the TPB, MGDB and the SCT postulate a direct relationship between self efficacy or PBC and behaviour in addition to intention and behaviour (Conner & Norman, 2005).

Despite a substantial amount of work using the main SCMs, little has been done in the way of comparing the predictive power of the different models (Conner & Norman, 2005), especially in children; as a result the remainder of this section will concentrate on comparison studies involving adults. In one study, Tavares, Plotnikoff and Loucaides (2009) compared the TTM, TPB, PMT and SCT for predicting physical activity behaviours of employed women with and without children. Cross section analysis was conducted for the TPB and SCT and a prospective analysis was conducted for the TTM and PMT. Overall, the explained

variances between the groups of women for each of the SCMs were relatively similar, however there were differences in the explained variances between the different models. For example, the TTM, SCT, PMT and TPB explained 24%, 36%, 29% and 37% of the variance in energy expenditure for employed women with children respectively. For employed women without children the models explained 24%, 31%, 25% and 34% of the variance in energy expenditure respectively. Self-efficacy and intention were the strongest predictors of energy expenditure among the theory constructs for both groups of women across all theories and time points. Limitations of this study include self report data, the cross sectional analysis of the TPB and SCT and failure to examine the TTM (e.g. temptation) and SCT (e.g. outcome expectations) in their theoretical entirety.

Perugini and Conner (2000) compared the predictive power of the TPB, the MGDB and an extended MGDB with regard to body weight regulation (i.e. dieting and exercise) or studying effort in a sample of 104 students from the UK. Researchers found that the TPB was able to predict 30% of the variance in behavioural volitions (a broader class of intentions encompassing aspects of planning, commitment and effort). This was substantially lower than the variance obtained for both the MGDB and extended MGDB (74% and 76%). In another study Perugini and Bagozzi (2001) compared the MGDB with the TPB and a variant TPB to predict intentions and behaviour. Similar to the results above, the MGDB accounted for significantly more variance in intentions to diet (74%), exercise (78%) and study (53%) than the TPB (diet – 34%, exercise – 58%, study – 34%) and its variants. By the same token the MGDB (diet – 25%, exercise – 46%, study – 24%) also accounted for more variance in behaviour than both the TPB (diet – 19%, exercise – 38%, study – 15%) and its variants. Thus the MGDB appears to outperform the TPB by showing superior predictive power.

Another study compared the predictive power of the TRA, TPB, Theory of Self regulation and the Theory of Trying (See Bagozzi & Kimmel, 1995) with regard to exercise behaviour in a sample of 142 undergraduate students. In this study the Theory of Self Regulation explained the greatest amount of variance in exercise

intentions (55%), followed by the TPB (46%), the TRA (41%) and the Theory of Trying (39%). In contrast the Theory of Trying explained the greatest amount of variance in exercise behaviour (43%) followed by the TPB (12%), Theory of Self Regulation (5%) and the TRA (4%). The results showed that attitudes significantly predicted intentions in all theories; however subjective norms lead to intentions only in the Theory of Trying.

Finally, Hagger, Chatzisarantis and Biddle (2002) conducted a meta-analytic review of 72 studies (involving both adults and children) comparing the predictive power of the TRA and TPB. Results revealed that the TRA explained 37% of the variance in physical activity intentions and 26% of the variance in behaviour. The TPB on the other hand explained 45% of the variance in physical activity intentions and 27% of the variance in behaviour. While the major relationships of both the TRA and TPB were supported, the TPB demonstrated greater predictive superiority.

Two main conclusions can be drawn from the comparisons outlined above. First, there is considerable overlap between the key constructs included in the main SCMs. Given the overlap it is hardly surprising that many comparison studies have shown the models to perform at a relatively similar level, suggesting that there may be little to choose between them. In this instance the parsimony of the model may help us to draw conclusions regarding predictive superiority, i.e. the model which accounts for the greatest amount of variance using the fewest constructs. Second, behavioural intentions typically emerge as the strongest predictor of behaviour; however they also mark the end of the motivational phase of decision making. For this reason there is a strong argument for including behavioural intentions in all SCMs as a mediating variable between other social cognitive variables and behaviour (Conner and Norman, 2005).

On the basis of these conclusions then, both the MGDB and the TPB present a strong case for predictive superiority, however the TPB is more parsimonious in that it uses fewer constructs to explain and predict behaviour. What's more MGDB aims to explain the concept of desires as the most proximal predictor of behaviour as

opposed to intentions and focuses on behavioural goals rather than behavioural enactment per se (Hagger & Chatzisarantis, 2005a). Nonetheless, a major limitation of the TPB is that it fails to consider post intentional influences on behaviour.

Table 3.1 Summary of key Social Cognition Models used in physical activity research

Model	Type of model	Determinants/Stages	Major criticisms
HBM	Motivational	Perceived susceptibility Perceived severity Perceived benefits Perceived barriers Health motivation Cues to action	- Does not capture all psychological determinants of behaviour, e.g. self-efficacy - Does not offer clear operational definition of key constructs - Does not specify how constructs combine to predict intentions and/or behaviour - Emphasis on the individual, i.e. ignores social and economic factors - Absence of a role for emotional factors such as fear denial - Focuses on beliefs that are not relevant to many
PMT	Motivational	Severity Vulnerability Response efficacy Self-efficacy Response costs Protection motivation	- Many criticisms of HBM relate to the PMT, however it has been less widely criticised - Meta-analysis found only moderate effects on behaviour (e.g. Floyd, Prentice-Dunn & Rogers, 2000) - Does not explain how attitudes might change, - Does not assume that behaviour is always rational
SCT	Motivational	Self-efficacy Outcome expectations Socio-structural factors Goals	- Broad, lacking unifying principle or structure - Many applications of the SCT focus on one or two constructs, such as self-efficacy, while ignoring the others - Central role of self-efficacy suggests that it is probably more important than SCT per se - Minimizes emotional responses - Ignores biological/physiological responses
TRA	Motivational	Attitude Subjective norms Intention	- Deals purely with volitional behaviours - Relies solely on cognitions and omits other potentially important determinants - Unidirectional model, fails to offer the possibility that variables can act in a reciprocal manner

Model	Type of model	Determinants/Stages	Major criticisms
			- Insufficient attention has been paid to the measurement of behaviour
			- Inconsistent role of subjective norms
TPB	Motivational	Attitude Subjective norms PBC Intention	- Many of the criticisms of the TRA can be applied to the TPB, with the exception of the point concerning volition since the inclusion of PBC accounts for this - Does not account for all of the variance in intention and behaviour - Lack of consistency in defining PBC - The sufficiency of the TPB has been debated and a number of additional predictors have been suggested
MGDB	Motivational	Attitudes Positive affect Negative affect Subjective norms Desires PBC Intentions FPB RPB	- Similar criticisms to the TRA/TPB, i.e. does not account for all of the variance in intention and behaviour, lack of consistency in defining PBC, inconsistent role for subjective norms etc. - Frequency and recency of past behaviour are thought to reflect automatic habitual processes, nevertheless past behaviour and habit are two distinct (but related) constructs - As yet no intervention studies have tested the utility of the model in promoting physical activity

PBC – Perceived behavioural control, FPB – Frequency of past behaviour, RPB – Recency of past behaviour

3.4   Limitations of the Social Cognition approach

According to Norman and Conner (2005a) the advantages of using SCMs are four fold. First, they offer a theoretical back ground to research, i.e. they guide the selection of cognitions and describe the ways in which cognitions combine to determine health behaviours; second, because the models have been repeatedly tested they provide valid and reliable measures of key constructs, for example Ajzen's website provides guidance on developing TPB measures (although he provides no direct guidance on how to target key beliefs for intervention); Third, they add to our understanding of the most proximal determinants of behaviour and fourth they can be used to inform the development of health behaviour interventions. Irrespective of their advantages parallel disadvantages can also be drawn. For example, Norman & Conner (2005a) argue that by providing such a clear theoretical framework, SCMs may lead us to overlook constructs that are not included in the models but nonetheless play an important role in predicting certain behaviours. They also argue that an over exclusive focus on SCMs may lead to the neglect of other potentially effective behaviour change interventions which may not have their effects through the cognitions specified in SCMs, e.g. increased taxation.

There has been one widely cited critique of the social cognition approach written by Ogden (2003). Her critique was based on a review of 47 empirical studies which focused on the HBM, PMT, TRA and the TPB. First, she concluded that the models are indeed useful, both from the perspective of the researcher and to inform service development. Second, she argues that SCMs do not enable the generation of specific hypotheses because their constructs are unspecific; they therefore cannot be tested. Ogden supports this by arguing that researchers do not conclude that they have disconfirmed a theory when they find that one or more of its determinants do not predict the outcome measure or that the findings do not explain all or most of the variance in intentions and behaviour. Third, Ogden claims that SCMs focus on analytic truths (rather than synthetic ones that can be known through observation) because the correlations observed between cognitions (and measures of behaviour as these are often based on self-report) are likely to be attributable to overlap in the way the constructs are measured. Finally, Ogden suggests that asking participants

to complete a questionnaire to describe their cognitions may create and change both cognitions and behaviour as opposed to revealing a pre-existing state of mind.

Ajzen and Fishbein (2004) challenge each of Ogden's claims and contend that SCMs can be tested, that measures used to test them are not redundant but possess discriminant validity and that the effect of completing a questionnaire on cognitions and behaviour is an empirical question. Take for example, the TPB, Ajzen and Fishbein have noted repeatedly that the relative importance of the TPB constructs in the prediction of intentions is expected to vary from behaviour to behaviour and population to population. Furthermore, they argue that there is no justification for Ogden's conclusion that no data can be collected to show that the TPB is wrong. If all three antecedent variables failed to predict intention, the TPB would indeed be disconfirmed. Concerning Ogden's claim that observed correlations between TPB components are likely to be attributable to overlap in the way that the constructs are measured, the TPB constructs have been validated in numerous investigations that have tested for convergent and discriminant validity among the different measures. Besides, the fact that attitude, SN or PBC sometimes fail to carry a significant weight in the prediction of intention also demonstrates that the predictor and criterion variables are valid indicators of the constructs in question. Regarding Ogden's concerns that self reports of behaviour may be 'contaminated' by self-report cognitions, Armitage and Conner (2001) in their meta-analysis of the TPB found that intention and PBC still explained 21% of the variance in behaviour when objectively measured. Finally, Ogden suggests that responses to questionnaire items may in fact create new cognitions or change existing cognitions. Ajzen and Fishbien (2004) argue that this concern is common to all questionnaire studies and whether completing a questionnaire does or does not influence cognitions and behaviour in a given investigation is an empirical question. Indeed, Ajzen, Brown and Carvajal (2004) tested this proposition and found no evidence whatsoever that responding to a TPB questionnaire affected later (observed) behaviour or that performance of behaviour changed later cognitions.

Despite the various criticisms, SCMs still provide an important and widely used approach to understanding health behaviours by describing the key social cognitive variables that underpin such behaviours. For this reason they provide an important

basis for behaviour change interventions by identifying appropriate targets for intervention work.

Chapter 4 of this thesis reviews one of the most influential and oft-cited social psychological theories used to predict and explain health behaviours; the TPB. Chapter 4 outlines the background and description of the model. It also focuses on the strengths and limitations of the TPB as it is applied to children's physical activity.

Chapter 4

The Theory of Planned Behaviour

"One mark of the success of any theory is its longevity. By this measure the Theory [of Planned Behaviour] has achieved due recognition as a fundamental model for explaining social action" (Bagozzi, 1992).

4.1   Introduction

One of the most popular conceptual frameworks within the social cognition approach for explaining and predicting physical activity is provided by the TPB. The TPB is an extension of an earlier model; the TRA and provides a theoretical account of the way in which deliberative decisions influence the performance of social behaviour.

4.2   Background and description of the model

According to the TRA the most proximal determinant of volitional behaviour is one's intention to engage in that behaviour. Intentions are assumed to encapsulate an individual's motivation to behave in a particular way and provide an indication as to how hard the individual is willing to try and how much effort they are willing to exert in order to perform that behaviour (Ajzen, 1991). In turn, intention is influenced by two components; attitudes, which refer to an individual's expectations and evaluations and about a given behaviour and SNs which refer to the perceived social pressure to perform or not to perform a particular behaviour (Ajzen, 1991).

The TRA was explicitly developed to explain and predict volitional behaviours, i.e. simple behaviours that are solely dependent on the formation of an intention. Yet Ajzen (2005) himself concedes that very few behaviours are under complete volitional control. Take for example brushing one's teeth, even the execution of a simple act such as this requires the availability of one's toothbrush and toothpaste (Streobe & Streobe, 1995). Viewed in this light it becomes apparent that the

performance of most intended behaviours are subject to some degree of uncertainty. This type of reasoning led Ajzen to develop the TPB. The TPB extends the TRA by incorporating the concept of PBC. PBC refers to the perceived ease or difficulty of performing a behaviour and is assumed to reflect the presence of internal or external factors that may facilitate or impede its performance. In this way PBC is often compared to Bandura's concept of self-efficacy which is the belief that one can execute specific behaviours in specified situations (Bandura, 1997). The inclusion of PBC is important because it extends the applicability of the theory beyond easily performed volitional behaviours to complex behaviours which are, to some extent, dependent on skills, opportunities and/or resources. As a general rule, the more favourable the attitude and SN and the greater the PBC, the stronger the intention to perform the behaviour in question (Ajzen, 1991).
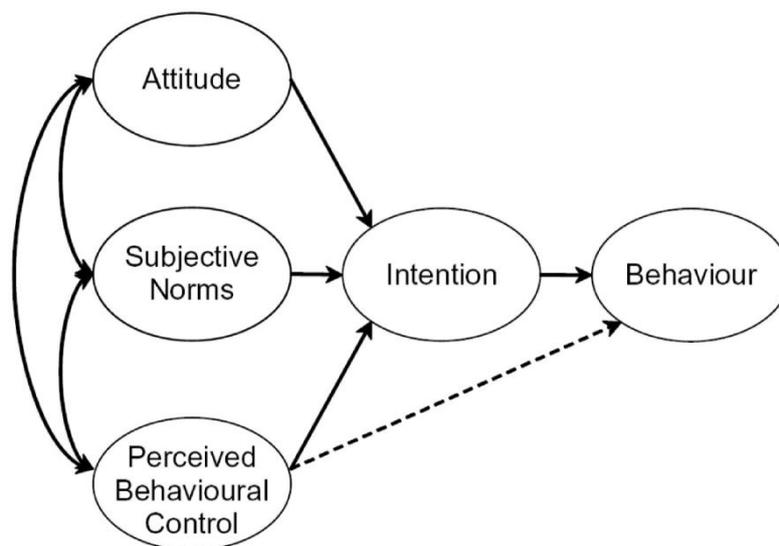
Figure 4.1. The TPB (Ajzen, 1991)

PBC is held to exert both a direct and indirect influence on behaviour (indicated by the broken line in figure 4.1). As mentioned earlier, in most instances, the performance of behaviour will depend not only on a person's intentions but also on the opportunities available and the resources needed for action. Hence it follows that PBC can predict behaviour independently of intentions to the extent that it reflects actual control with some degree of accuracy (Ajzen, 1986). Strictly speaking, it is actual control that is expected to exert a direct influence on

behaviour, however because such measures are difficult to obtain, perceptions of control are used as substitute measures for actual control (Conner & Sparks, 2005). The direct path from PBC to behaviour thus represents a non-volitional source of influence. The indirect influence of PBC on behaviour is based on the notion that PBC has motivational implications for intentions. For example, people are more likely to form strong behavioural intentions if they feel confident in their ability to perform a behaviour (Ajzen, 1986). Thus the indirect path from PBC to behaviour represents a volitional source of influence. To the extent that PBC predicts intentions and behaviour one can evaluate which behaviours are under volitional control and which are hindered by personal or environmental factors.

Behavioural, normative and control beliefs

Just as intentions are held to have determinants, the attitude, SN and PBC components also have determinants. The determinants are sometimes referred to as indirect measures and are thought to reflect the underlying cognitive structure. At the most basic level of explanation, the TPB postulates that behaviour is a function of salient beliefs concerning the behaviour. Three kinds of salient beliefs are distinguished; behavioural beliefs which are assumed to influence an individual's attitude towards a given behaviour, normative beliefs which make up the underlying determinants of SN and control beliefs which constitute the basis for PBC (Ajzen, 1991). The belief based constructs are modelled on Fishbein and Ajzen's (1975) expectancy-value model; thus each salient belief is multiplied by a valuation part and summed across *n.*

The TPB does not claim that an individual performs these calculations every time he/she is faced with a decision about performing a behaviour, but rather that the results of such considerations are stored in memory and retrieved when required (Eagly & Chaiken, 1993). Finally, although the TPB focuses on the socio-cognitive determinants of human behaviour, it does not deny the existence of personal, environmental or demographic factors, but considers these background variables that influence behaviour indirectly by affecting a person's behavioural, normative and control beliefs (Ajzen & Manstead, 2007).

Hundreds of studies have applied the TPB in a great variety of behavioural domains and a great number of these have provided support for the proposition that intentions can be predicted from attitudes, subjective norms and perceived behavioural control. Indeed, several meta-analyses have been reported for the TPB, including general reviews, those focusing on health behaviours and those focusing on specific behaviours. For example, Armitage and Conner (2001) reported across 154 applications that attitude, SN and PBC accounted for 39% of the variance in intentions, while intentions and PBC accounted for 27% of the variance in behaviour across 63 applications. Attitudes were the strongest predictor of intentions while intentions were the strongest predictor of behaviour. Likewise, in their meta-analysis of meta-analyses, Conner & Sparks (2005) report that attitude, SN and PBC explained 34% of the variance in intentions, while intentions and PBC explained 26% of the variance in behaviour. Once again, attitudes were the strongest predictor of intentions and intentions were the strongest predictor of behaviour[1].

4.3   The TPB and physical activity

The TPB has been applied extensively to the study of physical activity. Reviews of applications of the TPB to physical activity include Godin and Kok (1996) and Hausenblas, Caron and Mack (1997). However the most comprehensive review to date was provided by Hagger et al. (2002). They meta-analysed 72 studies that allowed calculations of the relationships proposed by the TPB. By using the correlation matrix corrected for sampling and measurement error they then tested the TPB through path analysis. Results revealed that Attitude, SN and PBC explained 45% of the variance in intentions, with attitude (β = 0.40) and PBC (β = 0.33) being stronger predictors than SN (β = 0.05). Indeed, measures of SN consistently predict little if any variation in physical activity behaviour indicating that social influences on physical activity intentions maybe less important than individual attributes (Thirlaway & Upton, 2009). In relation to the prediction of

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[1] Given that there is some overlap in included studies between meta-analyses, findings should be interpreted with caution. Also, It should be noted that the range of behaviours considered in both of these meta-analyses extend beyond health behaviours.

behaviour, Hagger et al. (2002) report that intentions and PBC explained approximately 27% of the variance, with intention ($\beta = 0.43$) being a stronger predictor than PBC ($\beta = 0.15$).

A number of studies have investigated the pattern of influence among the TPB variables with adolescent samples. Typically, these have followed the same pattern as adult studies, i.e. demonstrating strong effects of attitudes and PBC on intentions and intentions on physical activity behaviour (e.g. Hagger, Chatzisarantis, Biddle & Orbell, 2001; Hagger et al., 2002; Hagger et al., 2007). Nevertheless, several recent studies have shown that SNs exert an important influence on physical activity behaviour particularly among younger children (e.g. Martin et al., 2005; Rhodes, Macdonald & Mckay, 2006; Martin, Oliver & McCaughtry, 2007). For instance, Rhodes et al. (2006) examined the predictors of leisure time physical activity intentions and behaviour among children aged 9 - 11 in a longitudinal sample. The TPB accounted for 74% and 76% of the variance in physical activity intentions and 35% and 50% of the variance in physical activity behaviour. Overall, SN was the most important predictor of intention (standardized effect = .42 and .46), followed by PBC (standardized effect = .39 and .41). PBC was the most important predictor of behaviour (standardized effect = .35 and .48). It seems then that the relative contribution of the TPB variables in the prediction of intentions and behaviour may change throughout the life course. Indeed, Hagger et al. (2002) found that age moderates the intention-behaviour relationship such that older samples are more likely to implement their intentions than younger samples; possibly due to external compromises on control such as parental influence.

4.4   Limitations of the TPB

The popularity of the TPB can be attributed to its efficacy in accounting for a large proportion of the variance in intentions and behaviour, its parsimony and its flexibility. Moreover, attitude, SN and PBC have been shown to mediate the effects of other constructs on intention and behaviour. However researchers have also indicated that the theory does not explain all of the variance in intentions and behaviour, nor does it mediate the effects of certain 'background' variables.

Ajzen (1991) states the theory should be viewed as a flexible framework which in principle is open to the inclusion of additional predictors provided that the proposed variable is theoretically justified and makes a meaningful and unique contribution. Indeed a number of additional predictors have been found to have a unique effect on physical activity intentions and/or behaviour. These generally fall into one of two camps; first, predictors incorporated through the reconceptualisation of each of the major constructs; these include instrumental and affective attitudes (Ajzen & Timko, 1986; Ajzen & Driver, 1992), descriptive norms (Rivis & Sheeran, 2003) and self efficacy (Hagger, Chatzisarantis & Biddle, 2001) and second, new predictors that constitute useful additions to the model, e.g. anticipated regret (Abraham & Sheeran, 2004), moral norms (Jackson, Smith & Conner, 2003), self identity (Hamilton & White, 2008), frequency of past behaviour (Hagger et al., 2002) and habit (de Bruijn, Kremers, Singh, van den Putte, van Mechelen, 2009).

Although research suggests that a host of other variables can be incorporated into the TPB, it is important to acknowledge that the contribution of these additional variables has been relatively modest (Hagger et al., 2002). What's more extensions and/or modifications to the model must be evaluated alongside the original theory's parsimony in accounting for a large amount of variance in intentions and behaviour (Hagger & Chatzisarantis, 2005a). A further issue of concern when extending or modifying the theory is the potential conceptual overlap between additional variables. For example, anticipated affect and anticipated regret are very similar in that they both describe post-behavioural affective reactions (Parker, Manstead & Stradling, 1995).

We do not often do things for the first time; the vast majority of everyday activities are behaviours we repeat over and over again. These include behaviours that have consequences for health. Few would dispute the claim that most behaviours are repetitive, yet most SCMs including the TPB ignore the fact that we repeat most of our behaviours. It is particularly the cumulative effects of repetition that make behaviour detrimental or beneficial to health (Verplanken & Melkevik, 2008). The most widely discussed theme with regards to repetition in the social psychological literature is the dictum 'past behaviour is the best predictor of future behaviour. Indeed, a number of studies have found it to be the best predictor of future

behaviour over and above the TPB variables (e.g. Ouellette & Wood, 1998; Jackson et al., 2003; Wing Kwan, Bray & Martin Ginis, 2009). Such findings have led to a call for past behaviour to be included in the TPB as an additional predictor variable. However, Ajzen (2002a) has cautioned against such a move, pointing out that prior behaviour may predict later behaviour because of other unmeasured variables which are stable over time. Another issue with past behaviour is that it is a psychologically empty construct, i.e. individuals do not perform a behaviour just because they have performed it in the past, therefore one should be careful when giving it the same status as other predictors in the TPB (Conner & Sparks, 2005). Nonetheless, Sutton (1994) has since suggested that habit may be one way of conceptualizing past-behaviour future-behaviour relations.

Typical applications of the TPB devote little attention to the role of habit. However research suggests that deliberate intentions may become irrelevant in predicting behaviour when habit strength for that behaviour increases. For example, a recent study concluded that intentions were insufficient to account for the variability in the prediction of children's physical activity when this behaviour was habitual (e.g. Kremers, Dijkman, Meij, Jurg & Brug, 2008), suggesting that intentional control of physical activity behaviour may be more limited than the TPB assumes. Finally, the TPB fails to recognize the importance of non-cognitive variables. For example, decisions to engage in social behaviours are not made in a vacuum; there is always a context most notably in terms of social, environmental and political factors.

4.5   The intention – behaviour gap

Given the centrality of the concept of intention in the TPB it is important to ask how well intentions predict behaviour. Recall the meta-analysis discussed earlier in which Hagger and Colleagues (2002) found that approximately 45% of the variance in intentions could be explained by attitude, SN and PBC and that 27% of the variance in physical activity behaviour could be explained by intentions and PBC. It is evident from this pattern of association that the TPB is much less effective in predicting actual behaviour. So what is the source of this discrepancy or gap between intentions and behaviour?

To gain insight into this issue Orbell and Sheeran (1998) decomposed the intention – behaviour relation into a 2 x 2 matrix (intention to act vs. not to act and behaviour: acted vs. did not act). This decomposition revealed that participants with positive intentions who did not act were primarily responsible for the gap. So why is it so difficult for people to enact their intentions? According to Sheeran, Milne, Webb & Gollwitzer (2005), three processes underlie this discrepancy. First, relates to intention activation. For example intention diminution may be the result of prospective memory failure or goal reprioritization (i.e. an intention fails to attract sufficient activation to permit its realisation). The second process concerns intention elaboration. For instance individuals may fail to engage in an analysis of the particular actions and contextual opportunities that would permit realisation of their intentions. The third process concerns intention viability which refers to the idea that it is impossible for most intentions to be realised in the absence of environmental resources and/or opportunities. Indeed, attributes of the environment as correlates of physical activity have begun to be identified. This interest reflects a growing recognition, not only in research but in public health policy, of the influence that environmental factors may have on physical activity (Owen et al., 2005). For this reason chapter 5 reviews the literature examining environmental correlates of children's physical activity. It discusses the different ways in which the environment has been conceptualised and measured and considers general limitations of the environmental approach.

Chapter 5

Physical activity and the Environment

*"The environment is everything that isn't me" (*Albert Einstein 1879 - 1955*)*

5.1   Introduction

The potential impact of the environment to facilitate or restrict physical activity has been recognised by the UK government and has led to a shift in emphasis on public health policy. For example, 7 out of the 15 recommendations included in the UK National Institute for Clinical Excellence (NICE, 2009) guidelines for promoting physical activity for young people relate to how various sectors can shape the environment to increase physical activity.

The following section will consider research investigating environmental determinants of physical activity. First though it will examine the numerous ways in which environmental categories and hierarchies have been described, before moving on to discuss two superficially similar but very different means of assessing the environment; the use of either perceived or objective measurements.

5.2   Conceptualising the environment

The development of effective interventions and policies to increase physical activity requires a proper understanding of its determinants. Until relatively recently however, physical activity determinant studies have mostly been informed by psychological theories of human behaviour such as the TPB (Brug et al., 2010). This approach has been criticised because it places undue emphasis on the individual (Giles-Corti & Donovan, 2002) and has led to a strong focus on cognitive determinants such as attitudes, perceived control and motivation (Brug et al., 2006). However, people's abilities and opportunities to be active may be dependent on the environments in which they live (Brug et al., 2006). Indeed, environmental determinants of physical activity are receiving growing attention in the literature;

although comparatively, little empirical research has been conducted in this area (Biddle & Mutrie, 2008).

Different academic disciplines adopt different definitions of the environment. For example, geographers focus on the physical environment, ecologists focus on how the environment affects an individual's thinking, while psychologists see the environment as being constructed through the perceptions of the experiences of the individual (Foster & Hillsdon, 2004). That said, no standard definition of the *'physical activity environment'* has been developed and its boundaries are not clearly established. This lack of definition is likely due to the embryonic nature of the field and the absence of solid conceptual underpinnings (McKinnon, Reedy, Handy & Brown Rodgers, 2009). That said there are many environments that will influence an individual's ability to be active. For example, Mclaren and Hawe (2005, p.9) point out the environment is "an open ended concept that includes all that is external to and potentially or actually influential upon an object of investigation". This could include physical or structural influences (often called ecological factors) such as access to resources, policies or organisational climate, and/or social influences (which are often called social ecologies) such as norms, social support and reinforcement. Foster and Hillsdon (2004, p.756) on the other hand ignore the influence of social factors and define the environment in relation to physical activity as "any aspect of the physical (natural) environment or the urban or constructed environment that unconsciously or consciously relates to an individual and their physical activity behaviour". Given this rather expansive definition then, the environment is a hugely complex topic to consider when exploring physical activity behaviour.

Environmental categories and hierarchies of behavioural influences have been described in numerous ways from McLeroy, Bibeau, Steckler and Glanz's (1988) five sources of influence, i.e. intrapersonal, interpersonal, institutional factors, community factors and public policy, to Broffenbrenner's (1979) systems theory which describes four levels of environmental influence; microsystems, mesosystems, exosystems and macrosystems. Early on there was a progression from the concept that only perceptions of the environment were important (e.g. Lewin & Cartwright, 1951) to an emphasis on direct effects (e.g. Roger Barker,

1968). For example, Barkers, (1968) notion of behaviour settings, i.e. the social and physical situations in which behaviours take place, concluded that behaviours could be predicted more accurately from the situations people are in than from their individual characteristics. Many models and environmental classification systems were designed to apply broadly to behaviour, but more recently models have been created for application to health behaviours and health promotion. For example, Swinburn et al. (1999), developed the ANGELO framework (analysis grid for environments linked to obesity) (see figure 5.1); a conceptual model for understanding the obesogenicity of environments and a practical tool for prioritizing environmental elements for research and intervention. The basis of the framework is a 2 x 4 grid which comprises two sizes of environment (micro-environmental settings and macro-environmental settings) on one axis and four types of environment on the other (physical, economic, political and sociocultural). According to the framework, individuals interact with the environment in multiple micro-environments (e.g. homes, schools, workplaces etc.); these in turn are influenced by broader macro-environments (e.g. governments, education and health systems and society). Within these settings four types of environment are distinguished; physical, economic, political and sociocultural.

The physical environment in the widest sense refers to what is available. For physical activity then, the physical environment includes opportunities for participation in leisure, occupational and/or incidental activity. For example, the availability and quality of recreational spaces, parks, sports grounds and community clubs could be considered physical environmental factors which influence participation in leisure activities. The economic environment refers to the costs associated with behaviour. Although physical activity does not necessarily have any direct financial costs, there are some economic factors which can influence the amount of physical activity people engage in. For example, some factors may reduce the cost of physical activity (i.e. gym membership subsidiaries), increase opportunities for physical activity (budget allocations for recreational facilities) or increase motivation to participate (i.e. such as funding health campaigns). The political environment refers to the rules related to physical activity and include laws, regulations, policies and institutional rules. An example, of the political environment

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influencing physical activity would be family rules on the amount of television watched, or at the macro level, town planning policies which give priority to active transport over car use. The sociocultural environment refers to a communities or societies attitudes, beliefs and values. In schools for example, the school ethos is considered a central component of a health promoting school. At the macro environmental level the mass media are an important sector influencing the socio-cultural aspects of physical activity, particularly through the effects of advertising and marketing (Swinburn et al., 1999).

	Micro-environment	Macro-environment
Physical environment		
Economic environment		
Political environment		
Socio-cultural environment		

Figure 5.1 The analysis grid for environments linked to obesity (ANGELO grid) (Based on Swinburn et al., 1999)

As far as physical activity is concerned the environment can enable or discourage (i.e. function as a barrier) activity. Terms such as 'toxic' (Ebbeling, Pawlak & Ludwig, 2002), 'obesogenic' and 'leptogenic' (Swinburn et al., 1999) have been used to describe some of these influences. The term 'leptogenic' (leptos as in Greek for thin) describes an environment that promotes healthy food choices and encourages physical activity. The term 'obeseogenic' on the other hand describes the physical, economic, social and cultural environments that promote weight gain and obesity. The term 'slothogenic' has since been suggested to characterise the activity element of this description (Biddle & Mutrie, 2001).

According to Foster and Hillsdon (2004), the ANGELO framework is an oversimplification of the dynamic relationship between the scale and types of the environment. For example, the framework does not make inferences about the causal mechanisms that link the environment to behaviour. Nonetheless, Kremers et al. (2006) and Brug and van Lenthe (2005) point out that it has proven useful to

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categorize the potential determinants of physical activity and to identify potential intervention settings and strategies with respect to this behaviour.

5.3   Measuring the environment

Studies investigating the physical activity environment have mostly focused on physical environmental factors; however a major criticism in relation to much of this research concerns the measurement of these physical characteristics.

Measurement of physical activity environments is a relatively young field, although many 'first generation' measures exist. Measurement work has drawn from a number of research fields and different sectors including public health, transportation and city planning and leisure and recreation studies. Measuring physical activity environments is challenging for many reasons. For example, gathering primary data may be expensive and time consuming, generally accepted measures may or may not exist, secondary data may be incomplete and/or difficult to integrate into analyses, data may need to be gathered several times (because physical activity environments are changeable) and the key variables of interest may not entirely clear or may be difficult to measure (McKinnon et al., 2009).

Researchers currently use a variety of methods to measure the physical environment, including survey instruments (self-reported and observed) and methodologies such as geographic information systems (GIS). The first group of measures, interview or self administered questionnaires, examine the extent to which individuals perceive access and barriers to various elements of recreation, land use and transportation environments. Evidence for the association between the physical environment and physical activity is mostly derived from self report data on individual's perceptions of their environment; for instance Brownson, Hoehner, Day, Forsyth and Sallis (2009) identified more than 100 published studies examining physical activity behaviour in relation to the perceived environment.

Perceived physical environment measures

A range of perceived physical environment measures exist including; the Neighbourhood Environment Walkability Scale (NEWS) (Saelens, Sallis, Black & Chen 2003), the San Diego scales of home and neighbourhood environments and

convenient facilities (Sallis, Johnson, Calfas, Caparosa & Nichols, 1997), the Neighbourhood Quality Index (Yang, Yang, Shih & Kawachi, 2002), Perceptions of Environmental Support Questionnaire (Kirtland et al., 2003), the Women and Physical Activity Survey (Evenson, Eyler, Wilcox, Thompson & Burke, 2003), the Perceived Physical Activity Environment questionnaire (Evenson & McGinn, 2005) and so on. Most of these surveys have been developed with adult populations, however environmental attributes may have different meanings in youth versus adults and physical activity barriers and facilitators will almost certainly vary by age. That said, a few child specific measures do exist e.g. the safety, aesthetics, facilities and transportation environment scales developed for the Trial of Activity in Adolescent Girls study (TAAG) (Cohen et al., 2006), the Preadolescent Environmental Access to Physical Activity Questionnaire (Erwin, 2008) and the Children's Perceptions of their Physical Activity Environment Questionnaire (Hume, Ball & Salmon, 2006).

Early measures of the perceived environment were criticised for their lack of metric data (Humpel, Owen & Leslie, 2002). Indeed, compared to traditional physical activity questionnaires, the psychometric properties of perceived physical environment measures have been less well explored (Bauman, Phongsavan, Schoeppe & Owen, 2006). For example, some forms of validity testing, e.g. criterion validity, require a gold standard (e.g. an objective measure) against which to compare the perceived domains, however for some attributes of the environment it can be argued that perceptions are the reality (Brownson et al., 2009). Studies which have examined test re-test reliability of such measures generally report higher correlations for variables in the physical environment than for those in the social environment. Consensus is lacking however about the applicability of other reliability measures such as inter-item correlations and factor analysis as there is little reason to expect conceptually similar environmental variables to co-occur. Likewise, conceptually dissimilar items may appear together frequently (e.g. foot paths and heavy traffic), so alphas and factor analyses may be difficult to interpret (Brownson et al., 2009).

The development of perceived environment measures has generally emerged outside Europe; in Australia and the US. However characteristics of the physical

environment in Europe differ considerably from those in the US or Australia. This raises questions about the applicability of these questionnaires in a European context. A small number of European studies have developed their own or have adapted international questionnaires, however a consensus about which environmental questionnaire should be used in Europe has yet to be established (Spittaels et al., 2010).

Systematic observations and audit tools

The second set of measures uses systematic observations or audits to 'objectively' quantify attributes of the environment e.g. street pattern, number and quality of public spaces, foot path quality etc. Audit tools typically require in-person observation for collecting data. For example, researchers might walk or drive through a neighbourhood or park systematically coding characteristics using a standardised form. The audit tool itself is usually a paper form containing close-ended questions (check boxes/Likert scales) (Brownson et al., 2009). Several audit tools have been developed in recent years including; the Analytic Audit Tool (Brownson,et al., 2004), the Systematic Pedestrian and Cycling Environmental Scan Instrument (SPACES) (Pikora et al., 2002), the Irvine Minnesota Inventory (Day, Boarnet, Alfonzo & Forsyth, 2006), the Physical Activity Resource Assessment (PARA) Instrument (Lee, Booth, Reese-Smith, Regan & Howard, 2005) and the System for Observing Play and Leisure Activity in Youth (SOPLAY) (McKenzie, Marshall, Sallis & Conway, 2000). These tools vary significantly in the detail in which they measure various features, from one or two items to dozens of items addressing many distinct characteristics. Compared with perceived measures, objective measures of the environment have received much less attention (Story et al., 2009).

Inter-observer reliability is the primary form of reliability assessed; although test re-test reliability is relevant for assessing stability of observed features. For community audit tools, measures of physical disorder, tidiness and safety related features tend to be less reliable than measures of land use and street characteristics (Brownson et al., 2009). In-person observation is time consuming. For example, researchers must select sites, define and sample segments within sites, train and monitor observers, collect data, enter data and compute summary variables. However, many

characteristics of the physical environment can be readily measured without direct observation using existing data such as aerial photos. Such remote methods may be less labour intensive and therefore less time consuming. Relevant skills that are needed for observing the physical environment include some knowledge of the content area as well as the ability to carry out the technical methods of direct observation (Brownson et al., 2009).

Graphical information systems

The third group of measures, graphical information systems (GIS), have come into wide use in research on physical activity environments and health. It is a powerful tool for merging and managing spatial databases and can be used to extract new measures from existing sources of data (McKinnon et al., 2009). GIS based measures can be used to assess; population density, land-use mix, access to recreational facilities, street pattern, sidewalk coverage, vehicular traffic, crime, building design, public transit and green space. Evidently then, GIS has much to offer public health researchers interested in the effects of the neighbourhood or regional environment on physical activity.

The accuracy and completeness of existing data sources as well as the geographic scale at which measures are available and aggregated contribute to the validity and reliability of the GIS based measures; although the degree to which such errors affect associations with physical activity is unknown (Brownson et al., 2009). Temporal concerns may also be introduced if the age of the existing data does not match the timing of the outcome measurement. For example, if the study is carried out in a town or region experiencing major environmental change, the GIS based measure and time periods may represent a 'reality' that never actually existed (Forsyth, Schmitz, Oakes, Zimmerman & Koepp, 2006). To date, validity studies of GIS based measures come mostly in the form of construct validity (e.g. Papas et al., 2007; Handy, 2004); however Brownson et al., (2009) suggest more head to head comparisons of GIS based measures should be conducted. In terms of reliability, test re-test reliability is partially dependent on how quickly the physical environment changes, as well as the consistent maintenance of GIS databases over time, across regions and sources. Nevertheless, none of these issues have been sufficiently examined.

Knowing how to obtain, clean, manage and analyze GIS based data requires trained personnel and sufficient time to conduct such activities. To this end, obtaining GIS data can be time consuming and expensive. Currently no standardized method of measuring or cataloguing these measures and no centralized national repository of such data exist (Brownson et al., 2009).

Conclusion

The development and evaluation of measurement properties across all three categories are still at a relatively early stage and no single measure is without its limitations. Nonetheless in order to understand the impact of the environment on physical activity, to strengthen interventions and ultimately inform policy, the development of high quality measures is essential (Brownson et al., 2009). Clearly then much work still remains. In terms of choosing an appropriate measure, this will of course depend upon the question to be studied and the resources available.

5.4   Environmental correlates of physical activity

Humpel et al. (2002) provided an excellent systematic review on the environmental factors that might influence physical activity in adults. In their review of 19 studies they found that accessibility, opportunities and aesthetics of the environment were all associated with higher levels of physical activity. In contrast they found that weather and safety did not show a pattern of significant associations. More recently a systematic review of 47 studies was conducted by Wendel-Vos, Droomers, Kremers, Brug and van Lenthe, (2007) who demonstrated consistent associations between physical activity and availability of equipment and connectivity of trails. Other possible, but less consistent correlates of physical activity reported were availability, accessibility and convenience of recreational facilities.

In yet another a review, conducted as part of the UK governments foresight programme, Jones, Bentham, Foster, Hillsdon and Panter (2007) reported that there was no consistent pattern of associations between categories of environmental perceptions (i.e. safety, availability and access, convenience, local knowledge and satisfaction, urban form, aesthetics and supportiveness of neighbourhoods) and overall activity. The pattern of associations for objectively measured environmental variables (i.e. access, urban form, aesthetics and quality

and supportiveness) and overall activity was also unequivocal. Jones et al. (2007) concluded that the environment does influence levels of physical activity, but the influences of the environment are small and the mechanisms remain unclear. Duncan, Spence and Mummery (2005) also confirmed the ambivalence in current empirical evidence. In their meta-analysis of 16 studies, no single 'crude' environmental factor could be identified as consistently linked to physical activity.

Most research examining environmental influences on physical activity has focused on adults (Kerr et al., 2006). Yet the determinants of physical activity in children may be quite different and will encompass considerations such as parenting style and school policy (Jones et al., 2007). In a systematic semi-quantitative review of 150 studies, Ferreira et al. (2006) found that the most consistent positive correlates of children's physical activity were school physical activity related policies and time spent out-doors. Non-vocational school attendance and low crime incidence were most consistently related to physical activity in adolescents. Sallis, Prochaska and Taylor (2000), in their systematic review of correlates of physical activity for young people, reported consistent associations between physical activity and programme/facility access and time out doors for children and opportunities to exercise for adolescents. A large population based survey (n = 17,766) conducted by Gordon-Larson, McMurray and Popkin (2000) also suggests that higher levels of physical activity in children are associated with the use of a community recreation centre and lower levels of crime. Conversely, high crime rates, personal safety concerns (Gomez, Johnson, Selva & Sallis, 2004; Davison & Lawson, 2006) and transport infrastructure (Davison & Lawson, 2006) have been found to be related to decreased levels of physical activity. More recently, de Vet, de Ridder and de Wit (2010) conducted a systematic review of reviews examining the environmental correlates of physical activity. Of the 11 reviews they examined, researchers found that the most consistent positive correlates of children's physical activity were school and neighbourhood characteristics. Indeed, physical activity was more consistently related to these factors than to interpersonal and societal environments.

5.5   Limitations of the environmental approach

Although recognized as complex, there are several advantages to environmental approaches. For example, environmental interventions may influence those groups which are hard to reach with health education programs, such as those with lower educational attainment, lower incomes and language barriers (Swinburn et al. 1999). Environmental changes may also be cost effective and have a more lasting effect on behaviour because they become incorporated into structures, systems and policies. Nonetheless several limitations should also be considered.

Evidence regarding environmental determinants of physical activity has often been the result of non-theoretical approaches (e.g. Norman et al., 2006) (Owen, Humpel, Leslie, Bauman & Sallis, 2004). Indeed, a lack of conceptual models for differentiating the causal role of environmental influences on behaviour has been identified (e.g. Humpel et al., 2002). Consequently, Baranowski, Cullen, Nicklas, Thompson and Baranowski (2003) argue that more conceptually refined models of how environments affect behaviour are necessary, such as whether they affect behaviour directly or through mediating variables.

Most studies investigating the environmental correlates of physical activity have used cross-sectional designs, non-validated measures of environments and/or behaviour (Wendel-Vos et al., 2007) and have examined a restricted range of physical activity outcomes (this may give a poor guide to effects on overall activity levels) (Jones et al., 2007). Moreover, many studies rely on self-reported measures of physical activity and few have examined the associations with objectively measured environmental variables (Jones et al., 2007). For this reason Kremers et al. (2006) argue for the application of both objective and subjective measures of environmental and behavioural factors. That said, Jones et al. (2007) concluded in their review, that perceptions of the environment seem to be more important than the environment per se. They argued that future research should concentrate on modifying these perceptions so that the environment is seen as a positive facilitator rather than a negative barrier. Finally, Davison and Lawson (2006) conclude that additional research using a transdisciplinary approach is necessary to appropriately inform policy interventions. For this reason it is important to view environmental research and intervention as complementary to more individual approaches.

Chapter 6

Ecological models of behaviour

"In the planning and designing of new communities, housing projects, and urban renewal, the planners both public and private, need to give explicit consideration to the kind of world that is being created for the children who will be growing up in these settings" (Urie Broffenbrenner, 1973)

6.1   Introduction

Experts have argued that research is needed to document the extent of environmental influences on physical activity and how they affect different individuals (Baranowski et al., 2003; Kremers et al., 2006). One way of conceptualising the interdependence among people, their health and their environment is through the use of ecological models. The ecological approach has roots in several disciplines dating back more than a century (McLaren & Hawe, 2004); however its application to health promotion programming has been a recent development. There are a number of primary contributors to the ecological approach including Kurt Lewin (1951), Roger Barker (1968), Rudolph Moos (1980), Urie Brofenbrenner (1979), Kenneth McLeroy and colleagues (1988) and Daniel Stokols (1992) among others.

6.2   Ecological models of health behaviour

Ecological models are comprehensive, multifaceted health promotion models which include the individual components of health behaviour theories and place them within the context and influences of the environment. Ecological models specify that intrapersonal, socio-cultural, physical environments and public policy at multiple levels can influence health behaviours (see figure 6.1). The philosophical underpinning of the ecological approach is the idea that behaviour does not occur within a vacuum.

Central to the ecological approach is the assumption of interaction and reciprocal causation among variables. Thus well developed models will not only specify what variables are important for behaviour change but also how they interact to influence behaviour (Thirlaway and Upton, 2009). Finally, ecological models propose that environments directly influence health behaviours as well as indirectly through other factors such as an individual's beliefs.
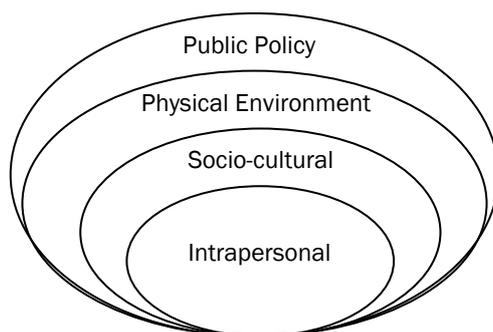
Figure **6.1** An Ecological model of health behaviour (adapted from Biddle & Mutrie, 2008)

The main purpose of ecological models is to inform the development of comprehensive health behaviour interventions that can systematically target mechanisms for change at multiple levels of influence. Change is expected to be maximized when environments and policies support healthy choices, when social norms and social support are strong and when individuals are motivated and educated to make those choices (Sallis, Owen & Fisher 2008). Educating individuals to make healthy choices when environments are unsupportive often produce weak and short term effects, indeed findings in the physical activity domain have found that environmental influences shape the return to previous behaviour when the intervention is over (Gauvin, Levesque & Richard, 2001; Laitakari, Vuori & Oja, 1996). Yet, just providing the necessary environmental resources is no guarantee that people will make use of them. Hence a central conclusion of the ecological approach is that it usually takes a combination of individual level and environmental policy interventions to achieve significant changes in health behaviours (Sallis et al., 2008).

6.3   Ecological models of physical activity

Many ecological models were designed to apply broadly to health behaviours; more recently however, behaviour specific models have been developed. For instance, Sallis et al. (2006) synthesized the findings from a broad range of disciplines including; health, behavioural science, transportation, city planning, economics and so, on to develop an ecologic model for active living that highlights the complexity of understanding and increasing physical activity in the population (see figure 6.2). The model utilizes the common onion structure to represent the multiple levels of influence; intrapersonal, perceived environment, behaviour; active living domains, behaviour settings; access and characteristics and policy environment, but with three distinguishing features. First, the model is organised around four domains of physical activity; active recreation, household activities, occupational activities and active transport, reflecting the principle that behaviour specific models are useful. Second, some types of influence are not tied to settings where the behaviour takes place. For example, the information environment is pervasive and can influence physical activity in various domains. The third key feature is that the social and cultural environments operate at multiple levels (Sallis et al., 2008).
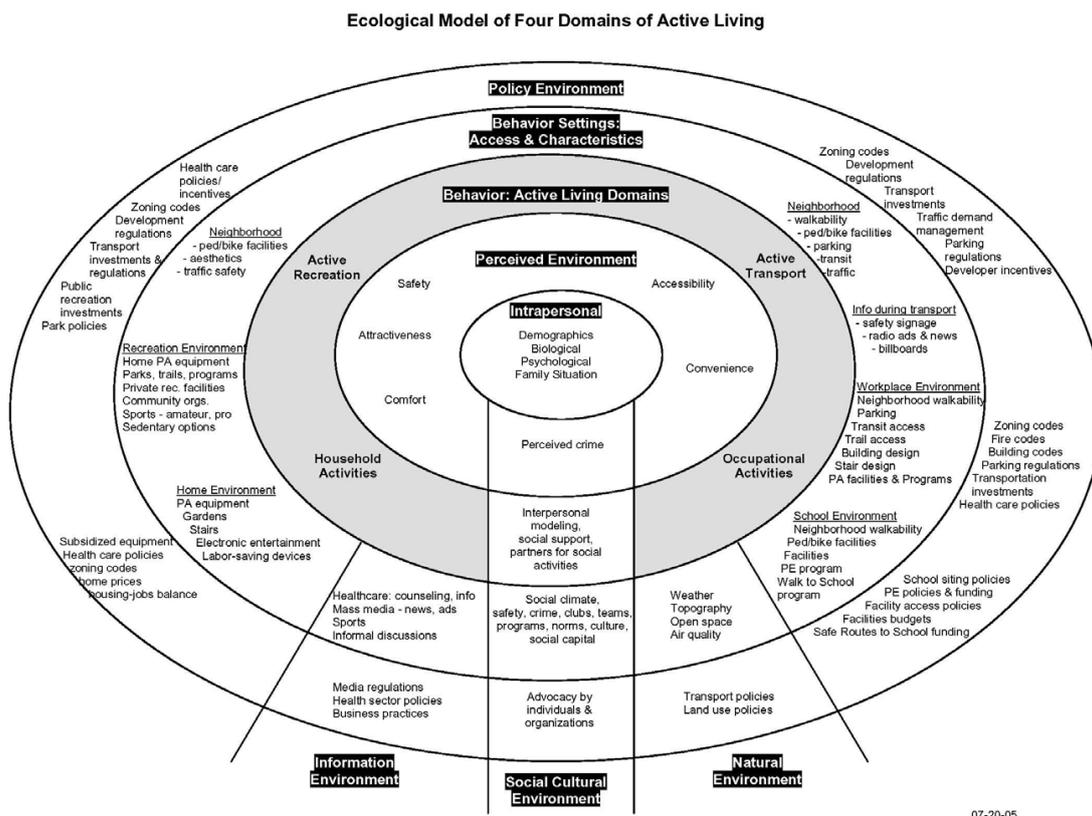
Figure 6.2 Ecological model of four domains of active living (Sallis et al., 2006).

Other ecological models have been developed for specific physical activity behaviours and population subgroups. For example, Salmon (2010) recently developed a socio-ecological model of youth physical activity participation, based on the results of the Children Leisure Activities Study (CLASS), the Children Living in Active Neighbourhoods Study (CLAN) and the Health, Eating and Play Study (HEAPS) (see figure 6.3). The combined sample consisted of more than 2700 children from Melbourne Australia aged 5 - 6 and 10 - 12 years at baseline. Results revealed that 5 individual, 10 social and 17 physical environmental factors were significantly associated with children's physical activity. However, patterns of associations varied according to the age and sex of the child and also the type of activity, e.g. walking/cycling 3 x a week, total walking, active commuting, weekend MVPA and after school MVPA. Given the different patterns of association identified across these studies, the development of behaviour/population specific models are likely to be more effective when informing comprehensive physical activity interventions.
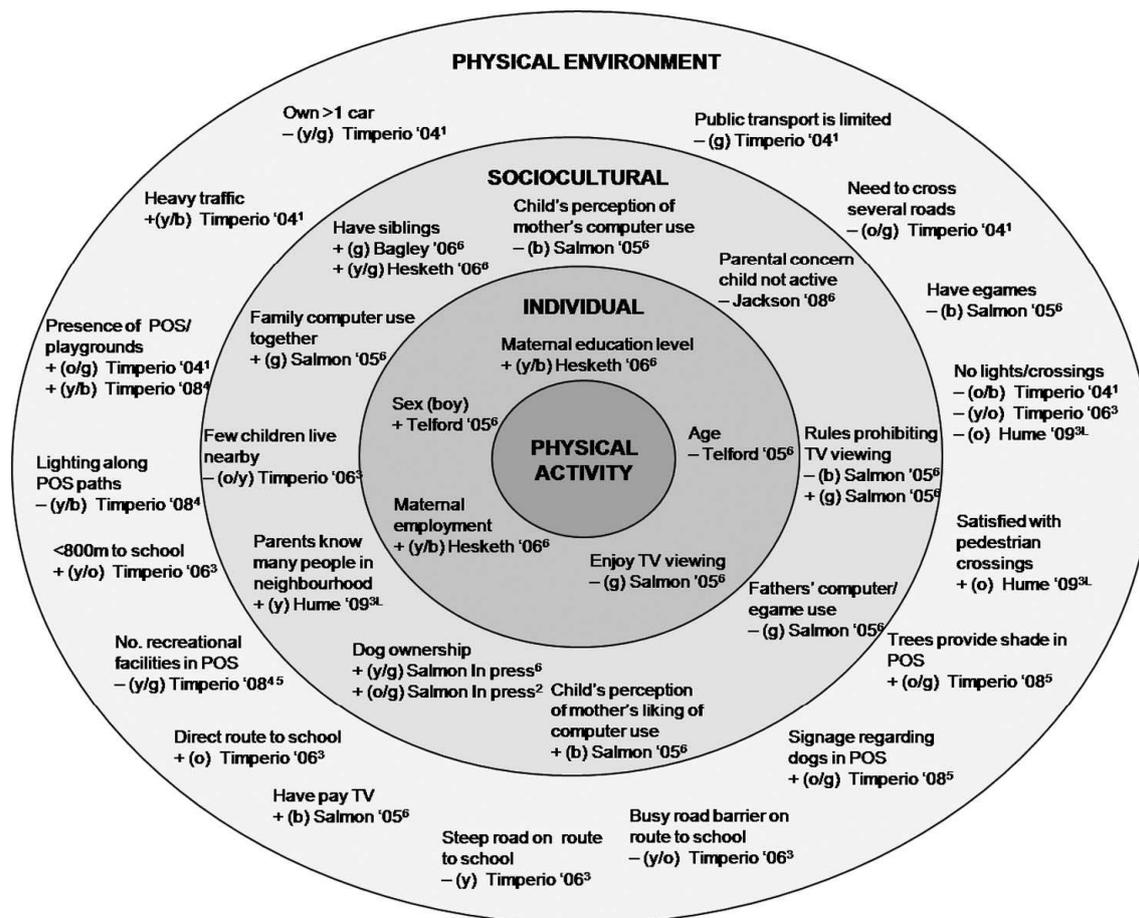
Type of physical activity assessed: 1 - walk/cycle 3+ times/wk; 2 - total walking; 3 - active commuting; 4 - weekend MVPA; 5 - after school MVPA; 6 - MVPA.

Note: y = younger children; o = older children; b = boys; g = girls; L = longitudinal; POS = public open space; MVPA = moderate- to vigorous-intensity physical activity.

Figure 6.3 Summary of significant socio-ecological variables from the CLASS/CLAN and HEAPS studies (Salmon, 2010).

6.4   Limitations of the ecological approach

Ecological models address multiple levels of behavioural influence, leading to a more comprehensive approach to health promotion. Many of the predominant theories of health behaviour such as the TPB focus on only one dimension of health promotion and do not necessarily result in desired behavioural change. On the other hand ecological models emphasize a shared framework targeted at individual behaviours and the environment. This may lead to improved program effectiveness. For example, Sallis et al. (2008) argue that policy and environmental interventions establish settings and incentives that can affect entire populations and persist in

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sustaining behaviour change. This is in contrast to individually directed interventions which are often poorly maintained and reach only those individuals who choose to participate.

A limitation of many ecological models is their lack of specificity regarding the most important hypothesized influences. A related weakness is the lack of information about how the broader levels of influence operate or how variables interact across levels (Sallis et al., 2008). Recently however, researchers have begun to test the principles of ecological models by developing behaviour/study specific hypotheses. Indeed, several physical activity studies now support the principle of multi-level influences and interactions across levels (e.g. de Bruijn, Kremers, Schaalma, van Mechelen and Brug, 2005; Rhodes, Brown and McIntyre, 2006; Rhodes, Courneya, Blanchard and Plotnikoff, 2007; Maddison et al. 2009).

Ecological models propose complex interactions between intrapersonal, socio-cultural, physical environments and public policy that are difficult to manipulate experimentally (Sallis et al., 2008). A further limitation is that research based on ecological models is more demanding than behavioural research conducted at an individual level. Developing measures, collecting data and conceptualising and implementing interventions at multiple levels place substantial demands on investigators. Moreover, most environmental variables and policies relevant to health behaviours are not controlled by the investigator and change requires political process (Sallis et al. 2008). Finally, the need to identify environmental and policy variables that are specific to each behaviour or category of behaviours presents a challenge, as lessons learned in relation to one behaviour may not translate into an apparently similar category of behaviours. For example, Owen, Humpel, Leslie, Bauman & Sallis (2004) found that attributes associated with walking for exercise were different from those associated with walking as a means of active transport.

The ecological approach tends to overcome many of the deficiencies associated with individual approaches such as the TPB, which portray action as the deliberate pursuit of conscious intention, and environmental approaches which set out to establish objective regularities independent of the individual consciousness or will.

To this end the ecological approach has much in common with social practice theory and the work of French sociologist Pierre Bourdieu (1930 – 2002) (who is perhaps the most famous social theorist associated with this method).

There is no unified theory of social practice (Schatzki, 2001); rather it embraces a wide variety of theoretical approaches which aim to introduce the agency and action of the individual into the analysis of social systems, structures, laws etc. Practice theory then, attempts to integrate the individual with the environment relative to the actions and practices of the individual. It seeks to make clear the links between specific practices and context and focuses on the transformation of consciousness or subjectivity. Practice theory views the environment as a system which is powerfully constraining, but also looks at how the system can be altered through the intentional actions and interaction of individuals. The practice itself then, rather than the individuals who perform them or social structures that surround them, become the core unit of analysis (Hargreaves, 2011).

The notion of 'practice' is important, not only because of its cumulative effects on health, but also because it forms the basis of habits. According to social psychological theorising habits are defined as learned sequences of acts that have become automatic responses to specific cues (Verplanken & Aarts, 1999). According to this definition then, habits are well practiced response dispositions that are cued by features in the environment. From this perspective the concept of habit may provide a useful locus to accommodate for both individual and environmental accounts of behaviour within the ecological framework.

Chapter 7

Habit

"Most of the time what we do is what we do most of the time. Sometimes we do something new (Townsend & Bever, 2001).

7.1   Introduction

If Townsend and Bever (2001) are correct, the majority of day-to-day living is characterised by repetition. Attesting to the regularity of everyday action, Quinn and Wood (2005 in Wood & Neal, 2007) conducted a diary study in which participants were required to record what they were doing, thinking and feeling every hour for several days. In both student and community samples approximately 45% of the behaviours participants listed tended to be repeated in the same physical location nearly every day. This consistency in everyday life has also been documented in other naturalistic paradigms. For example, in Barker and Schoggen's (1978) ecological analysis, observers from a Midwest psychological field station recorded the details of children's everyday activities in small town. Researchers reported a high degree of repetition in daily activities, and consistent with Quinn and Wood (2005 in Wood and Neal, 2007), this repetition was linked to specific environments.

Because everyday behaviours are repeated, they exert a significant cumulative impact on health outcomes experienced at both the individual and societal level. This realization, along with the lack of attention to repetition in current models of health behaviour, e.g. the TPB, provides a strong argument for focusing on the repetitive nature of physical activity.

Repetition of behaviour is not only important in its own right due to its cumulative effects on health, but it also forms the basis of habits. Logan (1988) for example, provides one explanation of how repetition and practice can lead to habit formation. He argues that if a task can be restructured so that performance depends on retrieval from long-term memory, then a habit is born. For example if you multiply 6

x 6 you can retrieve the answer 36 from long term memory; the process is fast and effortless. On the other hand if you multiply 18 x 32, the only route is to calculate the answer unless you have performed the same problem numerous times before.

The concept of habit has had a long history in the social sciences and was used fairly broadly by early Western thinkers to denote rules of conduct that characterize a civil society (Durkheim, 1893 in Verplanken, Aarts & Van Knippenberg, 1997). However within current theorising, psychologists have been fairly unanimous in adopting a more narrow conceptualisation of habit as learned sequences of acts that become automatic responses to specific cues (Verplanken & Aarts, 1999). Following the behaviourist tradition habit has always been equated with behavioural frequency and usually quantified using a retrospective self-report of past behavioural frequency. Although a degree of practice is required for habits to develop, there are strong arguments for why behavioural frequency should not be equated with habit but instead considered a mental construct involving features of automaticity, i.e. lack of awareness, difficulty to control and mental efficiency. For instance, a high frequency of behaviour does not necessarily imply the existence of a strong habit; an athlete may have run a marathon frequently in the past, but this can hardly be qualified as a habit (Verplanken & Melkevik, 2008). What's more habit may also vary independently of behavioural frequency. For example, Verplanken and Melkeik (2008) demonstrated how exercise habit could be empirically distinguished from exercise frequency after controlling for the potentially confounding effects of intention and PBC (also see Verplanken, 2006).

7.2   Automaticity in habitual responding

When habit is merely conceived as past behavioural frequency one could rightly criticize it as an empty construct; how can one prescribe or intervene on prior experiences? The creation of habit however, is based on more than simple practice effects (Rhodes, de Bruijn & Matheson, 2010). So what are habits aside from a history of behavioural repetition? A consensual view on habit mechanisms has yet to develop; nonetheless common to all perspectives is the idea that habits are performed repeatedly in stable environments. When responses and features of the environment occur in contiguity, the potential exists for associations to form

between them, such that environments automatically cue behavioural responses (Neal, Wood & Quinn, 2006).

Evidence concerning the importance of repetition and context stability in habit formation was provided by Ouellette and Wood (1998). They conducted a meta-analysis of past behaviour – future behaviour relations and found that frequency of past behaviour was a weaker predictor of future behaviour in domains that were encountered only annually or biannually in unstable contexts than in domains encountered on a daily or weekly basis in stable contexts. However, certain aspects of the methodology and interpretation of the results have been questioned. For example, Sheeran (2002) argues that the meta-analysis of past behaviour – future behaviour relations was based on only eight studies of frequent/stable behaviours and six studies of infrequent/unstable behaviour. Furthermore, because of the way behaviours were classified, it was not possible to delineate whether the observed effects were due to the frequency of performance, context stability or both. Finally, the habitual account of the direct effect of past behaviour on future behaviour is based on the premise that habitual responses are likely to form when behaviours are performed repeatedly in stable contexts. However Ajzen (2002a) argues that this explanation does not account for the residual impact of past behaviour that is often found for low frequency behaviours e.g. attendance at health checks.

Further support for the idea that habits depend on context stability comes from work on habit change. Anecdotally, people sometimes report that changing well practiced behaviours is easiest when they are otherwise removed from everyday circumstances. The context change presumably disrupts the automatic cueing of action, thereby freeing it from stimulus control (Wood, Tam & Guerrero Witt, 2005). Empirical evidence for stimulus control of habitual action comes from Wood, Tam and Guerrero Witt (2005). They examined the habits of college students as they underwent naturally occurring changes in performance contexts through a transfer to a new university. One month before and one month after the transfer students reported their habits, intentions and aspects of the performance context with respect to three behavioural domains; exercising, reading the news paper and watching TV. Researchers found that when the transfer involved a change in circumstances habit performance was disrupted, but when aspects of the

performance context did not change across the transfer habit performance survived. These results not only support the claim that habits reflect more than just past behavioural frequency but also that habits are facilitated when actions are repeated in stable contexts.

So although repetition of behaviour is a necessary condition for habits to develop, the defining feature of habit is the automaticity of behaviour occurring in stable environments. In a recent series of studies, Orbell and Verplanken (2010) examined habitual automaticity in regard to different aspects of the cue response relationship characteristic of unhealthy and healthy habits, i.e. smoking and dental flossing. Researchers found that habitual automaticity was characterized by attentional bias to habit related cues (study 1) and to counter-intentional behavioural responses when a habit related cue was encountered (study 2). Researchers also showed that by forming an implementation intention (see chapter 8) to respond to a specified situational cue, habitual automaticity of behaviour was rapidly enhanced (study 3). The results of these studies provide three very different demonstrations of the importance of cues in the operation of habitual responding.

Bargh (1994) developed a decompositional model of automaticity which broke down the concept into four separable features; (un)intentionality, (un)controllability, (lack of)awareness and efficiency. According to Bargh (1994), each of these features may or may not be present, which results in a number of qualitatively different types of automaticity. Most researchers agree that the habit concept fits three of these components as habits most often occur outside of awareness, can be difficult to control and are mentally efficient. There is less agreement however with respect to the role of (un)intentionality which has ultimately led to two different streams of literature. In the language of the stimulus driven approach habits can be categorized as a form of *goal independent* automaticity, i.e. habit performance does not depend on a goal/intention for its performance. In contrast, habits are sometimes defined as a form of *goal dependent* automaticity. In this view habits are represented as goal-action links that emerge when environmental cues activate a goal and thereby an associated action to achieve that goal. In an attempt to bridge the gap between these two approaches Wood and Neal (2007) proposed a synthetic theory that integrates habit responding with the recognition of the

essentially *goal directed* nature of human action. According to this theory habits are neither simple-stimulus-response links nor the automatic expression of people's goals. The issue of goal (in)dependency in habit formation will be discussed in section 7.3, but first lets address Bargh's (1994) less controversial features of automaticity; (un)controllability, (lack of)awareness and efficiency.

Lack of awareness and efficiency

"Habit and routine free the mind for more constructive work" (Theodore Roosevelt in Connolly & Martlew, 1999, p.97).

Roosevelt's insightful observation makes intuitive sense. Without habits people would be doomed to plan, guide and monitor every action from making that first cup of tea in the morning to sequencing the finger movements required to type an e-mail. It is clearly more constructive to think about the content of the e-mail one is going to send than it is to use the keyboard. Thus the most prominent features of the automaticity of habits are lack of awareness and mental efficiency (i.e. one may do other things in parallel). Indeed these features most closely resemble how the habit construct is represented in everyday language (Bargh, 1994).

The limited conscious awareness devoted to habit performance was documented by Wood, Quinn and Kashy (2002) using a signal contingent diary procedure. Participants in this research recorded what they were doing at a particular point in time and also what they were thinking about during behaviour performance. Two independent raters then judged whether or not participants were thinking about the behaviour in which they were engaged at each recording. In the case of non-habitual behaviours, participants were thinking about what they were doing for 70% of the reports. In contrast for habitual responses, thought action correspondence was significantly lower as participants were thinking about what they were doing for only 40% of the reports. This suggests that habitual behaviours can easily occur in parallel with other unrelated processes. Minimal conscious awareness in habitual responding was also evident in participant's self report ratings of the attention and thought required to perform each behaviour (Wood et al., 2002, study 2).

(Un)controllability

"I can't help it, it's just a habit".

By offering such accounts people are perhaps acknowledging that habits are hard to break and difficult to control. However through effortful endeavour and sheer dint of will most of us, to some extent, are capable of over-ruling many of our habits. On the other hand the occurrence of action slips demonstrates that we sometimes do not control habits when we should. For instance, in an early example of action slips, James (1890) describes a man who enters his bedroom to change a tie ready for dinner but instead ends up getting undressed and getting into bed. Using an event sampling diary method, Reason (1990) found that such habit capture errors are relatively common in daily life and tend to occur when components of the habit overlap with the intended action. In Reason's (1992) diary studies this kind of error constituted 40% of all action slips. Such habit capture errors were especially common when the habit shared similar location, movements and objects as the intended action. Evidence that well practiced actions can be cued independently of intentions is discussed further in section 7.5 (also see section 4.4)

Aarts and Dijksterhuis (1999 in Verplanken & Aarts, 1999) also demonstrated the difficulty of suppressing habitual responses, this time related to travel mode choices. Under severe time pressure participants were asked to mention which mode of travel they would use when presented with several familiar travel destinations. Other participants were asked to mention the travel mode option they would *not* use for the presented destination. Moreover half of the participants carried out the task while their mental capacity was overloaded. Researchers found that when overloaded, participants found it more difficult to suppress responses that were related to habitual, compared to non-habitual choices, i.e. they made more mistakes when asked to mention a mode of travel they would *not* use when travelling to a particular destination.

7.3   Mechanisms underlying habit performance

So far we have established that habits are response dispositions that are cued by stable features in the environment and are acquired through a process of repetition

and associative learning. By their origins in past experiences habits form a distinct type of behaviour that has a number of features of automaticity. For this reason habits are often performed with limited conscious awareness, can be hard to break and difficult (but not impossible) to control. Building on this understanding, three main perspectives of habitual control have been proposed; the direct context cueing model, implicit goals model and the motivated contexts model. The main point of divergence between these models is with respect to the role that people's active/explicit goals and intentions play in mediating or moderating habit performance.

Direct context cueing model

According to the direct context cueing model, repeated co-activation between context and behaviour forges direct links in procedural memory via associative learning. Once these links have been forged merely perceiving the context triggers the associated behaviour. The mechanism behind direct context cueing involves cognitive neural changes that result from repeated co-activation of responses and contexts. Simple co-activation plausibly explains how perception of the environment activates mental representations of an historically associated response, however it is less clear how heightened cognitive accessibility drives overt habit responses. In one account, habitual responding emerges via an ideomotor mechanism, such that the mere thought of a behaviour leads to its performance. Thus the environment may directly activate the mental representation of an historically associated response via associative learning. This mental representation may then be enacted via an ideomotor mechanism (Neal, Wood & Quinn, 2006).

Supporting evidence for ideomotor effects comes from a series of studies conducted by Bargh, Dijksterhuis and colleagues who showed that participants primed with the elderly stereotype walked slowly (Bargh, Chen & Burrow, 1996), generated slow response latencies (Dijksterhuis, Spears & Lepinasse, 2001) and displayed poor memory (Dijksterhuis, Bargh & Miedema, 2000). Nonetheless, as Bargh et al. (1996) pointed out, activation of the elderly stereotype influenced the expression (e.g. walking speed) but not necessarily the initiation of responding (walking itself). It remains to be demonstrated whether simple co-activation in direct

context cueing (e.g. representations of walking + elderly stereotype) provides sufficient impetus to initiate an overt habit response (e.g. actually walking) as opposed to initiating an already intended stream of action (Wood & Neal, 2007).

Further support for the direct context cueing model comes from neuropsychology and animal learning literature. For example a myriad of findings in cognitive neuroscience reveal reduced involvement of goal related neural structures when behaviours have come under habitual control (Daw, Niv & Dayab, 2005). As regards the animal learning research, when rats initially perform an instrumental behaviour, such as pressing a bar for a food pellet, they appear to be guided by specific goal expectations (receiving food); they cease the behaviour if the reward is devalued. However, when rats extensively repeat the behaviour reward devaluation has little impact on continued performance; their responses appear to be triggered directly by the cues in the environment (e.g. the bar) (Dickinson & Balleine, 1995).

Recently, Neal, Wood, Lally and Wu (2009) conducted a series of studies exploring the perceived and actual role of goals in guiding habit performance. Study 1 demonstrated that as habit strength increases so does the strength of people's belief that goals motivate them to perform the behaviour in question, however studies 2, 3 and 4 demonstrated that these beliefs do not correspond with the with the direct cueing mechanisms that actually guide habit performance. For example study 3 demonstrated that among those who had frequently visited sports stadiums in the past, incidental exposure to images of sports stadiums cued the response of speaking loudly. This cuing did not occur among those who had not frequently visited sports stadiums in the past. Critical to these findings, the context-cuing of speech habits did not depend on the activation of a goal to speak loudly. In other words, participants with strong habits spoke loudly despite displaying no changes in goals related to loudness of their speech. Researchers concluded that although people strongly believe that goals drive their habits, in reality these behaviours are directly cued by the context cues that consistently covaried with past performance.

Motivated contexts model

In another framework for understanding habit performance, habits can also develop through a process in which the reward value of the response is conditioned onto

environmental cues. This process is referred to as motivated cueing as the environment carries motivational influence in that it signals opportunities to perform rewarded responses. Evidence for the motivating quality of the environment also comes from animal studies. For example, when monkey's first learn that a light predicts a reward when they press a lever, dopamine is released just after the receiving the reward. After repeated practice the animal reaches for the level when the light is illuminated however the dopamine response is no longer elicited by the reward but by the light itself (Schultz, Dayan and Montague, 1997). In this way environmental cues (i.e. the light) can acquire motivational value. The motivated context model has been tested primarily in animals, although its promise as a model of human habits comes from evidence that reward-related neurotransmitter systems are shared across species (Neal, Wood & Quinn, 2006).

So far then, both the direct and motivated models provide an account of the means by which environmental cues trigger overt habitual responding. In both models, repeated responses are activated in memory by associated contexts, the activated response representations then drive performance without the involvement of a mediating goal. Direct context cueing however represents a cold, unmotivated process, where as motivated cueing emerges from the value of the rewarding experiences associated in the past with contexts and responses.

Implicit goals model

In implicit–goal models (e.g. Bargh, 1990; Verplanken & Aarts, 1999; Aarts & Dijksterhuis, 2000) habits develop when people repeatedly pursue the same goal (e.g. feeling fit) via a specific behaviour (e.g. running) in the same context (e.g. in the park after work). An indirect association then forms between the context and the behaviour within the broader goal system. This way, habitual action maybe initiated and subsequently executed without much awareness of the goal driving the action. In the language of this approach then, habit is defined as a form of goal-dependent automaticity. This suggests that habits do not develop randomly, but are formed first and foremost because they serve us. Thus in keeping with the behaviourist tradition habits are created and maintained under the influence of reinforcement. That is behaviour that has positive consequences is more likely to be

repeated. For example, exercising may serve the goal of health maintenance or enjoyment, while eating snack food may serve the purely hedonic goal of providing a physical sensation of satisfaction. Evidence that environmental features automatically activate goals and that goal activation automatically elicits behaviour was provided by Bargh, Gollwitzer, Lee-Chai, Barndollar & Trotschel (2001). In one experiment participants worked on a word search task. For one half of the participants, achievement related words were embedded in the task (in order to activate achievement goals), whereas for the remaining participants the embedded words were neutral with respect to achievement. Participants then completed a series of word puzzles. Researchers found that participants who had been primed with achievement performed significantly better on the task compared to control participants. Furthermore participants reported no awareness of the impact of the goal on their behaviour during debriefing. Thus the environment automatically elicited the relevant behaviour as dictated by the primed goal.

There is also evidence concerning these processes as they directly relate to habit. For example, Aarts and Dijksterhuis (2000) conducted a series of experiments which demonstrated that the automatic activation of habitual responding, in this instance cycling, only occurred when a relevant travel goal (having to attend lectures at University) had first been made accessible. However, these studies utilized a response latency paradigm to provide an index of mental readiness and did not measure real world behaviour. An analogous pattern of results was reported by Sheeran, Aarts, Custers, Rivis, Webb and Cooke (2005) who investigated the goal directed automaticity of drinking habits. Like Aarts and Dijksterhuis (2000), researchers found that when habits were established simply activating a goal (socialising) related to the focal behaviour (alcohol consumption) triggered that behaviour. This study however, used a more objective index of alcohol consumption, namely the uptake of a coupon for either beer/wine or tea/coffee for a specified cafe bar.

Although the laboratory studies of Aarts & Dijksterhuis (2000) and Sheeran et al., (2005) appear to support the view that habit is a form of goal dependent automaticity, there are good reasons to be cautious about such a conclusion. First, it remains to be seen whether goal activation actually drives behaviour. For

example, signing for a coupon was not an element of participant's typical drinking habits but was instead a novel action which most likely involved reflection and decision making. Further research is required to determine for example, whether activation of the socializing goal would prompt participants with strong drinking habits to head to the bar at which they habitually drink upon leaving the experiment (Wood & Neal, 2007). Second, the strategies used by Aarts and Dijksterhuis (2000) and Sheeran et al. (2005) directed participants to attend to responding during performance (e.g. by judging whether the habitual response i.e. cycling is an appropriate means to some end), thus subjecting their habitual responses to a greater degree of focal attention. As a result the evidence for goal mediated control of habits may be confounded by the high degree of conscious awareness participants likely devoted to their responses during testing (Neal & Wood, 2007). Third, defining habit as a form of goal-dependent automaticity runs counter to the laboratory studies in neuroscience and animal learning which have demonstrated the stimulus driven nature of habitual responding. Unlike Aarts and Dijksterhuis (2000) and Sheeran et al. (2005), neuroimaging studies tracking the neural correlates of habit development do not appear to involve procedures that heighten conscious awareness. Finally, Wood and Neal (2007) explain that the features of goal dependent automaticity do not correspond with the features of habit. They argue that automatic goal pursuit is characterized by variability in responding rather than repetition of any particular behavioural means. That is goals can be met via multiple behaviours; for instance activating the goal to be healthy might prompt people to exercise and at other times to eat healthily. In contrast habits develop in a rigid pattern such that the habitual runner is unlikely to substitute a cycling class for running. Besides, real-world habit performance often persists when the value of the goal has changed or dissipated suggesting that habits proceed in a manner that is relatively insensitive to people's current goals (Neal & Wood, 2007). This is significant as many key theories of behaviour, including the TPB, are predicated on the idea that intentions/goals are key determinants of behaviour.

The habit goal interface

According to Neal and Wood, implicit goals are an implausible mediator of habit performance; these researchers argue repetition in everyday life is likely to be a

product of direct context associations and diffuse motivations (Wood and Neal, 2007). However given that habits typically originate in goal pursuit, habit performance may often inadvertently promote goal consistent outcomes, so although habits may not be goal dependent, they may to some extent be goal directed. This is the central tenet of Wood and Neal's (2007) model of the habit-goal interface. In this approach habit retains its rigid context cued nature (i.e. perception of the environment triggers the associated response without a mediating goal), but interfaces with goals during learning and performance (see figure 7.1).

Habits arise from context response associations that accrue slowly with experience. Consequently habit dispositions do not shift appreciably in response to people's current goals or occasional counter habitual responses. For example, so called bad habits reflect behaviours that are out of line with what people wish they were doing. This may occur for instance when a person accustomed to a more sedentary lifestyle decides to become more active. Thus habits possess conservative features that constrain their relation with goals, however within these constraints goals and habits can direct each other. Evidence that habits persevere when in conflict with goals comes from Webb and Sheeran (2006). They conducted a meta-analysis of 47 studies using persuasive appeals and other interventions to change people's behavioural goals and subsequent behaviour. Researchers found that when interventions addressed behaviours which were conducive to habit formation, i.e. they could be performed frequently in stable contexts, people continued to perform the habitual behaviour despite having new behavioural goals. However interventions that addressed behaviours that were not conducive to habit formation yielded more substantial behavioural change.

Real world habits are often not in conflict with goals or intentions; assuming that people usually repeat more preferred actions over less preferred ones, habits are likely to develop in line with intentions. Therefore, goals can direct habits by motivating repetition that leads to habit formation and by promoting exposure to cues that trigger habit performance. There is also good reason to believe that this pathway can be reversed; that is people can rely on their habits to make inferences about their goals. People often have limited introspective access to the causes of their thoughts and behaviours (Nisbett & Wilson, 1977). Under such circumstances

people may be forced to draw inferences about states from their own behaviour and other external cues (Bem, 1972). For example, people might infer their goals/intentions from their past behaviour, reckoning that 'I did it in the past; I will do it in the future' (Neal & Wood, 2007). So even if repetition was not initially intentional a positive relation between habits and intention might emerge. Finally, the habit goal interface arises when responses are habitual and yet also directly related to a currently held goal state. In this case the context-response associations do not merge with the goal but instead the two interact in guiding behaviour. When habits and goals dictate the same response, Wood and Neal (2007) suggest that goals are rendered an epiphenomenon, as action control is outsourced to the environmental cues that co-varied with past performance. Findings in behaviour prediction research often bear out such a pattern in which intentions typically correspond with but do not appear to guide habitual behaviours (see section 7.5).
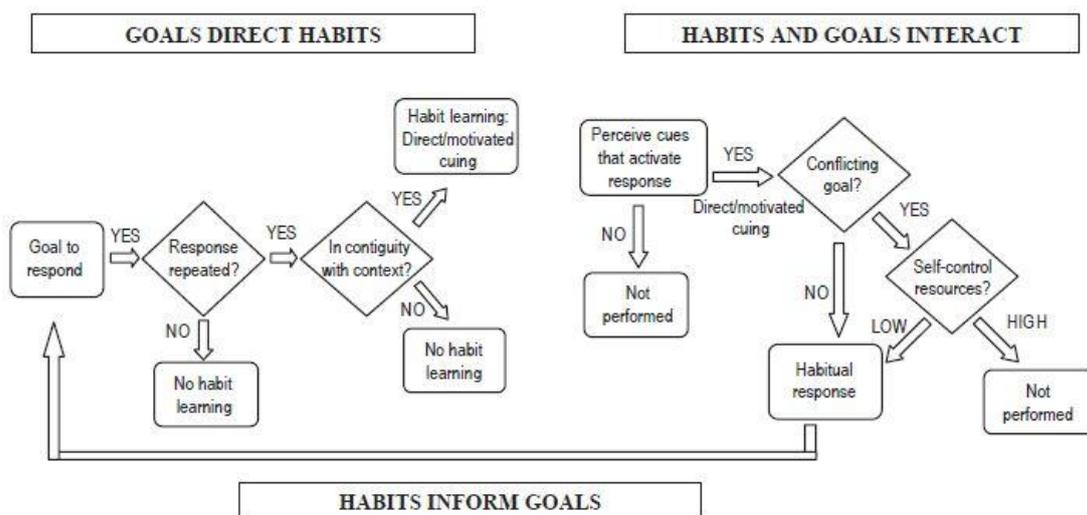
Figure 7.1 Illustration of the interface between habitual and goal based systems of action control (Wood & Neal, 2007).

Conclusion

In summary, direct context cueing, motivated contexts and implicit goal models all agree that features of a person's environment can automatically trigger habitual responding. There is less agreement however with respect to the role that people's goals play in mediating habit performance. Some researchers argue that habits are most accurately understood within a rigid stimulus driven framework, but that

habits nonetheless interface with goals (e.g. Wood & Neal, 2007). Others (e.g. Bargh, 1990; Verplanken & Aarts, 1999; Aarts & Dijksterhuis, 2000) see habits as a more flexible, goal dependent form of automaticity in which environments prime responses indirectly via the activation of relevant goals.

Habitual responding is likely to be the product of direct context associations and diffuse motivation, however implicit goals undoubtedly motivate some types of repetition that lead to habit formation by promoting exposure to cues that trigger habit performance. This is exemplified by so called 'implementation intentions' (see chapter 8). What's more the standard finding in behaviour prediction research is that habits and goals interact in their prediction of future performance such that goals do not predict future behaviour when habit is strong. Instead behaviour is a product of the strength of those habits.

7.4   The measurement of habit strength

The measurement of habit strength has long been an under developed issue. Indeed, some authors argue that research on habit in social psychology has stalled due to the availability of a reliable and valid measure that directly taps into the heart of the habit construct, i.e. automaticity (Eagly & Chaiken, 1983; Verplanken & Orbell, 2003).

Self-reported past behavioural frequency

The first problem in the measurement of habit is that most studies typically rely on the use of behavioural frequency as a measure of habit. In some studies, indicators of past behavioural frequency were obtained via observation (e.g. Landis, Triandis & Adamopoulos, 1978) or reports of ongoing experiences (e.g. Wood et al. 2002); however, habit is most often measured using some kind of retrospective self-report. Because a history of repetition forms the basis of a habit, using a measure of past behavioural frequency as a measure of habit does not seem unreasonable. Nevertheless, although repetition is undoubtedly part of the habituation process, a high frequency of behaviour does not necessarily imply the existence of a strong habit as some behaviours may be executed deliberately and consciously every single time (Verplanken and Melkevik, 2008) Clearly then, past behavioural frequency is only a proxy for a true measure of habit. The second problem is that

equating past behavioural frequency with habit suggests that habit strength keeps increasing with increasing frequency; however there is no empirical evidence to support such a notion and behaviourist models of conditioning do not suggest such a relation. These models suggest that once a habit has been established repetition and reinforcement are needed to sustain it, but not that repetition will infinitely strengthen it (Verplanken, Myrbakk & Rudi, 2005). Finally, self-reported frequency measures ask participants to recall instances of behaviour, yet episodic memories are notoriously inaccurate – even more so when behaviour is habitual. For example, Menon (1993) showed that information about irregular and dissimilar behaviours are likely to be present in episodic format and retrieved by a recall and count strategy. Conversely, information about the frequency of regular and similar behaviours (i.e. habitual) is typically generated by a rate-based estimation strategy. Such inferences may also be prone to biases stemming from the wording of the question or self presentation bias.

Self-reported habit strength

Some researchers measure habit strength by using a variant of a self-reported frequency measure by asking participants how often a behaviour was conducted in the past 'without awareness' or by 'force of habit' (e.g. Kahle & Beatty, 1987; Mittal, 1988; Towler & Shepherd, 1991). Although such a measure taps into the automatic qualities of habit, it suffers from the same potential problems as frequency estimates discussed earlier. What's more the validity of such a measure is compromised by being double barrelled, i.e. one item asks two questions at the same time, i.e. a frequency estimate and the extent to which behaviour is automatic. Anyhow, attempting to measure a construct like habit with only one item is likely to result in an unreliable measure (Verplanken et al., 2005). Verplanken and Aarts (1999) and Verplanken and Orbell (2003) suggest that asking participants to directly report on their perceptions of habit maybe problematic because people may have little access to such states or are not used to thinking along such lines. Taken together then, measures of self-reported habit strength are especially likely to suffer from invalidity.

Response frequency measure

The response frequency measure (e.g. Verplanken et al., 1994; Verplanken et al., 1997) was developed as part of a research programme on travel mode choices and is based on the notion that general habits are represented as behavioural schemas. When such a schema is activated, in this case by presenting participants with a travel destination, it is supposed to elicit the dominant response associated with that schema, i.e. taking the car. Thus rather than asking participants to report past behavioural frequencies, the response frequency measure focuses on the strength of the connections between cues and responses in terms of behavioural choice options.

The response frequency measure has been used and validated in a number of studies (Aarts et al., 1996 in Verplanken & Aarts, 1999). For example, the response frequency measure correlated substantially with car use amongst commuters who lived very close to their work (r = 0.66) and remained strongly correlated when statistically controlling for one's attitude (r = 0.56). It has also demonstrated good test re-test reliability over a four month period (r = 0.92). In contrast to measures of past behavioural frequency which rely on episodic memory, the advantage of the response frequency measure is that it relies on what is generally called semantic memory. Whereas pieces of information in episodic memory tend to be lost, memory traces that are common to many episodes (i.e. habits) form a more permanent script-type structure in semantic memory, and it is these memory structures that the response frequency measure is aimed at (McClelland, McNaughton & O'Reilly, 1995; Verplanken & Aarts, 1999). Although the response frequency measure taps into the automatic qualities of habit and does not ask participants to make estimates or judgements about their own behaviour, there are several limitations to its use. For instance, it is restricted to multiple choice situations and difficult to use in self-administered questionnaires because participants are supposed to respond as quickly as possible to the fictitious choice situation. If participants are given the opportunity to think and deliberate, the measure may tap other constructs such as attitudes rather than habits (Verplanken et al., 2005). A further inconvenience is that a new version of the questionnaire has

to be constructed for each new behaviour which requires extensive pilot work and pre-testing of the vignettes (Verplanken et al., 2005).

The Self-Report Habit Index

The SRHI (Verplanken & Orbell, 2003) is a generic 12-item self report questionnaire which breaks down the concept of habit into a number of features, i.e. perceptions of frequency, automaticity and self-identity. A history of repetition plays a central role in the development of habit. In the same way the concept of automaticity taps the very heart of the habit construct.

Following Bargh's (1994) analysis automaticity is also broken down into a number of separable features, namely; lack of awareness, difficulty to control and mental efficiency. The latter element 'self-identity' was included to refer to the fact that habits may be considered as idiosyncratic behaviours which may be part of a person's self-description. For example, some habits may reflect attitudes or values that are central to the self-concept (Verplanken et al., 2005). The reasoning behind this measure was that it might be easier to reflect and report on the qualities of habitual behaviour, rather than habit per se.

So far the reliability of the SRHI has proved excellent with many studies reporting coefficient alphas in excess of 0.90. It has also demonstrated good test re-test reliability and provided evidence for convergent, discriminant (Verplanken & Orbell, 2003; Verplanken et al., 2005) and predictive validity for a variety of habits. For instance it has been shown to be associated with various eating behaviours including snacking, fruit and vegetable consumption and consumption of sugar sweetened beverages (Brug, de Vet, de Nooijer & Verplanken 2006; Verplanken & Orbell, 2003; Kremers, van der Horst and Brug, 2007; Verplanken, 2006; Reinaerts, de Nooijer, Candel & de Vries, 2007; de Bruijn et al., 2007), active commuting (Lemieux & Godin, 2009) and most importantly physical activity and sedentary behaviours in both adults and children (Chatzisarantis & Hagger, 2007; Verplanken & Melkevik, 2008; Kremers & Brug, 2008).

Because the SRHI includes items that refer to past behavioural frequency there seems to be the danger of circular reasoning. For example, one could argue that habit effects occur because items referring to past behavioural frequency are used to predict behavioural frequency as a criterion. In this respect the results may not be particularly new or insightful. However, items included in the index tap the experience of repetition and thus differ from the frequency estimates that are utilized by measures of past behavioural frequency or self-reported habit frequency. Indeed, analyses have been conducted with the SRHI after the removal of the frequency items. In these studies, all of the initial effects reported remained intact and reliability of the measure remained satisfactory α = .85 (Verplanken, 2006).

There is also controversy over whether habits are more or less fundamental to an individual's identity compared to non-habits. For example, Wood et al., (2002) examined participants' interpretations of habitual and non-habitual behaviours and concluded that given the low intensity emotions and the minimal cognitive monitoring associated with habit performance, habitual behaviours may not form a strong part of the person's self-identity. On the other hand, Bargh et al. (2001) argue that goals and associated behaviours that become automated through frequent selection are likely to reflect individuals' guiding values, suggesting that habitual behaviours may be especially self-defining. Finally, although the SRHI suffers from the same disadvantages as other self-report methods, the use of multiple items makes it less vulnerable to such threats compared to a single-item instrument. What's more, from a practical point of view, the SRHI can easily be included in questionnaires and does not require extensive pilot work, instructions, equipment or a highly controlled research environment (Verplanken & Orbell, 2003).

Self-Report Behavioural Automaticity Index
Recently Gardner & Abraham (2009) developed and validated a brief automaticity specific subscale of the SRHI. These researchers argue that there is little evidence for self-identity as a central facet of habits. They also argue that if habits are cue response links, then habit performance will vary according the frequency with which the cues are encountered and so items assessing behavioural frequency are not a

necessary component of true habit measures. The SRBAI was constructed by asking 7 independent raters with expertise in social cognition to complete a discriminant content validity task. Each rater was given the 12-item SRHI and asked to judge whether each item measured automaticity, frequency or self-identity and to rate confidence in their judgements. Four SRHI items were consistently judged to measure automaticity with at least 90% certainty from each judge that that item represented the construct. These items were chosen for inclusion in the SRBAI.

Gardner and Abraham (2009) subsequently conducted a series of follow up studies in order to assess the convergent and predictive validity of the SRBAI across three behaviours; car commuting, bicycle commuting and unhealthy eating. In each study intention and habit (using the 12-item SRHI) were measured at baseline and behaviour was measured one week later. Researchers found that the SRBAI formed a reliable scale (α's = .84 - .95 across three studies), showed convergent validity with the SRHI (α's = .91 - .97), correlated with behaviour (car commuting – r = .75, bicycle commuting – r = .86 and healthy eating – r = .38) and was equally as sensitive to moderation effects, i.e. the intention – behaviour relationship, as the SRHI.

Conclusion

So which method provides the best measure of habit strength? Well, that depends on what the goal of the measurement is, whether or not the target behaviour clearly involves making choices amongst multiple alternatives and of course the practicality of using that method with a particular population. If for example a researcher is interested in behavioural frequency, then self-reported frequency of past behaviour is the best measure. The self-reported habit frequency measure should be disqualified outright because it lacks both validity and reliability. If the target behaviour involves making choices among multiple alternatives then the response frequency measure maybe a good choice provided that the researcher has ample time to pilot and pre-test the vignettes and is able to conduct the study in a controlled research environment. If however the researcher is interested in habit profiling or monitoring the changes in habit strength and habit qualities over time then the SRHI is the most appropriate measure. Conversely, if the research

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requires greater conceptual clarity and parsimony concerning the automatic aspect of habit, then the SRBAI represents a better measure. In terms of practicality, both the SRHI and SRBI are suitable for use in self-administered questionnaires (see table 7.1 below).

Table 7.1 Characteristics of the five habit measures

Characteristic	PBF	SRHF	RF	SRHI	SRBAI
Type of measure	Meta-judgemental	Meta-judgemental	Operational	Meta-judgemental	Meta-judgemental
Number of items	1	1	Multiple	12	4
Frequency estimate	Yes	Yes	No	No	No
Focus on multiple options	No	No	Yes	No	No
Usable in self-administered questionnaires	Yes	Yes	No	Yes	Yes

Note: PBF – Past behavioural frequency, SRHF – Self-report habit frequency, RF – Response frequency measure, SRHI – Self-report habit index, SRBAI – Self-report behavioural automaticity index.

7.5   Habit vs. planned behaviour

Research in the tradition of the TPB has identified behavioural intentions as a strong predictor of behaviour. However a robust finding in this domain is that measures of past behavioural frequency or habit contribute significantly to the prediction of future behaviour over and above measures contained within the TPB (see section 4.4). Over 30 years ago Triandis (1977) suggested that habit may provide an independent role in explaining behaviour from intention and interact with the intention – behaviour relationship.

A comprehensive review of the direct and indirect effects of past behaviour on future responses was conducted by Ouellette and Wood (1998). They reported that in 11 out of 13 studies reviewed past behaviour emerged as a significant predictor of future behaviour. What's more 6 out of 6 studies revealed that past behaviour was significant after controlling for PBC and intention, while 4 out of 4 studies revealed that past behaviour was significant after controlling for attitudes, SN's and intention. Although only four studies were available for the critical control analysis these four studies reflect the data from a total of 1265 participants, suggesting that

past behaviour effects can be interpreted independently of the TPB variables. Similar results have been reported by Connor and Armitage (1998) who found that after controlling for intentions and PBC, past behaviour explained a further 13% of the variance in future behaviour across seven studies.

Although the power of measures of past behaviour as predictors of future behaviour is beyond doubt, the exact role of habit remains unclear in these studies, mainly due to the methodological and theoretical problems associated with equating habit with past behavioural frequency. Remember, just because a behaviour has been performed many times in the past does not prove habituation in the sense of constituting an automatic response (Ajzen, 2002a). Besides, Ajzen (2002a) pointed out that prior behaviour may predict later behaviour because of other unmeasured variables which are stable over time or may reflect common method variance (i.e. resulting from the similarity of measures used to assess behaviour at both time points). He further argues that past behaviour - future behaviour relations are attenuated when measures of intention and behaviour are matched on the principle of compatibility (see section 10.2), when intentions are strong and well formed, where expectations are realistic and specific plans for implementation of intentions have been developed. Finally, Ajzen (2002a) asserts that inferring the existence of habit from strong past behaviour – future behaviour correlations and then using the concept to explain the existence of the strong correlation involves a circular argument. Consequently past behaviour – future behaviour relations and habit effects in general cannot be properly investigated without an independent measure of habit (Ajzen & Fishbein, 2005).

Alternative measures of habit strength have been developed and these were presented in section 7.4. Indeed, studies dealing with the TPB have shown that such measures are often better predictors of social behaviours than intentions. For instance, Verplanken, Aarts, van Knippenberg and Moonen (1998) conducted a field experiment investigating the prediction and change in repeated behaviour in the domain of travel mode choices. Car use during seven days was predicted from habit strength measured using self-reported frequency of past behaviour and a more covert measure based on personal scripts incorporating the behaviour, i.e. a response frequency measure. Researchers found that intention, PBC and the two

habit measures were significantly related to behaviour. In fact, habit strength was the strongest predictor and contributed significantly over and above intention and PBC. In another study, Lemieux and Godin (2009) employed the SRHI to investigate the contribution of habit strength in the prediction of active commuting. Regression of active commuting at follow up on past behaviour, TPB variables and habit strength showed that habit was the strongest predictor, albeit marginally stronger than behavioural intentions. The SRHI has also proved a stronger predictor than intentions for behaviours such as soft drink consumption and television viewing (de Bruijn & van den Putte, 2009), saturated fat consumption (de Bruijn, Kroeze, Oenema & Brug, 2008) and fruit consumption (de Bruijn, 2010) amongst others.

Whereas a main effect of habit may not be particularly revealing as to how habits and planned behaviour actually relate to each other, interactions between intention and habit may be more enlightening, as these indicate when intentions no longer guide future behaviour (Verlpanken & Aarts, 1999). In this respect Triandis (1977) argues that when behaviour is new, it is fully under the control of behavioural intentions. However, when a behaviour is sufficiently repeated, the weight of intention drops and the habit component takes over. In other words when habit strength increases, the influence of behavioural intentions decreases and vice versa.

Empirical support for the habit x intention interaction is rife. In a recent systematic review and meta analysis of applications of the Self-Report Habit Index (SRHI) (Verplanken & Orbell, 2003) to nutrition and physical activity behaviours researchers found 23 habit behaviour correlations and 9 habit x intention interactions (Gardner, de Bruijn & Lally, 2011). Weighted habit behaviour effects were medium to strong. Eight tests found that habit moderated the intention-behaviour relation, i.e. intentions were unrelated to behaviour in those with strong habits. Researchers concluded that a more comprehensive understanding of nutrition and physical activity behaviours can be achieved by accounting for habitual responses to contextual cues.

The results of Gardner et al's. (2011) meta-analysis suggests that habit strength marks a boundary limitation concerning the applicability of the TPB. However, one

should be cautious when interpreting habit x intention interactions. First, one should be aware of artefacts due to restriction of range effects. For instance, variance in behaviour may be smaller under conditions of strong versus weak habits. However in the context of strong habits restriction of range effects are meaningful as restricted variance forms the very nature of a habit. Interactions may also appear when intentions are vague and ill-formed, i.e. when an individual has not given much thought to a choice, which is likely to be the case when strong habits have been established. Consequently, ill-formed intentions are likely to be less well remembered, less stable and thus less predictive of behaviour (Verplanken & Aarts, 1999). Finally, Bagozzi & Kimmel (1995) suggested that past behaviour itself may induce biases in measures of intention due to the availability in memory of recent events. To test the role of habits in behaviour prediction and to explore the correct interpretation of predictive measures, Ji and Wood (2007) conducted two 7-day diary studies in which participants tracked the frequency with which they purchased fast food, watched the television news or rode the bus. At the beginning of the study, participants reported on their intentions to perform each of these actions during the week and estimated the frequency of their past performance and the stability of performance circumstances. The results yielded the anticipated pattern in which participants repeated habitual behaviours even if they reported intentions to do otherwise. However the study ruled out a number of artifactual accounts for these findings including that they arise from the level of abstraction at which intentions are identified, the certainty with which participants held intentions, a restriction of range in the measures, and the strategy participants used to estimate frequency of past performance.

7.6   Physical exercise habit formation

Aarts, Paulussen and Schaalma (1997) developed a model of physical exercise habit formation (see figure 7.2) which brings together ideas from the literature on motivation and habit mechanisms by illustrating the ways in which behaviour is initiated (focusing on the proximal psychological determinants), the way in which habits are formed and the effects of exercise experiences and habit on subsequent decisions to exercise.

First of all it should be noted that decisions to exercise are influenced by the social and physical environment; this is line with current ecological theorizing (see chapter 6). As such the environment may exert an impact on behaviour in all stages of the decision making process. According to the model, when an individual feels the need to exercise they will first consider perceptions of desirability, social norms and behavioural control; this will lead to an intention to exercise or not. If the goal to exercise is set, the deliberately formed intention will be implemented, resulting in actual performance. The first part of the model then is essentially a modified version of the TPB.

Once an individual has chosen a particular course of action, say cycling to work or school, they may discover that things are not quite as pleasant as they first expected. For instance the individual may find it more difficult than they first expected or perhaps ends up with an injury. Such unsatisfactory experiences directly feedback into one's perceptions of desirability, social pressure and behavioural control. Therefore any further contemplation or attempts to exercise will have to start from scratch at the top of the model, but now with updated perceptions.

If the exercise experience turns out to be satisfactory, an enhanced tendency to repeat the action emerges. In other words satisfactory experiences reinforce the need to choose the same course of action when facing the *same situation* next time, thus making repetition of the behaviour more likely. So repetition of behaviour is contingent on the opportunity to perform the behaviour under similar, if not identical circumstances (context stability). To this end, individuals probably first have to learn to recognize if and when the same behaviour can be executed – this first process of potential repetition is depicted on the far left of figure 7.2.

With increased repetition, the contemplative decision process may gradually change into a more heuristic one via memory of past experiences. What's more as the same behaviour is repeated under similar circumstances, the potential exists for associations to form between them, such that these circumstances or events come to automatically cue behavioural responses. Once evoked by situational cues, this well learned script may guide attention and behavioural decisions within that

situation such that the need for deliberate planning gradually diminishes. Thus according to Aarts et al. the core features of heuristic processing concern the retrieval from memory of conclusions reached in previous choice situations. This type of learning is depicted by the feedback of behaviour (or past behaviour) into memory of past experiences and the influence of memory of past experience on perceptions.

Genuine habit formation in the sense of automatic responding only occurs in those instances in which the same behaviour is repeatedly followed by satisfactory outcomes. To this end, the probability of behaviour occurring again next time increases with an increasing number of satisfactory experiences. Thus positive experiences with the chosen type of exercise will further enhance the strength of the habit. The feedback loop in bold arrows represents the habit formation process. According to Aarts et al. all that the behaviour requires to occur is the instigation of the goal to act in memory, which in turn is supposed to be triggered by the situational cues that usually precede the behaviour.

In sum, the model suggests that the initiation of behaviour is largely determined by deliberate decision making. However, when satisfactory experiences reinforce repetition of behaviour in similar if not identical circumstances the decisional process shifts from being a deliberate via a heuristic to a rather automatic/habitual one. A major limitation of the model is the implicit assumption that habits are goal dependent, however section 7.3 argued that habits are likely to be the product of direct context associations and diffuse motivations. Finally, while the model is congenial with ecological analyses and responds to calls for behaviour specific models, what it fails to clarify is precisely which social and physical environmental factors influence physical exercise. It also fails to generate specific hypotheses regarding environmental influences.
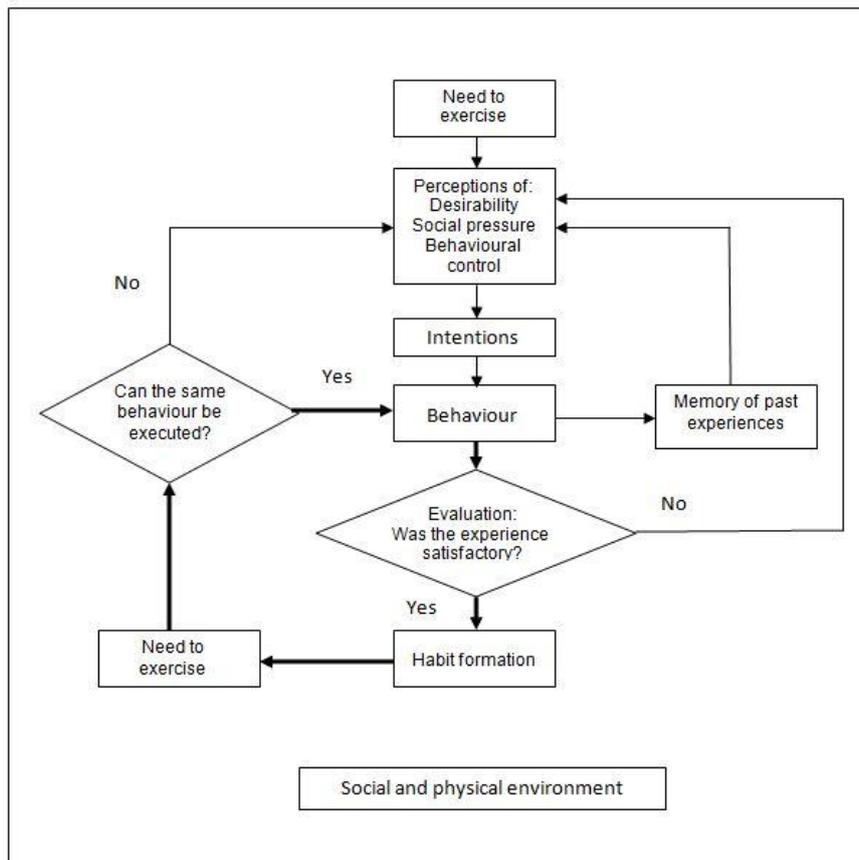
Figure 7.2 Model of physical exercise and habit formation (Aarts et al., 1997).

So how long does it take to form a habit? How many repetitions are necessary for a habit to develop? Does the amount of time or number of repetitions required to form a habit vary from behaviour to behaviour and does missing an opportunity to perform the behaviour compromise habit development? Lally and Colleagues (2010) recently addressed these issues in the first systematic study to examine the development of 'real world' habitual behaviours in individuals, i.e. using an ideographic approach.

Ninety six volunteers chose an eating, drinking or activity behaviour to carry out daily in the same context (for example 'after breakfast') over 12 weeks. Participants completed a measure of habit on each day and recorded whether or not they carried out the behaviour. For the majority of participants, automaticity increased steadily over the days of the study supporting the assumption that repeating a behaviour in a consistent setting increases automaticity. However, early repetitions resulted in larger increases in automaticity than those later in the habit formation

process and there was a point at which behavioural automaticity plateaued i.e. it did not increase even with further repetition. The average time to plateau was 66 days, although this ranged from 18 to 254 days, indicating considerable variation in how long it takes people to reach their limit of automaticity and highlighting that it can take a very long time. What's more, time to plateau was 65, 59 and 91 days for eating, drinking and exercise behaviours respectively. It was notable that the exercise group took one and a half times longer to plateau than the other two groups, supporting the idea that the complexity of the behaviour impacts the development of automaticity. Missing one opportunity to perform the behaviour however, did not materially affect the habit formation process. Considering that it can take a large number of repetitions for an individual to reach their highest level of automaticity, researchers concluded that creating new habits will require self control to be maintained for a significant period before the desired behaviour acquires the necessary automaticity to be performed without self control.

7.7   Habit and decision making processes

Habits are not only response programs, but may have far reaching consequences for cognitive functioning, in particular the way we perceive situations and process information. For example, the more deliberate an action is, the stronger will be the awareness of choice. Conversely, habitual behaviour is not likely to be experienced as making a choice, even when alternative courses of action are explicitly available (Verplanken & Aarts, 1999).

Appreciation of situational cues and choice option information

Three studies examined the role of habit on information acquisition concerning travel mode choices (Verplanken, Aarts & van Knippenberg, 1997). The three studies focused on different phases in the choice process, namely the appreciation of situational cues and appreciation of choice option information. On the basis of Triandis' (1980) model of interpersonal behaviour it was expected that habit strength would attenuate the elaborateness of choice processes. As expected researchers found that compared to weak habit participants, those who had a strong habit towards choosing a particular travel mode acquired less information and gave evidence of less elaborate choice strategies. Subsequently researchers

attempted to break the effects of habit by manipulating either accountability demands of level of attention. Although accountability demands raised the level of information acquisition, no interactions with habit were found. Enhanced attention to the choice process did initially override habit effects, however chronic habit effects emerged during later choice trails. Thus the results of this study demonstrate the profound effects that habit may have on the appreciation of situational cues and choice option information.

Information integration

In another experiment Aarts, Verplanken and van Knippenberg (1997) addressed the question of how habit effects the integration of information use underlying daily travel mode choices into judgements using the policy capturing paradigm. Participants performed a multi-attribute travel mode judgement task in which they could use information about travel circumstances in order to make a number of judgements. Measures of information use were then obtained by performing multiple regression analyses for each participant. Researchers found that habit reduced the elaborateness of information use in judgements of travel mode use and that this was independent of the effects of manipulated accountability demands.

It should be noted that while the present study focused on judgement, the previous studies by Verplanken et al. (1997) focused on choice. Although choice and judgement are often treated as equivalent one may argue that judgement usually elicits a more deliberate mode of processing, as judgement does not necessarily encourage participants to use simplifying heuristic strategies as is often the case in a choice context (Aarts et al., 1997). Consequently judging the performance of a specific behaviour may be less habitual than deciding to follow a specific course of action. Thus it appears that habit attenuates the elaborateness of information processing in both judgement and choice, suggesting that habit affects various aspects of the decision making process (Aarts et al., 1997).

Routine maintenance, confirmation bias and appraisal of evidence

In another unrelated set of experiments, Betsch, Haberstroh, Glöckner, Haar and Fiedler (2001) manipulated routine strength in the laboratory using a computer controlled micro world simulation to assess its effects on information search and choice in deliberate, unconstrained decision making (habits are a special case of routinized behaviour, i.e. automatic routines[2]). Researchers found that routine strength can effect information search and subsequent decisions. For example, if routines evolved from a large sample of positive experiences (strong routine condition), decisions reflected a remarkable degree of sensitivity to prior information, even if new information clearly suggested that a deviation from the routine would be beneficial. Researchers also demonstrated that routines yield confirmation biases in information acquisition. For example, information search was biased toward confirmation if the task was said to be similar to the tasks in the learning phase[3]. However confirmatory tendencies could be eliminated by announcing that the task was novel.

Routines not only influence how individuals search for information, but also how they appraise the encoded evidence. For instance, earlier research demonstrated that strong routine individuals are especially likely to attenuate contradicting evidence if cognitive capacities are constrained. For example, Betsch, Brinkman, Fiedler and Breining (1999) and Betsch, Fiedler and Brinkman (1998) showed how with increasing time pressure participants tend to maintain their routines, despite detecting evidence that contests the routine choice. This finding indicates that routine decision makers may discount disconfirming evidence under the pressure of situational constraints. Processing constraints however are not a necessary condition for the occurrence of attenuation effects. Even if decision makers have enough time and capacity, they tend to discard unfavourable evidence if their routines are strong. For instance, the Betsch et al. (2001) experiments described

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[2] Conversely, not all of our routines are habits in such that they are instigated and performed automatically.

[3] Similar results have been reported by Orbell and Verplanken (2010) who showed that strong habits are associated with attentional bias to habit related cues.

above show how with increasing repetition of a routine choice, participants tend to neglect information if it suggests pursuing an alternative course of action.

Conclusion

Taken together the results of Verplanken et al. (1997), Aarts et al. (1997) and Betsch et al. (2001) suggest that habit limits the appreciation of basic information that describes the context in which choices are made, information that describes choice options and the basis of information that is used for judgements that ultimately underpin choices. What's more, individuals are especially likely to attenuate evidence contradicting routine choice and thus less likely to pursue an alternative course of action if cognitive capacities are constrained. This provides a grim picture for those who wish to influence habitual behaviour through information based interventions. Although an inherent problem of laboratory studies in general, the major drawback of the aforementioned research is the artificial nature of the experimental tasks, thus posing the question of external validity.

Chapter 8

Implementation intentions

"The concept of implementation intentions has a short past and a bright future"

(Sheeran, Milne, Webb & Gollwitzer, 2005)

8.1   Introduction

The effectiveness of physical activity interventions depends not only on the change of existing habits but also on the initiation and maintenance of new desired behaviour. One mechanism to ensure that new behaviours are maintained is through the creation of new habits (Verplanken & Wood, 2006). The following chapter will introduce the concept of implementation intentions and examine the role that they play in establishing new habits. First though, the Model of Action Phases and Mindsets (Gollwitzer, 1990) is presented as it provides the basis from which implementation intentions evolved.

8.2   Action phases and mindsets

Mind set theory was developed and refined by Gollwitzer (1990); the concept of which was set to denote a cognitive orientation that promotes the completion of a goal directed task. According to this theory the pursuit of goals comprises two broad phases. Each phase comprises a distinct profile of cognitive processes or mindsets. The first phase is called the predecisional phase. During this phase an individual deliberates which goal is most desirable and feasible. This is accompanied by a convergent cognitive orientation toward accurate and impartial processing of information, open mindedness and heightened receptivity to information in general. This cognitive orientation is referred to as a deliberative mindset and should originate whenever people become intensely involved with deliberating their wishes (Gollwitzer, 1990).

The second phase is called the postdecisional phase. During this phase individuals must initiate an action to realize the goal they selected. Their main objective is to

remain committed to the goal. Gollwitzer (1990) distinguished three further mindsets within the postdescisional phase namely the implemental mindset, the actional mindset and the evaluative mindset. The implemental mindset should originate whenever people become involved with planning the implementation of their goals. An implemental mindset is therefore tuned toward information relevant to where, when and how to act. It is also characterised by a closed mindedness in the sense of concentrating on information that helps promote goal attainment. Once action is undertaken an actional mindset is adopted which focuses exclusively on aspects of the self and the environment that sustain the ongoing action; any potentially disruptive aspects are ignored. Therefore the mindset that facilitates goal achievement is one of closed mindedness to information that could trigger re-evaluation of the goal that is pursued. Finally, an evaluative mindset should originate whenever people become involved with evaluating outcomes and consequences of goal-striving. Accordingly an evaluative mindset is tuned toward information relevant to assessing the quality of the achieved outcome and the desirability of its consequences. There should be a cognitive orientation toward accurate an impartial processing of this information, while the intended outcome and the desired consequences should be compared with its actual outcome and actual consequences.

So how does mindset theory relate to habit? Drawing upon the research presented in section 7.7, habits seem to go together with a cognitive orientation that makes an individual less attentive to new information and new courses of action and is characterised by a preference for simple, heuristic based choice rules. A habit thus appears to be accompanied by a habitual mindset. A habitual mindset seems to be important in the maintenance of a particular behaviour over time and in the case of a general habit such as physical activity, in various contexts (Verplanken & Aarts, 1999). Like the other mindsets described the habitual mindset can be switched off and replaced by another mindset when the habitual act cannot be executed or when thought and deliberation is required. However, a habitual mindset is an enduring 'default' state of mind, which is inherently associated with the habitual behaviour, thus it may be present on a relatively chronic basis and not exclusively during the time the habitual act is performed (Verplanken & Aarts, 1999). For these

reasons habits are strong durable structures; indeed, the fundamental lack of attention for new information may make habits especially hard to break.

When applying this notion of habitual mind-set to a behaviour change context, the down side is of course, that we may miss opportunities for improvement or progression. Habits may turn into suboptimal behaviours when we enter new situations or changing environments or when we adopt new goals that are incompatible with current habits (Verplanken & Aarts, 1999), e.g. starting an exercise programme and binge drinking. On the up side however, intervention programmes designed to establish a new desired behaviour want that behaviour to be performed frequently, automatically, stable over time and resistant to other influences, i.e. information that undermines the new desired behaviour and/or alternative, less desirable courses of action. The planning of new habits may therefore be explicitly adopted as an intervention goal (Verplanken, 2005).

8.3 Implementation intentions

Implementation intentions evolved from Gollwitzer's (1990) Mindset theory Remember, according to Mindset theory individuals tend to operate in one of two modes: deliberation or post-decisional. During the post-decisional phase individuals must initiate an action to realize the goal they selected. To implement goals, some individuals form implementation intentions which specify where, when and how to act in future situations ('when I encounter situation X, then I will perform behaviour Y'). Implementation intentions are quite different from what Ajzen (1991) refers to as intentions. For example, goal intentions specify a desired end state that the individual intends to achieve – thus goal intentions create a link between the desired end state and the person who forms the intention. Implementation intentions however, install contingencies between anticipated situational cues and goal directed responses, so that the individual commits him/herself to initiate the desired behaviour once the situational cue has been encountered (Bargh & Gollwitzer, 1994).

In the model of Action Phases and Mindsets, goal intentions play their role in the transition between the pre-decisional phase and the post-decisional phase. Implementation intentions on the other hand are formed in the post-decisional

phase and are thought to ease the transition from the post-decisional but pre-actional to the actional phase (Bargh & Gollwitzer, 1994). Implementation intentions then, are a vital part of planning the execution and initiation of a behaviour and are understood to be in the service of a respective goal intention.

The strategy of forming implementation intentions has been proposed as an effective tool when it comes to enacting intentions, i.e. bridging the intention – behaviour gap as well as the speed of action initiation, especially considering the simplicity of most implementation intention instructions. For example, a meta-analysis of 94 studies by Gollwitzer and Sheeran (2006) demonstrated that forming an implementation intention had a medium to large effect (d = .65) on goal attainment over and above the impact of forming relevant goal intentions. What's more, Aarts and Dijksterhuis (2000) found that participants without strong travel habits who formed implementation intentions selected a mode of travel by which to reach a particular destination just as quickly as participants whose travel mode was relatively habitual.

Implementation intentions promote behaviour by instigating psychological processes that enhance the identification of environmental cues. As a consequence the environmental cue is more easily detected, readily attended to and successfully remembered thus reducing the risk that good opportunities to act will pass by unnoticed (e.g. Aarts, Dijksterhuis & Midden, 1999). Implementation intentions are also said to benefit action initiation by strengthening the link between the planned situation and the goal-directed response (Gollwitzer, 1993). According to Gollwitzer, by linking the intended response to a suitable opportunity, one does not need to deliberate whether to act, or how to act because specified situational cues elicit behaviour automatically. This is supported by demonstrations that initiation of the behaviour in the presence of the critical situation is immediate, efficient and does not require conscious awareness (e.g. Webb & Sheeran, 2004; Brandstätter, Lengfield & Gollwitzer, 2001; Bayer, Moskowitz & Gollwitzer, 2002 in Sheeran et al.,

2005)[4]. In this way, implementation intentions have much in common with the way habits work; both involve automatic cue-response links which ultimately delegate control of behaviour to the environment in which it takes place. Like the habitual mindset discussed earlier, implementation intentions go along with a convergent cognitive orientation which focuses on one behavioural option thus increasing the likelihood of acting in the specified place at the specified time. The difference between habits and implementation intentions is of course, that habits develop through repetition and reinforcement, whereas implementation intentions are formed by deliberate planning.

Because the basic mechanisms of implementation intentions and habits seems very similar, implementation intentions may be an efficient tool to create future habits (Verplanken, 2005). For instance implementation intentions regulate behavioural frequency which means that behaviour will be repeated. They also transfer (or at least in part) control over the behaviour from the person to the environment, thus mimicking habitual cue-response links. In this way implementation intentions may form the cognitive framework for the development of future habits. Orbell and Verplanken (2010, study 3) assessed the ability of implementation intentions to enhance habitual automaticity. They conducted a field experiment in which participants were randomized to form an implementation intention to floss their teeth everyday for the next 14 days. Researchers found that people whose goal intention was supplemented by an implementation intention were not only more likely to act but also more likely to establish a habit compared to a control group. What's more, the automatic component of habit engendered by implementation intentions was most likely when participants initially held strong goal intentions. The results show that by forming an implementation intention to respond to a specified situational cue, habitual automaticity of behaviour was rapidly enhanced. However, it remains to be seen whether implementation

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[4] It should be noted that these studies were laboratory-based and examined effects on behaviour in the immediate experimental setting. As such, it remains unclear whether a simple implementation intention manipulation is sufficient to change behaviour outside the laboratory via these same processes.

intentions enhance habitual automaticity for more complex behaviours like physical activity.

So far this thesis has established the link between physical activity and health, discussed the complexities surrounding the measurement of children's physical activity and identified various psychosocial and environmental determinants. The following chapter pulls together this research, provides a sound rationale for the thesis and justifies the sequence of studies. It also provides an explicit statement of the research aims and objectives.

Chapter 9

Research aims: Justifying the thesis and sequence of studies

9.1   Rationale

It is becoming increasingly inappropriate to attempt to understand individual behaviour in isolation from its environmental context. As a result environmental determinant studies have received growing attention in the physical activity literature; nonetheless, few studies have acknowledged or explored the potential mechanisms underlying relevant environmental influences.

This project addresses the gap in current knowledge by increasing insights into the pathways linking *specific* environmental settings and physical activity in children beyond the limits of models such as the TPB by exploring more complex automatic and habitual mechanisms underlying behaviour. It is anticipated that habit will provide a useful locus to accommodate for both individual and environmental accounts of behaviour.

The project is mainly grounded on insights from health and social psychology, since the focus is on perceptions of the environment (as opposed to the objective environment per se), however it is also congruous with the ecological approach and social practice theory since it attempts to integrate the individual with the environment, relative to the actions and practices (i.e. habits) of the individual.

Children aged 9 – 11 years attending Local Education Authority maintained primary schools in Worcestershire are the focus of the project. According to Armitage and Sprig (2010) this is a critical period when physical activity habits are created. This period of transition, between childhood and adolescence is critical, since from a life course perspective it represents a time when children develop more behavioural autonomy and as a result may make negative or potentially harmful health behaviour choices (Brug, 2007). Indeed, this transition period appears to coincide with a distinct drop in physical activity levels. For example, Craig and Mindell (2008)

report that activity levels generally peak at around 9 years of age and decrease thereafter. Evidently then, further research and intervention in this age group is warranted.

9.2   Aims and Objectives

Studies that explore mediating pathways between environment and physical activity are largely lacking (Brug et al., 2010), especially during the critical period, i.e. 9 – 11 years, however it is important to investigate such associations in order to develop well planned interventions to encourage physical activity. Therefore the main aims of this project were;

1. Examine associations between access to convenient facilities and physical activity resources in the home and school environment, and MVPA in children aged 9 – 11 years.
2. Examine whether associations between access to convenient facilities and resources in the home and school environment and MVPA are mediated by the TPB and/or by habit strength.
3. Develop a model of children's MVPA
4. Design, implement and evaluate a school based cluster randomised control trial to increase physical activity in children aged 9 – 11 years.

In order to achieve the aims set out above, the specific objectives of this project are:

1. Develop and validate a brief, standard direct measure of the TPB to assess physical activity social cognitions in children aged 9 -11 years; since no standard TPB questionnaire exists, research is required to construct a valid and reliable questionnaire suitable for the behaviour and population of interest.
   - Construct TPB questionnaire in accordance with established guidelines.
   - Submit questionnaire to internal consistency analysis (i.e. Coefficient alpha [Cronbach, 1951])
   - Establish convergent and discriminant validity of TPB measures.

2. Explore the psychometric properties of the Physical Activity Questionnaire for Older Children (PAQ-C) (Crocker et al., 1997); the PAQ-C has been identified as a potentially valuable instrument for use in large scale physical activity research, however further work is required to assess its suitability for use with British children.

- Examine general test score characteristics and item properties of the PAQ-C via descriptive statistics.

- Examine the item/scale relationship via corrected item-total correlations and Coefficient alpha.

- Examine the factor structure of the PAQ-C using an exploratory factor analysis (EFA).

- Assess two-week test re-test reliability using Pearson's r.

3. Explore the pathways linking *specific* environmental settings and MVPA in children.

1. Examine the reliability and factor structure of the Self-Report Behavioural Automaticity Index (SRBAI) (Gardner & Abraham, 2009) in children.

2. Examine associations between habit, cognition, access to convenient facilities and resources in the home and school environment and MVPA in children.

3. Examine whether associations between access to convenient facilities and resources in the home and school environment and MVPA are mediated by the TPB and/or by habit strength.

4. Design, implement and evaluate a school based cluster randomised control trial to increase physical activity in children aged 9 – 11 years.

- Examine the impact of the intervention on levels of physical activity in children

- Examine the impact of the intervention on perceived access to convenient facilities and habit strength

- Examine whether the effects of the intervention on physical activity levels are mediated by perceived access to convenient facilities and habit strength.

- Conduct a process evaluation to examine the factors that characterize the success or failure of the intervention.

Chapter 10

Development and validation of a brief TPB questionnaire to assess physical activity cognitions in children

"Investigators often mistakenly assume that direct measures of the theory's constructs are obtained by asking a few arbitrarily selected questions, or by adapting items used in previous studies. Although this approach often yields findings of interest, it can produce measures with relatively low reliabilities and lead to an underestimate of the relations among the theory's constructs and of its predictive validity" (Icek Ajzen, 2002b)

10.1 Abstract

Objective: Ecological models hypothesize that environmental factors influence behaviour both directly and indirectly; the indirect causal mechanism reflects the mediating role of behaviour specific cognitions. In order to explore potential associations between the environment, psychosocial factors and MVPA, this study sought to develop and validate a brief TPB questionnaire to assess physical activity cognitions in children. Since no standard TPB questionnaire exists, research is required to construct a questionnaire suitable for the behaviour and population of interest.

Method: 105 Pupils were recruited from a primary school in the West Midlands. Participants were recruited using an opportunity sample and consisted of both males and females aged 9 - 11 years. An initial item pool was generated based on a review of the literature. A 20 item questionnaire was then pre-tested to assess clarity of wording, participant comprehension, length and ease of administration and response. Based on feedback from the pre-test a second 13-item questionnaire was developed and tested for both reliability and validity.

Results: Coefficient alpha was 0.78, 0.68, 0.64 and 0.78 for attitude, SN, PBC and intention respectively. All inter-item correlations were significant ($P < 0.05$) and

ranged between .23 - .63 for attitude, .37 - .45 for SN, .47 for PBC and .45 - .64 for intention. Corrected item total correlations exceeded 0.30 demonstrating homogeneity of scale items. Inter scale correlations were < 0.85 demonstrating discriminant validity. EFA was employed to uncover the underlying structure of the attitude construct. Principle components analysis revealed one factor with loadings > 0.50.

Conclusion: Results suggests that the brief TPB questionnaire has acceptable measurement properties and is ready for application in the field.

10.2   Introduction

No standard TPB questionnaire exists. According to Ajzen (2002b) investigators often mistakenly assume that direct measures of the theory's constructs can be obtained by asking a few arbitrarily selected questions, or by adapting items used in previous studies. Nonetheless, this approach often produces measures with relatively low reliabilities which ultimately lead to an underestimation of the relations among the theory's constructs and of its predictive validity (Ajzen, 2002b). Formative research is therefore required to construct a questionnaire suitable for the behaviour and population of interest.

Ajzen (2002b) provides a clear step by step guide to producing a TPB questionnaire. First the behaviour of interest is defined in terms of its Target, Action, Context and Time elements (TACT) (although the minimum specification requires an action and time frame to be stated). Next, attitude, SN, PBC and intention are assessed directly by means of standard scaling procedures.

When developing scales, it is important to observe the principle of compatibility. According to the principle of compatibility all constructs should be formulated at the same level of specificity with regards to the TACT elements of the behaviour. The similar the TACT elements of one construct to those of the other, the stronger the statistical relation between them (Ajzen, 2005). Courneya (1994) has since suggested that the predictive power of the TPB could be further improved by ensuring that scales, as well as the TACT elements of the items correspond.

Beliefs play a central role in the TPB. By measuring beliefs we can explore why people hold certain attitudes, SN's and perceptions of control; this information can prove invaluable when designing effective behaviour change interventions. It is important to note however, that this explanatory function is only assumed for salient beliefs. Consequently, some researchers, in this instance Sutton (2002) among others, recommend that both direct and indirect measures should be included in TPB questionnaires. Modal salient beliefs are usually identified by using open-ended questionnaire techniques that require individuals to recall and list beliefs about the target behaviour.

According to Kremers, Visscher, Seidell, van Mechelen & Brug (2005) the number of items used to assess cognitive determinants in questionnaire research into physical activity should be kept to a minimum. They suggest that the use of the belief based constructs cause questionnaires to be too long, which may lead to low response rates and invalid data. Researchers argue that if studies show that a behaviour is not or to a minor extent under intentional control the measurement of cognitions is of little use. Second, only when we have proof that attitudes, SN's and PBC predict intention should we aim to assess the underlying belief system.

Attitudes

In the TPB attitudes are typically measured by semantic differential scales (Osgood, Suci & Tannenbaum, 1957), although any standard attitude scaling procedure can be used. While at one stage it was suggested that researchers need only ensure that such items form a single factor; empirical research has shown that attitudes often contain two separable components (Ajzen & Driver, 1991). Consequently, Ajzen (2002b) has suggested that steps be taken to ensure that both instrumental and affective items are included in attitude measures.

Subjective norms

In section 4.3 it was noted that SNs consistently predict little if any variation in physical activity behaviour indicating that social influences on physical activity intentions may be less important than individual attributes. One plausible explanation for the weak predictive power of normative measures may be the conceptualization of norms used. Traditionally, SN has been described as person's

subjective judgement concerning whether significant others would want him/her to perform the behaviour and measured using items such as:

Most people who are important to me think that I should be physically active over the next 7-days:

<div align="center">

1   2   3   4   5

Strongly disagree   Strongly agree

</div>

Items of his kind have an injunctive quality; however responses to such items are often found to have low variability because important others are generally perceived to approve of desirable behaviours and disapprove of undesirable behaviours (Ajzen, 2002b). To alleviate this problem Ajzen (2002b) recommends that the initial set of items also include questions to capture descriptive norms.

Perceived behavioural control

The measurement of PBC is perhaps the most controversial issue in TPB theory (Rhodes, Blanchard & Hunt Matheson, 2006). Early work identified problems with low PBC internal consistency and more recent studies have led to the identification of two distinct subcomponents (e.g. Terry & O'Leary, 1995). Consequently, Ajzen (2002b) suggests that appropriate PBC measures should contain items representing both controllability and self-efficacy. Rhodes and Courneya (2003, 2004) however, have suggested that self-efficacy items possess measurement complexity between intention and PBC and do not measure Ajzen's (1991) PBC construct as cleanly as do controllability items. As a result, they recommend against using self-efficacy type items in the TPB structure. Rhodes et al. (2006) have since suggested that measuring Ajzen's intended PBC subcomponents of perceived skills, opportunities and resources may help create a better component model. However, when they tested the measurement and predictive structure of this alternative model in the exercise domain they found evidence that a PBC measure using controllability items mediated measures of skills, opportunity and resources thus supporting the domain representation denoted by Ajzen's controllability items.

Intention

There has been some variation in the literature concerning the conceptualization of intention in TPB studies. For example, Warshaw and Davis (1985) noted a number of ways in which intentions had been operationalized and distinguished between measures of intention and self-predictions. Bagozzi (1992) has since suggested that attitudes may first be translated into desires, which then develop into intentions to act. Armitage and Conner (2001) conducted a meta-analysis specifically considering the role of intentions, self predictions and desires in the context of the TPB and found that intentions and self predictions were stronger predictors of behaviour than desires when PBC was included as a predictor. The data indicated that the most variance in behaviour was explained by employing measures of intention and PBC. Thus the results provide strong support for employing measures of intention rather than self-predictions or desires.

Although the conceptual and empirical distinction between instrumental and affective attitudes and injunctive and descriptive norms appears sound, extensions and/or modifications to the TPB must be evaluated alongside the original theory's parsimony in accounting for the variance in intentions and behaviour. A further issue of concern when augmenting the theory is the potential for conceptual overlap between variables (Hagger & Chatzisarantis, 2005b). According to Ajzen (2002b), Bagozzi, Lee and van Loo (2001) and Hagger and Chatzisarantis (2005b) for example, augmentations of the TPB that differentiate the model components can be subsumed by global higher order factors. These factors therefore represent an executive summary of the differentiated model components. This does not mean that the differentiated components model should be abandoned; indeed such models may be of value when attempting to identify specific components that account for changes in intention in target behaviours. However, if the researcher is principally interested in assessing the overall impact of the key theoretical variables, i.e. in more global terms, a more parsimonious model is desirable. On a more practical level, since Cronbach's alpha will often depend on the number of items in the scale, differentiating the model components would most likely result is a questionnaire that is too long for children to respond to; indeed, questionnaire brevity and respondent burden are important factors to take into consideration

when designing questionnaires for young children. Nonetheless an optimal balance between brevity and reliability must be achieved.

Many questionnaire developers routinely construct measures that contain both positively and negatively phrased items. The reason for using a questionnaire with mixed phrasing is that it will motivate respondents to read the items carefully to avoid providing contradictory responses (Barnette, 2000). In addition many researchers contend that the combining of positively and negatively phrased items reduce social desirability in responding, acquiescence and satisficing (i.e. the tendency to agree with an item due to the exertion of minimal cognitive effort) (Barnette, 2000). However, evidence suggests that the use of scales with mixed phrasing can adversely affect the psychometric properties of the scale, namely the factor structure, scale means, score reliability and, ultimately validity (Weems, Onwuegbuzie and Collins, 2006). Indeed, Benson and Wilcox (1981 in Weems et al., 2006) found that 4th and 5th grade students (i.e. years 5 and 6 or 9 – 11 years) struggled with scales that contained all negatively phrased items or mixed format. Benson & Hocevar (1985) obtained similar results with students in grades 4 – 6 (i.e. years 5, 6 and 7 or 9 – 12 years). Inspection of the items means suggested that it was difficult for students to indicate agreement by disagreeing with a negative statement. Thus evidence is steadily building that the use of negatively phrased items in questionnaires for use with children does not represent good practice.

10.3   Aims and objectives

Since no standard TPB questionnaire exists, the aim of the present study is to develop and validate a brief standard direct measure of the TPB to assess physical activity cognitions in children aged 9 -11 years.

In order to achieve the aims set out above, the specific objectives of the study are:

1. Construct TPB questionnaire in accordance with established guidelines.
2. Submit questionnaire to internal consistency analysis (i.e. Coefficient alpha [Cronbach, 1951])
3. Establish convergent and discriminant validity of TPB measures.

10.4 Method

Participants

105 Pupils were recruited from a primary school in the West Midlands. Participants were recruited using an opportunity sample and consisted of both males and females aged 9 to 11 years. School statistics indicated that the majority of pupils were of White British ethnicity. Indices of deprivation were obtained using the ACORN population profile tool. ACORN is a geo-demographic segmentation of the UK's population which segments small neighbourhoods, postcodes, or consumer households into 5 categories, 17 groups and 56 types. The ACORN population profile for this school was 3/H/29, suggesting that the catchment area primarily consisted of secure families, who are comfortably off, living in suburban semis.

Questionnaire development

An initial item pool was generated based on a review of the literature and procedures suggested by Ajzen and Fishbein (1980), Ajzen (2002b), Conner and Sparks (2005) Francis et al. (2004) and Kremers et al. (2005). The 20 item questionnaire was then pre-tested (*N* = 10) to assess clarity of wording, participant comprehension, length and ease of administration and response. The pre-test revealed a large variation in student reading levels. Respondents' also had considerable difficulty understanding the semantic differential scales. As a result the semantic differential scales were replaced with Likert type scaling as this was much easier for participants to answer without assistance. Based on feedback from the pre-test a second 13-item questionnaire was developed and tested for both reliability and validity. This time the items were separated and presented in a non-systematic order. A five point response format was used for all questionnaire items. The Flesch-Kincaid readability score for the final questionnaire was 7.7, indicating that it could be understood by an average pupil in the 7th grade (U.S grade level), or in the United Kingdom, a child aged 12 years.

Measures

Attitude: Instrumental attitudes were measured using two items; "Being physically active over the next 7 days would be..." 'healthy' and 'important'. The affective component was measured using three items; "Being physically active over the next

7 days would be…" 'enjoyable', 'pleasant' and 'fun'. Each item was anchored by 1 (strongly disagree) and 5 (strongly agree).

Subjective norm: SN was measured using three items. The injunctive component was assessed using 1 item; "Most people who are important to me like family, friends and teachers want me to be physically active over the next 7-days". The descriptive component was assessed using 2-items; "Most people who are important to me like family, friends and teachers will be physically active over the next 7-days" and "Most people like me will be physically active over the next 7-days". Each item was anchored by 1 (strongly disagree) and 5 (strongly agree).

Perceived behavioural control: Perceived controllability was measured using two items; "I am in control over whether I am physically active over the next 7-days", and "It is up to me whether I am physically active over the next 7-days". Each item was anchored by 1 (strongly disagree) and 5 (strongly agree).

Intention: Intention was measured using three items; "I intend to be physically active over the next 7-days", "I will try to be physically active over the next 7-days" and "I plan to be physically active over the next 7-days". Each item was anchored by 1 (strongly disagree) and 5 (strongly agree).

Behaviour: The standard response format for self reported exercise behaviour measurement is the continuous open scale (e.g. 'I engaged in exercise and/or physical activity _X_ amount of times during the last week'), however the TPB uses fixed graded Likert/semantic differential scales; a non-corresponding format (Rhodes, Matheson & Blanchard, 2006). Considering repeated encouragement to ensure scale correspondence (e.g. Courneya 1994), some researchers have chosen to employ single item self-report measures of physical activity behaviour presented in the same format as TPB variables. Although single item measures of behavioural frequency are not uncommon in the literature, they do not have the sophistication of behavioural measures that are often used in the domain of physical activity. Furthermore, to obtain a reliable self-report measure of behaviour it is desirable to use more than one item (Ajzen, 2002b). For these reasons the Physical Activity Questionnaire for Older Children (PAQ-C) (Crocker et al. 1997) was utilized as the behavioural measure in subsequent TPB studies. The PAQ-C is a self-administered,

7-day recall instrument developed to assess general levels of physical activity throughout the school year and is appropriate for students in grades 4 to 8; approximately 8 to 14 years of age. The PAQ-C provides a summary physical activity score derived from nine items, each scored on a 5-point scale. The psychometric properties of the PAQ-C are examined in chapter 11. The full TPB questionnaire can been seen in Appendix 1.

Procedure

All study procedures and related documents were approved by a University ethics committee. Letters explaining the study were sent to parents and guardians and informed consent was obtained. Letters informed parents of their right to with draw their child or their child's data from study at any time. The letter also ensured confidentiality and anonymity of individual results.

The pilot test was conducted in quiet classroom conditions in the presence of class teachers. The target behaviour - moderate to vigorous physical activity (MVPA), was defined for the participants as "sports or dance that make you sweat or make your legs feel tired or games that make you breathe hard like tag, skipping, running, climbing and others" (Crocker et al. 1997). Participants were then asked to provide their own examples of MVPA to the class to ensure that they had understood. Because of the large variation in student reading levels and high Flesch-Kincaid readability score the questionnaire was read aloud. A whiteboard/over head projector was also used; this ensured that each question was properly explained, read and completed before students moved on to the next question. An assistant was also on hand to help individual students if required.

10.5   Results

Of the 105 participants surveyed, 6 indicated that they suffered health problems which prevented them from participating in 'normal' physical activities. A further 3 questionnaires were incomplete, leaving 96 questionnaires eligible for statistical analysis. Forty percent of the sample were 9 years old, 47% were 10 years old and 13% were 11 years old.

Descriptive statistics

Descriptive statistics can be seen in table 10.1. The direction of the items scales meant that a high score could be interpreted as a positive belief. Nearly all of the questionnaire items had mean scores above 4 suggesting favourable cognitions towards physical activity. Only half of the questionnaire items demonstrated the full range of possible responses.

Indices of normality revealed that items were substantially negatively skewed and that there were several extreme scores. In order to improve the normality of the items distributions and to pull outliers closer to the centre of the range log transformations were performed on the data.

Table 10.1 Descriptive statistics for TPB items

Scale/Item	Range	Mean	SD	Skew
Attitude (5)				
Healthy	4 - 5	4.88	0.33	-2.30
Enjoyable	2 - 5	4.66	0.56	-1.76
Pleasant	2 - 5	4.50	0.68	-1.23
Fun	1 - 5	4.71	0.60	-3.14
Important	3 - 5	4.61	0.62	-1.39
SN (3)				
Want	1 - 5	4.27	0.76	-1.09
Like me	2 - 5	4.32	0.70	-0.73
Will	1 - 5	3.90	1.02	-0.88
PBC (2)				
Control	1 - 5	4.58	0.75	-2.21
Up to me	1 - 5	4.61	0.72	-2.43
Intention (3)				
Intend	1 - 5	4.58	0.72	-2.11
Try	3 - 5	4.64	0.53	-1.01
Plan	1 - 5	4.50	0.82	-1.87

N = 96

Internal reliability

Composite reliability coefficients were examined using Coefficient alpha. Coefficient alphas were 0.78, 0.68, 0.64 and 0.78 for attitude, SN, PBC and intention respectively.

Convergent and discriminant validity

Inter-item correlations for the TPB variables can be seen in table 10.5. Convergent correlations are highlighted in bold. All convergent correlations were significant (P< 0.05) and ranged between .23 - .63 for attitude, .37 - .45 for SN, .47 for PBC and .45 - .64 for intention. The item scale relationship was explored via corrected item total correlations. According to field (2005) corrected item total correlations should exceed 0.30. All corrected item total correlations met this criterion (see table 10.2).

Table 10.2 Corrected item total correlations

Scale	Item	Corrected item total correlation
Attitude	Healthy	0.40
	Enjoyable	0.67
	Pleasant	0.57
	Fun	0.62
	Important	0.57
SN	Want	0.48
	Like me	0.53
	Will	0.48
PBC	Control	0.47
	Up to me	0.47
Intention	Intend	0.64
	Try	0.53
	Plan	0.68

N = 96

Weak inter-item correlations , i.e. < 0.30, between the instrumental and affective items (e.g. 'healthy' and 'enjoyable' - .26, 'healthy' and 'pleasant' - .23, 'healthy' and 'fun' - .33 and 'important' and 'fun' - .37) may suggest that attitude is most effectively modelled according to its differentiated components. To this end an EFA employing principle components analysis with varimax rotation was conducted to examine the factor structure of the attitude construct. Results of the EFA suggested the existence of one factor with an eigenvalue greater than 1, which accounted for 54.56% of the variance. All items on this factor loaded > 0.50 (see table 10.3).

From this pattern of association we can see that in this instance attitude is best modelled as a unitary factor.

Table 10.3 Results of the exploratory factor analysis

Item	Factor loading
Healthy	.59
Enjoyable	.84
Pleasant	.77
Fun	.79
Important	.69

Inter scale correlations can be seen in table 10.4. Although attitude, SN and PBC are conceptually independent predictors of intentions they are sometimes found to correlate with each other because they may be based in part on the same information (Ajzen & Fishbein, 2005). The correlation between attitude and SN was .55, attitude and PBC .05 and between SN and PBC .14. Table x also shows that attitude (r = .63) and SN (r = .59) were significantly correlated with physical activity intentions (P < 0.01), whereas PBC was not.

Table 10.4 Inter-scale correlations for TPB variables

	Attitude	SN	PBC	Intention
Attitude	1.00			
SN	.55**	1.00		
PBC	.05	.14	1.00	
Intention	.63**	.59**	.10	1.00

** Correlation is significant at the 0.01 level (1 tailed)

In showing that two scales measure different constructs, it is necessary to correct for attenuation in the correlation due to measurement error. It is possible to calculate the extent to which the two scales overlap by using the following formula;

$$\overline{\overline{}}$$

is the correlation between x and y,   is the reliability of x, and   is the reliability of y.

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Although there is no standard value for discriminant validity, Kenny (1998) suggests that a value greater than 0.85 is indicative of poor discriminant validity. The corrected correlation between attitude and SN was 0.75, attitude and PBC 0.10, attitude and intention 0.79, SN and PBC 0.21, SN and Intention 0.81 and PBC and intention 0.14. Since none of the values exceeded 0.85, we can conclude that discriminant validity exists between the composite measures. In demonstrating evidence for both convergent and discriminant validity evidence for construct validity has also been demonstrated.

Table 10.5 Inter-item correlations for TPB items

	Healthy	Enjoyable	Pleasant	Fun	Imp	Want	Like	Will	Control	Up to	Intend	Try	Plan
Healthy	1.00												
Enjoyable	.26*	1.00											
Pleasant	.23*	.63**	1.00										
Fun	.33**	.56**	.44**	1.00									
Important	.46**	.44**	.37**	.49**	1.00								
Want	.33**	.46**	.35**	.39**	.51**	1.00							
Like	.24*	.41**	.35**	.44**	.24*	.45**	1.00						
Will	.01	.25*	.32**	.23*	.20	.37**	.44**	1.00					
Control	.01	-.06	-.06	.03	-.04	-.09	.10	.18	1.00				
Up to me	-.06	.18	.09	.12	.13	.03	.08	.23*	.47**	1.00.			
Intend	.28**	.33**	.44**	.49**	.24*	.51**	.50**	.21*	.18	.09	1.00		
Try	.05	.37**	.40**	.38**	.32**	.47**	.42**	.24*	-.12	.06	.45**	1.00	
Plan	.27**	.56**	.40**	.61**	.42**	.48**	.46**	.25*	.11	.07	.64**	.51**	1.00

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

10.6 Discussion

The aim of the present study was to develop a brief measure of the TPB to assess physical activity cognitions in children aged 9 -11 years. Several analyses suggested that the questionnaire had acceptable measurement properties in this group, however several limitations should be considered. First, TPB questionnaires tapping socially desirable behaviours such as physical activity often produce high mean scores and standard deviations less than 1.0; the present study was no exception. Such skewed distributions and reduced variability may reduce the predictive power of the TPB (Ajzen, 1991).

According to Courneya, Conner and Rhodes (2006) there are at least two possible solutions to the problem of limited variability for highly desirable health behaviours. First, it may be that the 5-point scale does not provide enough response options on the positive side of the scale and thus one solution may is to use a 7/11 point scale that spreads out the 'agreement' descriptors among the extra points. They also suggest that the verbal descriptor 'strongly agree' might not be sufficiently strong enough to capture the most positive beliefs about a desirable health behaviour such as physical activity. Therefore it may be necessary to provide an even stronger verbal descriptor. In practice, most researchers working with the TPB use a 7-point scale, however it is at the researcher's discretion to use fewer or more points and that the decision will often depend on the characteristics of the sample. For example, participant's ability to discriminate meaningfully between response options must be taken into consideration. For instance, Godin and Kok (1996) suggest that if the level of cognitive development is not fully completed (e.g. school children) answers should be recorded on a 5-point or even a 3-point scale. Indeed, previous studies have found that children do not take well to 7-point response options, e.g. Rhodes et al. (2006). Thus, spreading out the agreement descriptors among extra points does not appear to be a viable solution in this instance. Also, because of the large variation in student reading levels and slightly higher than desired Flesch-Kincaid readability score it was difficult to change the verbal descriptors without sacrificing questionnaire readability and comprehension.

Second, internal consistency was measured using Cronbach's alpha. It is generally agreed that for a measure to be considered reliable Cronbach's alpha should be above .70 (Tabachnick & Fidell, 2001). However one of the problems with using this method to assess internal consistency is that the reliability coefficient will depend on the number of items in the scale, i.e. α will increase as the number of items increase. Internal reliability coefficients in the present study ranged from .64 for PBC (2-items) to .78 for both attitude (5-items) and intention (3-items). The reliability coefficient for SN was .68 (2-items). While shorter scales are usually recommended (especially for use with children) because they place less burden on respondents (DeVellis, 1991), longer scales are generally more reliable.

Measures of SN in particular, have typically been criticized in meta-analytic reviews for their poor reliability and lack of prediction, perhaps because they tap non-salient social influences (Armitage & Conner, 2001; Hagger et al., 2002). Hagger et al. (2007) suggest that such inadequacies may occur at the conceptual level, i.e. reflecting the multi-dimensional nature of the construct. The internal reliability of PBC items has also frequently been found to be low (e.g. Ajzen, 2002c; Sparks, 1994).

Third, convergent validity can be established by demonstrating that different items measuring the same construct correlate with each other; in this respect convergent validity and reliability merge as concepts. Examination of the correlation matrix revealed that all inter-item correlations were significant and sufficiently large, i.e. > 0.30, except for associations between the 'healthy' and 'enjoyable' (r = .26*) and 'healthy' and 'pleasant' (r = .23*) items. Corrected item total correlations also exceed the recommended 0.30.

In addition to concerns over the effects of restricted range, weak inter-item correlations between instrumental and affective items may reflect the multi-dimensional nature of the attitude construct. For example, there is no necessary association between how healthy a behaviour is perceived to be (instrumental attitude) and how much enjoyment the participant experiences when performing it (affective/experiential attitude). To this end an EFA was conducted in order to determine the factor structure of the attitude construct, i.e. whether the construct

was most effectively modelled by its differentiated components or as a single unitary factor. Results of the EFA suggested the existence of one factor with loadings > 0.50. From this pattern of association we can conclude that a global unitary factor provides an acceptable representation of the differentiated attitude components.

Conclusion

Irrespective of the limitations noted above, the TPB questionnaire has demonstrated acceptable measurement properties as a means of assessing physical activity cognitions in children. As a result the questionnaire is ready for application in the field.

Chapter 11

Psychometric evaluation of the PAQ-C

"Accurate and reliable measurement of physical activity levels in children is an important part of health promotion research and evaluation. Optimal measurement underpins all of the major evidence base for, and the practice of, health promotion"
(Sallis & Owen, 1999).

11.1   Abstract

Objective: Chapter 10 described the development and validation of a brief TPB questionnaire to assess physical activity cognitions in children. In this chapter the psychometric properties of the Physical Activity Questionnaire for Older Children (PAQ-C) (Crocker et al., 1997) will be examined with a view to utilizing the questionnaire as the behavioural measure in subsequent studies.

Method: One hundred and seven pupils were recruited from a primary school in the West Midlands. Participants were recruited using an opportunity sample and consisted of both males and females aged 9 – 11 years. In order to assess clarity of wording and comprehensibility of the PAQ-C a small focus group was conducted. Based on feedback from participants several minor modifications were made. The modified questionnaire was then tested for validity and reliability.

Results: Results indicated that the PAQ-C had acceptable item and test score characteristics, such as item distribution, item total correlations (> 0.30) and internal consistency (α = 0.81). Two week test-re-test reliability was also acceptable (r = 0.70). Exploratory factor analysis suggested the existence of 3 distinct factors which appear to be sensitive to the context in which the activity is performed. Results of a second order factor analysis suggested that the different dimensions emerging from the first order factor analysis could be represented by a higher order factor; total physical activity.

Conclusion: The results provide strong support concerning the reliability of the PAQ-C. Nevertheless, children's physical activity is a complex multi-dimensional construct, and further research examining the factor structure of the questionnaire in British Youth is recommended.

11.2 Introduction

Physical activity is a complex behavioural category that involves a variety of actions including transport related behaviours, work related activities, leisure time activities and sport participation. Because physical activity is a behavioural category which can be inferred from the assessment of single actions, self-report instruments are typically complex. The advantage of self-report questionnaires is that they are practical, economical and allow the researcher to test large numbers of participants in a relatively short space of time. Contextual prompts and items that query for location and/or purpose also improve the quality of data and provide important dimensions of physical activity not easily captured using objective measures such as heart rate monitors and accelerometers (Matthews, 2002). There are however concerns regarding the use of self-report instruments particularly in children because of the difficulty they have in correctly interpreting questions and accurately recalling activity (Janz, Lutuchy, Wenthe & Levy, 2008). For instance, children's activity is generally sporadic (Baquet, Stratton, van Praagh & Berthoin, 2007) and thus may not be memorable in terms of frequency duration and intensity, which is the type of information that self-report questionnaires commonly ask for (Hussey et al., 2007). For example, Sallis et al. (1996) found that children could not accurately recall minutes of activity as compared with heart rate monitors, despite a recall period of only one day. For this reason physical activity questionnaires for use with children need to be designed in such a way that the impact of cognitive, memory and estimation skills is reduced to an acceptable minimum (Kremers, et al., 2005).

Because of the diversity in available questionnaires, it is not easy for researchers to decide which instrument is most suitable for his or her specific demands (Chinapaw, Makkink, van Popper, van Mechelen & Terwee, 2010). What's more many self-report measures demonstrate poor psychometric properties and lack sufficient validation (Crocker et al., 1997; Moore et al., 2007). To this end a number

of reviews (e.g. Biddle, Gorely, Pearson & Bull, 2011; Chinapaw et al., 2010; Tessier, Vuillemin & Briançon, 2008; Corder, Ekelund, Steele, Wareham & Brage, 2008; Sirard & Pate, 2001; Welk et al., 2000; Welk & Wood, 2000) have been conducted attempting to select, synthesize and appraise available evidence concerning the general characteristics and psychometric properties of physical activity questionnaires. In one review Chinapaw et al. (2010) systematically summarized and appraised 61 versions of self-administered and proxy-reported physical activity questionnaires in youth and found that none of those included demonstrated reliability, validity and responsiveness. They did however suggest that the most promising methods of physical activity assessment in children were; the Physical Activity Questionnaire for Older Children (PAQ-C), Girls Health Enrichment Multisite Study Activity Questionnaire (GAQ), Children's Leisure Time Activities Study Survey (CLASS), Physical Activity Questionnaire for Parents and Teachers, the Assessment of Young Children's Activity Using Video Technology (ACTIVITY) and the Computerised Physical Activity Recall (CPAR). They concluded that considerably more high-quality research is required to improve and evaluate the psychometric properties of physical activity questionnaires for youth.

In another study, Tessier et al. (2008) reviewed 30, primarily self-administered physical activity questionnaires in order to assess their suitability for use with children and adolescents in France. Researchers reported that most of the proposed questionnaires were written and validated in English; in fact the review failed to identify any questionnaires validated in French. Nonetheless, the best psychometric properties were found for the PAQ-C, the Previous Day Physical activity Recall (PDPAR), the Physical Activity Questionnaire for Adolescents (PAQ-A) and the Modified Activity Questionnaire for Adolescents (MAQA). Researchers concluded that when measuring physical activity via self report priority should be given to those instruments demonstrating superior validity and reliability. They further concluded that cultural adaptation and examination of the psychometric properties of these culturally adapted measures is essential.

Recently, Biddle et al. (2011) reviewed available self-report physical activity instruments developed for use with children and adolescents to assess their

suitability and feasibility for use in population surveillance systems, particularly in Europe. Systematic searches were conducted which uncovered a total of 89 physical activity measures, 20 of which received a detailed assessment by an expert panel. Three physical activity measures received support from the majority of expert panel members; PAQ-C/PAQ-A, Youth Risk Behaviour Surveillance Survey and the Teen Health Survey. Nonetheless, researchers concluded that further development and testing of measures in young people is required.

One potentially valuable instrument identified in the Tessier et al (2008); Chinapaw et al. (2010) and Biddle et al. (2011) studies was the PAQ-C (Crocker, et al., 1997). The PAQ-C is a self-administered 7 day recall questionnaire designed to assess MVPA in children aged 8 - 14 years. The purpose of the PAQ-C is to provide a general indication of children's physical activity levels. It consists of ten items, nine of which are used to calculate a summary of activity scores. The other question assesses whether sickness or other events prevented the child from doing his/her regular activity in the last week. The first question in the PAQ-C is an activity checklist consisting of 22 common activities plus two blank spaces for 'other' physical activities. This question is scored as the mean of all activities using a 5-point scale, with higher scores indicating higher levels of activity. The primary purpose of this question is to aid memory recall through the use of memory cues. The remaining eight items are organized using a segmented time-of-day or day-of-the-week strategy. These items are also scored using a 5-point scale with higher scores indicating higher levels of activity. The summary score for the PAQ-C is the mean of the nine items.

So far the psychometric properties of the PAQ-C have been tested in largely white Canadian samples. In this group, the PAQ-C has demonstrated good internal consistency, test re-test reliability and sensitivity to detect gender differences (Crocker et al., 1997; Kowalski, Crocker & Faulkner, 1997). It has also been shown to converge with teachers ratings of children's physical activity (r = .45), the Godin and Shephard (1985) Leisure Time Exercise Questionnaire (r = .41), the 7-Day Physical Activity Recall Interview (r = .46, .43), physical activity measured via accelerometry (r = .39) and more (Kowalski et al., 1997).

Recently, Moore et al. (2007) examined the psychometric properties of the PAQ-C in a cohort of 10 year old children from the U.S. The sample varied with respect to race and ethnicity with sample sizes large enough to examine differences between African American, European American and Hispanic children. Study one sought to determine the factor structure of the PAQ-C in a predominantly Hispanic sample, (82% Hispanic). Both exploratory and confirmatory factor analyses (CFA) suggested a two-factor model. The items loading on factor 1 described physical activity conducted almost exclusively away from the school setting, while the items loading on factor two asked about physical activity during P.E or at recess. This is in contrast to results reported by Janz et al. (2008) who examined the psychometric properties of the PAQ-C in a sample of children from the Midwest (Iowa, U.S) and found that a one factor solution was most appropriate. Nonetheless, all most all of the children in this study were white (98%) and of a relatively high socio-economic status. In study 2, Moore et al. reported significant associations between the PAQ-C and systolic blood pressure, cardiovascular fitness and BMI in European American children. However these markers of physical fitness were not significantly associated with the PAQ-C in African American and Hispanic children (although the PAQ-C did show a small significant association with percentage body fat in Hispanic children). Taken together the results suggest that both the factor structure and concurrent-construct validity of the PAQ-C may vary by race. Thus modifications might be necessary before it becomes an appropriate measure of physical activity in children from diverse racial groups.

11.3 Aims and objectives

Evidently, there is need for a psychometrically sound self-report instrument that can be used in large scale physical activity research with children. One potentially valuable instrument that has been identified for this purpose is the PAQ-C. With the exception of Moore et al. (2007), the PAQ-C has previously been validated in white Canadian samples; thus further research is required in order to assess its suitability for use in a wide range of races and cultures. Therefore, the aim of this study was to examine the psychometric properties of the PAQ-C in a cohort of children aged 9 -11 years from the West Midlands, with a view to utilizing the questionnaire as the behavioural measure in subsequent studies.

In order to achieve the aims set out above, the specific objectives of this study are:

1. Examine general test score characteristics and item properties of the PAQ-C via descriptive statistics.
2. Examine the item/scale relationship via corrected item-total correlations and Coefficient alpha.
3. Examine the factor structure of the PAQ-C using an EFA.
4. Assess two-week test re-test reliability using Pearson's *r.*

11.4 Method

Participants

One hundred and seven pupils were recruited from a primary school in the West Midlands. Participants were recruited using an opportunity sample and consisted of both males and females aged 9 – 11 years. School statistics indicated that the majority of pupils were of White British ethnicity. The ACORN population profile for this school was 3/H/29, suggesting that the catchment area primarily consisted of secure families, who are comfortably off, living in suburban semis.

Measures

PAQ-C: Physical activity was measured using the PAQ-C. In order to assess clarity of wording and comprehensibility a small focus group was conducted (N = 10). Based on feedback from participants several minor modifications were made, most involving item wording (e.g. changing the word recess to break time) or cultural adaptations to the activities listed in the physical activity checklist (e.g. soccer was changed to football). The Flesch-Kincaid readability score for the final questionnaire (which can be seen in Appendix 2) was 5.5, indicating that it could be understood by an average pupil in the 5th grade (U.S grade level), or in the United Kingdom, a child aged 10 years.

Procedure

All study procedures and related documents were approved by a University ethics committee. Letters explaining the study were sent to parents and guardians and informed consent was obtained. Letters informed parents of their right to with draw

their child or their child's data from study at any time. The letter also ensured confidentiality and anonymity of individual results.

The PAQ-C was administered twice (two weeks apart) to pupils during school time in the autumn term. Each class was assessed separately in the presence of class teachers. Class sizes ranged from 20 to 30 pupils. Pupil assent was obtained verbally, immediately prior to the study.

The target behaviour MVPA was defined for participants as "Sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard like tag, skipping, running, climbing and others" (Crocker et al., 1997). Participants were then asked to provide their own examples of MVPA to the class to ensure that they understood. The questionnaire was read aloud. A whiteboard and overhead projector was also used; this ensured that each item was properly explained, read and completed before students moved on to the next question. A research assistant was on hand to support pupils and facilitate questionnaire administration. The questionnaire took approximately 20 minutes to complete.

11.5   Results

Of the 107 participants surveyed, 12 indicated that sickness or other events during the previous week prevented them from doing their regular physical activity. A further two questionnaires were incomplete, leaving 93 questionnaires eligible for statistical analysis. The final sample consisted of 54 males and 39 females with a mean age of 9.73 (SD – 0.68). Forty percent of the sample were 9 years old, 47% of the sample were 10 years old and 13% of the sample were 11 years old.

Descriptive statistics

Descriptive statistics for the PAQ-C items and overall score can be seen in table 11.1. Each item was scored on a five point scale with higher values indicating higher activity. Most of the items had means close to the centre of the range and demonstrated adequate variability. The checklist had a relatively low mean and variance mostly because of the large number of activities in the checklist that individuals had not participated in. However this item plays the important function

of enhancing memory recall by cueing specific physical activities. The overall score had an acceptable mean but low variance.

Indices of normality revealed a small number of extreme scores on the checklist, PE and break time items. In order to pull outliers closer to the centre of the range, outlying cases were assigned a score one unit larger or smaller than the next highest or lowest (non-outlying) score in the data set.

Table 11.1 Descriptive statistics for the PAQ-C

Item	Range	Mean	SD
Checklist	1.14 – 3.29	1.98	0.46
PE Class	2 - 5	4.13	0.77
Break	1 - 5	4.32	0.96
Lunch	1 - 5	3.96	1.41
After school	1 - 5	3.40	1.48
Evenings	1 - 5	3.23	1.32
Weekends	1 - 5	3.67	1.12
Describes best	1 - 5	3.68	1.16
Week summary	1.40 – 5.00	3.48	0.97
PAQ-C	2.07 – 4.75	3.54	0.70

N = 93

Corrected item total correlations and coefficient alpha

The item/scale relationship was evaluated by examining corrected item total correlations. According to Field (2005) corrected item total correlations should exceed 0.30. All corrected item total correlations met this criterion (see table 3.2.2). Internal consistency was examined using coefficient alpha. Scale reliability was acceptable (coefficient alpha = 0.81). Taken together, the findings provide good evidence that the PAQ-C has acceptable item/scale properties in this population.

Table 11.2. Corrected item total correlations for PAQ-C

Item	Corrected item total correlation
Checklist	.31
PE Class	.34
Break	.52
Lunch	.49
After school	.43
Evenings	.56
Weekends	.68
Describes best	.65
Week summary	.67

Exploratory factor analysis

In order to establish the construct validity of the PAQ-C an exploratory factor analysis (EFA) employing principle components extraction and varimax rotation was performed on the data. Results of the EFA suggested the existence of three distinct factors with eigenvalues greater than 1. Cumulatively they accounted for 68.59% of the variance. Items were retained if they had a factor loading > 0.40. The first factor, which accounted for 41.80% of the variance, had an eigenvalue of 3.76 and consisted of 6 items with factor loadings ranging from 0.47 – 0.77. The second factor, which accounted for 14.06% of the variance had an eigenvalue of 1.27 and consisted of 2 items with factor loadings of 0.87 and 0.88. The third factor, which accounted for 12.74% of the variance, had an eigenvalue of 1.15 and consisted of 3 items with factor loadings ranging from 0.57 – 0.84 (see table 11.3).

Table 11.3 Results of the exploratory factor analysis

Item	Factor 1	Factor 2	Factor 3
Checklist	0.64		
PE Class			0.84
Break		0.87	
Lunch		0.88	
After school	0.77		
Evenings	0.61		
Weekends	0.73		
Describes best	0.50		0.65
Week summary	0.47		0.57

* Coefficients < 0.40 are suppressed.

Second order factor analysis

Physical activity is a multi-dimensional construct (Miles, 2007) and the different factors that emerge from the EFA may be indicators of a higher order factor, i.e. total activity. If these factors do measure one overarching concept they could be expected to converge conceptually and statistically into a higher order construct. One way to assess this is through a second order factor analysis. This procedure assesses the common variance shared by the first order factors, obtained in the initial factor analysis. First, the values of the items within the first order factors were summed and divided by the number of items that loaded onto that factor. This gave an overall sub-scale score. Next a second order factor analysis employing principle components extraction and varimax rotation was performed on the data. Results revealed the presence of one factor with an Eigen value greater than 1, explaining 51% of the variance. See table 11.4 for individual factor loadings.

Table **11.4** Results of the second order factor analysis

First order factor	Second order factor loading
Factor 1	.78
Factor 2	.75
Factor 3	.60

Test re-test reliability

Of the 93 participants eligible for analysis from the first wave, 24 were absent, 4 reported unusual physical activity during the previous week and 1 had missing data. 29 Participants were therefore dropped from further analysis leaving a final sample at time two (T2) of 71 (45 male and 26 female). Two week test re-test reliability of the PAQ-C using Pearson's r was 0.70, P < 0.001.

11.6   Discussion

This study sought to determine the psychometric properties of the PAQ-C in a cohort of children from the West Midlands. Several analyses suggested that the PAQ-C had acceptable measurement properties in this group. This evidence included general

test score characteristics; corrected item total correlations, coefficient alpha and two week test re-test reliability.

Most of the questionnaire items had means close to the centre of the range and demonstrated adequate variability, one exception was the physical activity checklist; this was attributed to the large number of activities that individuals had not participated in. Low variability be responsible for this items reluctance to correlate with other items on the scale (see corrected item total correlation in table 11.2). This finding (i.e. restriction of range) is not uncommon in the literature; Indeed Janz et al. (2008) suggest rescaling this item to reflect a range consistent with the other items in the questionnaire.

Ceiling effects were observed on both the PE class and break time items. This may reflect social desirability in responding, especially considering that the questionnaire was completed in the school setting. Whilst ceiling effects may not be too problematic in discriminatory studies this has greater implications for intervention research. For example, children with high scores may have a substantial improvement in their MVPA which cannot be detected. Consequently, the questionnaire could be improved by modifying/rescaling these items.

The construct validity of the PAQ-C was examined using an EFA. Construct validity refers to the extent to which an instrument is a good representation of the construct being evaluated. The grouping of items which emerge from a factor analysis is taken as a working reference frame for a measure's domains. In essence then, the preferred construct will be the one which best fits with the initial theoretical model. Results of the EFA suggested the existence of three distinct factors. The items loading on factor 1 describe physical activity conducted away from the school setting (e.g. right after school, on the last weekend). The other items on factor 1 are more general asking about physical activity during the respondent's free time or for each day last week. The items on factor 2 describe physical activity during break time or at lunch. The item referring to physical activity during P.E did not load, as one might expect, on factor 1 with the other 'in school items', but formed a third factor with two high cross loading items from factor 1; the describes best and week summary items.

The findings of the EFA highlight many of the difficulties of assessing physical activity in children via self report. With open ended questionnaires, accurate recall in primary school children becomes questionable. With structured questionnaires such as the PAQ-C the choice of questions relative to contextual factors, (e.g. at school at home, in P.E) and psychometric concerns can become problematic (Moore et al., 2007).

The findings of the EFA are consistent with Moore et al. (2007), in that the PAQ-C appears to be sensitive to the context in which the activity is performed, i.e. "in school", "outside of school" and perhaps "structured". The results are also consistent with both the environmental and ecological perspectives discussed earlier, which suggest that physical activity may be tied to the setting or context in which it takes place.

Physical activity is a multi-dimensional construct (Miles, 2007). With this in mind the different dimensions emerging from the EFA are likely indicators of a higher order factor, i.e. total physical activity. Indeed, a second order factor analysis demonstrated that the first order factors could be represented by a second, higher order factor, presumably total physical activity. Nonetheless, Chinapaw et al. (2010) recently suggested that the construct 'physical activity' should be represented as a formative model, i.e. questionnaire items need not be highly correlated. If this is correct, factor analytic procedures may not be an appropriate method of assessing the validity of physical activity questionnaires.

The separate factors resulting from the EFA, if validated as such, may provide additional information on physical activity patterns and/or levels within specific behaviour settings. This is important as it permits the estimation of the relative contribution of MVPA in a particular domain to total MVPA, not to mention the possibility of examining inter-domain MVPA relationships. According to Shepard (2003) no existing questionnaire explores the type of environment in which the individual normally undertakes physical activity. However the type of environment has particular importance in the context of motivation and habit. Indeed, providing information on the environmental setting is becoming increasingly important in physical activity research.

Aside from the methodological limitations of the present study, the PAQ-C has some definite drawbacks. First, the sporadic short-burst nature of children's physical activity makes it difficult to capture via self-report methods; the PAQ-C is not immune to this and may therefore provide an underestimate of children's true activity levels. Second, the PAQ-C was developed to assess general levels of physical activity; it does not provide frequency and time information. As a result recommended physical activity levels are not represented in the PAQ-C scores. Nevertheless, children generally have difficulty when recalling the frequency and/or duration of activities, and this has been well documented (Hussey et al., 2007). According to Welk, et al. (2000), the PAQ-C's general measurement is beneficial for studies that do not need estimates of time or frequency. Finally, the PAQ-C cannot discriminate between moderate and vigorous activity and cannot assess physical activity during school holidays.

Conclusion

In conclusion, the PAQ-C is an acceptable method for assessing general levels of MVPA in British children aged 9 – 11 years. This is evidenced by the high response rate, relatively low levels of missing data and acceptable Flesch-Kincaid readability score. What's more its ease of use and efficient format makes it a feasible option for large studies and/or when time, money and manpower are limited. The findings of this study provide strong support concerning the reliability of the PAQ-C in this group. However, physical activity is a complex heterogeneous construct, and further research examining the validity of the questionnaire in British Youth is recommended. The next chapter describes a study which utilises the PAQ-C to explore the impact of psychosocial and perceived environmental factors on children's physical activity.

Chapter 12

Habit, cognition and the environment in the prediction of MVPA in children

"Cognition reigns but does not rule" (Paul Valéry 1871 - 1945)

12.1 Abstract

Objectives: Chapters 10 and 11 described the development and/or evaluation of measures to assess physical activity cognitions and MVPA in children. This chapter describes a study which utilizes these measures to delineate the mechanisms linking the environment and MVPA in children. The introduction provides a brief reminder of chapters 2 – 6 and introduces a new ecological model which integrates the environment with psychosocial factors by linking the ANGELO framework and the TPB. This model provides the theoretical basis from which the study hypotheses are derived. Specifically this study sought to determine whether associations between perceived access to convenient facilities and physical activity resources in the home and school environment and MVPA are mediated by the TPB and/or by habit strength.

Method: Six hundred and twenty one pupils aged 9 - 11 years were recruited from 4 primary schools in the UK. TPB variables, access to convenient facilities and resources in the home and school environment and habit strength were assessed at baseline. MVPA was assessed one week later.

Results: Access to physical activity resources in the home environment and convenient facilities held a significant positive effect on MVPA. Convenient facilities also held a small significant effect on physical activity intentions. Mediation tests revealed that 43% of the association between convenient facilities and intention was mediated through SNs (16%) and habit (26%), while 15% of the association between convenient facilities and MVPA was mediated through habit strength alone. There was no significant direct effect of convenient facilities on intention;

however there was a small significant direct effect of both convenient facilities and the home environment on MVPA.

Conclusion: The results suggest that environmental access to physical activity influences MVPA both directly and indirectly and that habit strength seems to be the most important mediator for this association.

12.2 Introduction

Physical inactivity among children and adolescents is a growing public health concern. Its increasing prevalence and associated health risks underline the need to develop interventions that are aimed at increasing this behaviour. In order to influence physical activity we need to gain insight into the important modifiable determinants of this behaviour. To this end, SCMs, especially the TPB have been widely used to explain and predict physical activity, however this approach has been criticised because it places undue emphasis on the individual (Giles-Corti & Donovan, 2002) and has led to a strong focus on cognitive determinants such as attitudes, perceived control and motivation (Brug et al., 2006). A further criticism of the TPB is its inability to account for repetitive or habitual behaviours (see section 4.4).

In recent years environmental determinants of physical activity have received growing attention in the literature. A focus on these broader determinants of behaviour is consistent with an ecological perspective. Ecological models are comprehensive, multifaceted health promotion models which include the components of health behaviour theories and place them within the context of the environment. Ecologic models emphasize the multilevel linkages and relationships among these factors and are well suited to guide environmental and policy research and intervention efforts. However, several researchers note the lack of strong and well-conceptualized theoretical models for testing the interactions among individual and environmental factors. For example, Baranowski et al. (2003) argue that more conceptually refined [behaviour specific] models of how environments affect behaviour are necessary, such as whether they affect behaviour directly or through mediating variables.

In line with this call for an increased focus on the mechanisms that link specific environmental features and behaviour, Kremers and colleagues (2006) developed the Environmental research framework for weight gain prevention (EnRG framework) (see figure 12.1). The EnRG framework integrates potential environmental determinants of energy balance related behaviours (EBRBs) (i.e. nutrition and physical activity) with cognitive factors by linking the ANGELO framework (Swinburn et al., 1999) and the TPB and describes the hypothetical mediating and moderating pathways between them (Kremers et al., 2006). In this way the EnRG framework generates questions related to *when, how* and *for whom* environmental factors may be influential. To this end the model builds on recent reviews that have shown a lack of consistent results relating to the impact of environmental factors on physical activity behaviour (see section 5.4).

For example, some studies examining environmental facilitators of youth physical activity suggest that children who have access to an abundance of physical activity supports are in turn more active (e.g. Sallis et al., 2000; Gordon-Larson et al., 2000; Duncan, Duncan, Strycker & Chaumeton, 2004; Davison & Lawson, 2006; Norman et al., 2006); other studies however show that access has little or no relationship with youth physical activity (e.g. Ferreria et al., 2006; Erwin, Mays Woods, Woods & Castelli, 2007). The notion that environmental access is not significantly related to physical activity suggests that participants may not use items to which they have access. That said, the few studies that have explored facility accessibility and utilization generally report positive associations, the strength and significance of which have been found to vary according to facility type (Jones & Panter, 2010). However, another plausible explanation for why some studies fail to find strong associations between environmental variables and physical activity maybe mediation by social cognitions (de Bruijn et al., 2006).

According to the EnRG framework environmental influences are hypothesized to influence EBRB's both directly and indirectly reflecting the automatic, unconscious influence of the environment and the mediating role of behaviour specific cognitions. For example, potentially important environmental factors such as accessibility may result in increased behavioural control which in turn may enhance physical activity. The notion that behaviour is the result of a simultaneous influence

of conscious and non-conscious processes represents a dual process approach (Kremers, et al., 2006). Dual process models conceive information processing as happening along a continuum, the anchors of which reflect the duality invoked by these models. On the one hand behaviour can be the result of direct automatic responses to environmental cues, while on the other it can be the result of explicit reasoning. Since it is inefficient to change cognitive factors when specific actions or behaviours are unmediated by cognitions such insights are highly relevant in order to inform intervention development (Kremers, 2006).
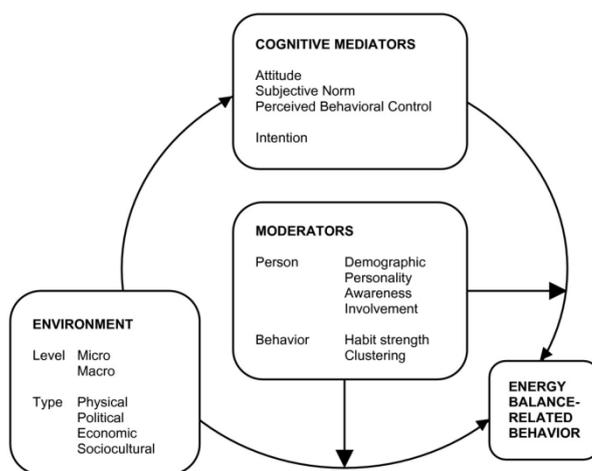
Figure 12.1 Environmental research framework for weight gain prevention (Kremers et al., 2006).

Direct or mediated influences of environments?

According to the TPB environmental factors are antecedents of attitude, SN, PBC and intention and should therefore be mediated by these constructs[5]. For instance, PBC is assumed to reflect the presence of internal and external factors that may facilitate or impede performance of behaviour. PBC should therefore mediate associations between the environment and physical activity. Indeed, a recent study by Lemieux & Godin (2009) found that PBC mediated the effects of car accessibility,

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[5] Any given variable can be said to function as a mediator to the extent that it can account for the relationship between a predictor and a criterion variable. In other words, a mediator explains how or why such effects occur (Baron & Kenny, 1986).

time to access services and time to get to work or school in the prediction of active commuting in a sample of Canadian students. In another study Tak et al. (2010) examined the association between neighbourhood and household environmental variables and fruit consumption and the potentially mediating role of individual cognitions. In this study, researchers found that the impact of home fruit availability on fruit consumption was mediated by attitude and SN. When adolescents have been studied, de Bruijn et al. (2006) found that the TPB mediated the environment physical activity relationship such that distance to physical activity opportunities were associated with physical activity through attitude and PBC, while aesthetics was mediated though attitudes only.

Despite empirical evidence regarding the mediating role of the TPB and in particular PBC, some studies have shown that environmental factors explain additional variance in physical activity over and above the TPB. Independent effects of the environment on physical activity are common in existing TPB and environmental integration research (e.g. de Bruijn et al., 2005, Rhodes et al., 2007; Maddison et al., 2009) and are sometimes explained in terms of methodological flaws (Ajzen & Fishbein, 2001). However, it takes little imagination to appreciate the importance of environmental factors, e.g. accessible recreational facilities, green space, neighbourhood walkability, for the successful execution of physical activity behaviour.

In one study, Rhodes et al. (2007) found that proximity to neighbourhood retail shops (standardised effect - .18) made an additional independent contribution to the prediction of leisure time walking in adults. In another study, de Bruijn et al. (2005) found that urbanisation made an additional contribution to the prediction of cycling as a means of transportation in students; this led researchers to conclude that factors related to the physical environment such as traffic volume and speed might be responsible for this effect. Finally, Maddison et al. (2009) found that home ownership of recreation equipment (standardised effect - .26) made a unique contribution to the prediction of self reported physical activity in adolescents. However, this effect disappeared when physical activity was measured via accelerometry. The reason for this is unclear, but may be because the systematic

bias associated with self-reported ownership is the same associated with self-reported behaviour (Maddison et al., 2009).

Moderators

So, it appears that the TPB does not always take sufficient account of variations in behaviour. To this end, the EnRG framework postulates that the level of cognitive mediation will differ along the lines of person and behaviour related factors. Six factors are specifically proposed by the model: demographic variables, personality, awareness of personal behaviour, involvement, engagement in clustered behaviour and habit strength. According to the model these factors can influence the level of cognitive mediation by moderating[6] either the environment cognition relation (i.e. the extent to which the environment influences attitudes, SNs and PBC) or the cognition behaviour relation (e.g. the extent to which intentions predict behaviour) (Kremers et al., 2006).

Limitations of the EnRG framework

The EnRG provides a comprehensive ecological framework that guides the formulation of hypotheses regarding psychosocial and environmental influences on EBRBs. Rather than focusing on which factors may be important, the EnRG framework generates questions related to *when, how* and *for whom* environmental factors may be influential (Kremers et al. 2006). However, this lack of specificity regarding influential environmental factors can also be considered a limitation of the model.

The EnRG framework postulates that environmental factors have a differential effect on behaviour, depending on the habitual level of the behaviour in question. In other words the EnRG framework uses the concept of habit to explain *when* mediated/unmediated environment – behaviour relationships will occur. However, in view of current theorising concerning habit mechanisms, habit might also explain

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[6] A moderator is a variable that affects the direction and/or strength of the relation between an independent variable and a criterion variable. Where as mediators explain *how* or *why* certain effects come about, moderators specify *when* these effects will occur (Baron & Kenny, 1986).

how or *why* environment – behaviour effects occur. Remember habits are defined as automatic responses to specific cues.

Few studies to date have explored mediation of the environment – behaviour relationship by habit strength, however some evidence for this association has been found. For example, Lemieux and Godin (2009) found that habit strength mediated the effects of the time to get to work or school in the prediction of active commuting, whereas Tak et al. (2010) found that habit strength meditated the effects of home fruit availability on fruit consumption. Recently, Tak et al., (2011) reported a study in which intention and habit strength partially mediated associations between home environmental factors and soft drink consumption in adolescents, suggesting that home environmental variables influence soft drink consumption both directly and indirectly. Whether or not habit strength mediates the environment – MVPA relationship in children is yet to be determined.

Finally, although the EnRG framework guides the formulation of hypotheses in specific studies, no single analysis can fully apply or test it. Integration of results from multiple types of research is needed to answer the hypotheses derived from the framework (Kremers, et al., 2006).

12.3   Aims and objectives

The key behavioural settings for children and youth are the home, school and community (Koplan, Liverman & Kraak, 2005). However, studies that explore mediating pathways between these environmental settings and MVPA are largely lacking (Brug et al., 2010). It is important to investigate such associations in order to develop well planned interventions to encourage physical activity. Therefore the main aims of this study were to;

1. Examine associations between access to convenient facilities, and physical activity resources in the home and school environment, and MVPA in children.
2. Examine whether associations between access to convenient facilities and resources in the home and school environment and MVPA are mediated by the TPB and/or by habit strength.

In order to achieve the aims set out above, the specific objectives of this study are:

1. Examine the reliability and factor structure of the SRBAI (Gardner & Abraham, 2009) in children.
2. Examine associations between habit, cognition, perceived access to convenient facilities and resources in the home and school environment and MVPA in children
3. Examine whether associations between perceived access to convenient facilities and resources in the home and school environment and MVPA are mediated by the TPB and/or by habit strength.

While mediation of the environment – behaviour relationship by the TPB and/or by habit strength has been explored in relation to active commuting, fruit consumption and soft drink consumption in both adults and adolescents, it has not previously been explored in relation to MVPA in children.

12.4   Hypotheses

Habits are conceived as behavioural responses brought on by environmental cues. They are also conceptualised as occurring from behaviours with strong reinforcing properties and ease of access (Verplanken & Aarts, 1999). Thus in line with the EnRG framework (Kremers et al., 2006), Verplanken and Aarts (1999) and previous research utilizing the TPB, it was hypothesized that the environment – MVPA relationship would be partially mediated by the TPB and habit strength, but that there will also be a significant direct effect of the environment on behaviour (see figure 12.2).

H_1 – Access to convenient facilities and resources in the home and school environment, will be significantly positively related to MVPA.

H_2 – The TPB and habit strength will significantly mediate the relationship between access to convenient facilities and resources in the home and school environment and MVPA.

H_3 – Access to convenient facilities and resources in the home and school environment will exert a significant, positive, direct effect on MVPA.
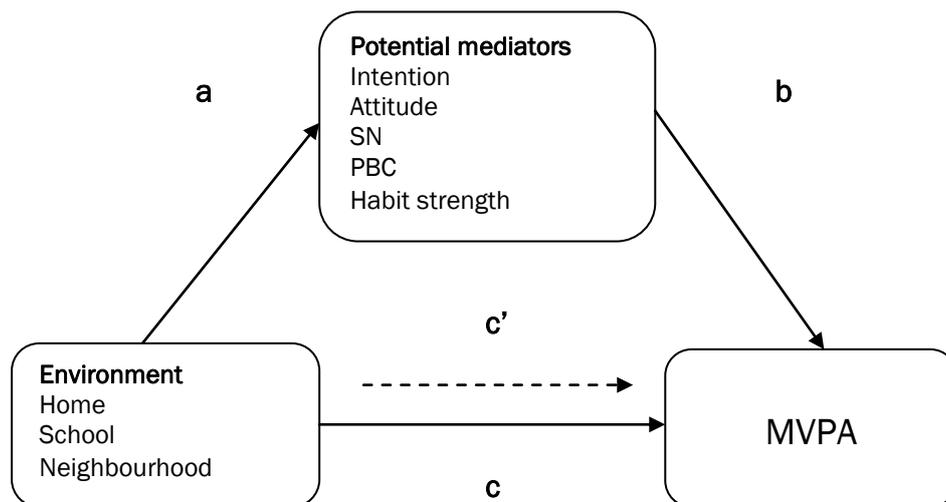
Figure 12.2 Conceptual model for the mediated effect of the TPB and habit strength on the association between perceived access to convenient facilities and resources in the home and school environment and MVPA.

12.5 Method

Participants

621 pupils were recruited from 4 primary schools in the West Midlands. Participants were recruited using an opportunity sample and consisted of both males and females aged 9 - 11 years. A priori power analysis (using G-Power) (Faul, Erdfelder, Lang, & Buchner, 2007) was conducted in order to compute required sample size for a standard multiple regression with 8 independent variables. Power calculations estimated that a sample size of 109 would provide power of 80% to detect a medium effect (0.15) with a significance level of P = 0.05.

School statistics indicated that the majority of pupils were of White British ethnicity. The ACORN population profile for the 4 schools were as follows: School 1 – 3/H/29 secure families, who are comfortably off, living in suburban semis; School 2 – 5/N/44 hard pressed struggling families, with low incomes; school 3 – 3/I/32 settled suburbia who are comfortably off and school 4 – 3/H/27 secure middle income families who are comfortably off, living in home owning areas.

Measures

TPB variables: TPB variables were assessed using the questionnaire developed and validated in chapter 10. Despite low variability on the item 'being physically active over the next 7-days would be healthy' (SD – 0.33), the item was retained to ensure that the attitude scale included a mixture of both instrumental and affective items.

Perceived environment: Items from the Preadolescent Environmental Access to Physical Activity Questionnaire (PEAPAQ) (Erwin, 2008) were used to assess children's perceptions of access to physical activity facilities and resources. Relevant items[7] concerning convenient facilities (i.e. within a 10 minute walk or a five minute bike ride from the child's home) and resources in the home and school environment were used to create the respective scales. The home environment (HE) scale presented 13 choices, plus two blank spaces for 'other' supports, while the school (SE) and convenient facilities (CF) scales presented 10 choices each, plus two blank spaces for 'other' supports. Participants responded by placing a check mark on the line next to the item if they had access to it. Since the questionnaire was developed in the United States, some of the wording was modified to ensure applicability to the current sample (see Appendix 3). Test re-test reliability for the original unmodified PEAPAQ is .95, .63 and .86 for the HE, SE and CF scales respectively (Erwin, 2008).

Habit strength: Because automaticity is the underlying dimension of habit that accounts for the instructional effect, habit will be measured using an automaticity specific scale – SRBAI (see Appendix 4). Since statistics concerning the reliability the SRBAI in children are not yet available, this study sought to examine the reliability of this measure with the target group. The SRBAI contains 4-items (scored on a five point Likert scale), taken from the SRHI, judged to represent automaticity by a panel of independent raters. The four items that were consistently judged to represent automaticity (i.e. each judge was at least 90% certain that the item represented automaticity) that were chosen for inclusion in the SRBAI were;

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[7] Some items were removed from the original questionnaire to ensure that the focus was on physical activity supports not inhibitors.

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Behaviour X is something 1) I do automatically; 2) Without having to consciously remember; 3) I do without thinking; 4) I start doing before I realise I am doing it. In adults reliability coefficients for the SRBAI range between α.84 - .95. It has also shown convergent validity with the SRHI (rs = .91 - .97) and predictive validity with car commuting, bicycle commuting and unhealthy eating (r = .75, .86 & .38 respectively) (Gardner & Abraham, 2009).

Procedure

All study procedures and related documents were approved by a University ethics committee. Letters explaining the study were sent to parents and guardians and informed consent was obtained. Letters informed parents of their right to with draw their child or their child's data from study at any time. The letter also ensured confidentiality and anonymity of individual results.

Questionnaires were administered in quiet classroom conditions in the presence of class teachers. Participants were given Crocker et al's (1997) definition of MVPA and asked to provide their own examples to the class to ensure that they had understood. Questionnaires were read aloud. A whiteboard/over head projector was also used; this ensured that each question was properly explained, read and completed before students moved on to the next question.

Physical activity was measured one week later using the PAQ-C. Selection of the PAQ-C for use in this study was based on several factors. First, a general measure of physical activity was considered acceptable for both discriminative purposes and for identifying intervention effects. Second, the PAQ-C was designed specifically for use with children, is easy to understand, quick to implement and has minimal participant and researcher burden. Finally, the PAQ-C has shown to be a valid and reliable measure of physical activity levels children (see chapter 11).

12.6 Results

Of the 621 pupils surveyed at T1, 458 were matched to their T2 data. Seventy three participants indicated that sickness or other events prevented them from doing their regular physical activities during the study period and a further 49 questionnaires were incomplete or spoiled, leaving 336 questionnaires (168 male

and 168 female) eligible for statistical analysis. The mean age of the final sample was 9.93 years (SD = 0.80). Thirty five percent of the sample were 9 years old, 37% were 10 years old and 28% were 11 years old.

Descriptive statistics

Descriptive statistics for the study sample are presented in table 12.2. Overall, participants held strong positive attitudes, SNs, perceptions of control and intentions towards physical activity. The mean score on the SRBAI was 4.02, indicating that physical activity was a largely automated behaviour[8]. Mean scores on the PAQ-C were also above mid-scale (mean = 3.49). PEAPAQ scores indicated that participants perceived greatest access to physical activity resources in their home and school environments followed by convenient facilities respectively.

Table 12.1 Descriptive statistics for study variables

| Variable | Total sample (n = 336) | | |
	Mean	SD	Scale
Attitude	4.41	0.44	1 – 5
SN	3.87	0.55	1 – 5
PBC	4.45	0.51	1 – 5
Intention	4.28	0.70	1 – 5
SRBAI	4.02	0.75	1 – 5
HE	9.01	2.26	0 – 15
SE	7.01	1.28	0 – 12
CF	5.71	2.60	0 – 12
PAQ-C	3.49	0.68	1 – 5

Indices of normality were examined for each of the study variables. In order to improve the normality of the distributions and to pull outliers closer to the centre of the range outlying cases were assigned a score one unit higher or lower than the next highest or lowest (non-outlying) score in the data set.

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[8] Fifty four percent of participants reported high levels of habit strength, i.e. they obtained a mean item-score of 4.00 (agreement) or higher, compared to 46% who reported low levels of habit strength for physical activity.

Psychometric properties of the SRBAI

Corrected item total correlations and coefficient alpha

The item/scale relationship was examined via corrected item total correlations. According to Field (2005) corrected item total correlations should exceed 0.30. All corrected item total correlations met this criterion (see table 12.2). Internal consistency was examined using coefficient alpha. Results revealed that scale reliability was acceptable (coefficient alpha = 0.76).

Table 12.2 Corrected item total correlations for SRBAI

Item	Corrected item total correlation
I do automatically	.58
Without remembering	.59
Without thinking	.60
Before realizing	.49

Exploratory factor analysis

In order to establish the construct validity of the SRBAI an exploratory factor analysis (EFA) employing principle components extraction and varimax rotation was performed on the data. Results of the EFA suggested the existence of one distinct factor with an eigenvalue of 2.35. This factor, presumably representing behavioural automaticity, accounted for 58.84% of the variance. All items loaded > .70, see table 12.3.

Table 12.3 Results of the exploratory factor analysis

Item	Factor 1
I do automatically	.79
Without remembering	.79
Without thinking	.79
Before realizing	.70

Taken together, the results suggest that the SRBAI, as a brief automaticity specific measure of habit, is a valid and reliable measure in relation to MVPA in children aged 9 – 11 years.

Psychological and environmental predictors of MVPA in children

Intercorrelations among study variables

Pearson correlation coefficients (and point biserial correlations) were computed to investigate relations between MVPA, intention and other study variables. Convenient facilities, habit strength and the home environment were most strongly correlated with MVPA, whereas attitude, habit and SN were most strongly correlated with intention (see table 12.4 below).

Table 12.4 Intercorrelations among study variables for the total sample

	Att	SN	PBC	Int	HE	SE	CF	SRBAI	PAQ-C	Sex
Att	1									
SN	.39**	1								
PBC	.39**	.22**	1							
Int	.61**	.45**	.42**	1						
HE	.14**	.00	.12*	.16*	1					
SE	.15**	.00	.13**	.01	.20**	1				
CF	.15**	.15**	.14**	.24**	.43**	.24**	1			
SRBAI	.45**	.27**	.35**	.53**	.16**	.15**	.26**	1		
PAQ-C	.35**	.27**	.22**	.43**	.32**	.14**	.45**	.44**	1	
Sex	-.04	-.03	-.07	-.003	-.07	-.10	-.22**	.02	-.18**	1

**Correlation significant at the 0.01 level; * Correlation significant at the 0.05 level

A series of hierarchical multiple regression analyses were conducted to examine associations between convenient facilities and resources in the home and school environment and MVPA and whether this association was mediated by the TPB and by habit strength. This variant of the basic multiple regression procedure was employed as it allows the researcher to specify a fixed order of entry for variables in order to control for the effect of covariates or to test the effects of certain predictors independent of the influence of others. The conceptual model (see figure 12.2) was tested in two stages; first with intention as the dependent variable and then with MVPA as the dependent variable. Since research suggests that boys are generally

more active than girls (e.g. Trost et al., 2002), gender was entered first in all analyses in order to control for its effect.

First though, the correlation matrix (see table 12.4 above) was examined for multicolinearity between independent variables, while linearity between the predictor and criterion variables was assessed via inspection of bivariate scatterplots. One way of identifying multicolinearity is to scan the correlation matrix for correlations > .80 (Field, 2005). All correlations were well below criteria. Examination of scatter plots revealed that all predictor variables were linearly related to the criterion.

Mediation tests to establish how perceived environmental factors contribute to the formation of intention and prediction of MVPA were performed using the method suggested Baron and Kenny (1986). Step 1: first it is necessary to show that the initial variable is correlated with the outcome. This is called the total effect or path c (see figure 12.2) (Kenny, 2009). Step 2: next the initial variable should be shown to be correlated with the proposed mediator. This provides the regression coefficient for path a. Step 3: it is necessary to show that the mediator affects the outcome whilst controlling for the effect of the initial variable. This provides the regression coefficient for path b. Step 4: To establish complete mediation, the effect of the initial variable on the outcome controlling for mediator should be zero. If not then partial mediation is indicated. This provides the regression coefficient for path c', the direct effect. In order to test the significance of the indirect effect, Sobel tests (Sobel, 1982) were performed using the Sobel test calculator developed by Soper (2011). Proportion/percentage mediated was calculated as the mediation effect divided by the total effect or (a x b) / c. In the opinion of most but not all analysts, step 1 is not required; the essential steps in establishing mediation are steps 2 and 3.

Predicting intention

Step 1 - Associations between HE, SE and CF and intention (path c) – total effect

Regression of intention on gender, HE, SE and CF showed that 5.2% of the variance in intentions could be explained by the model (P < .001). Nevertheless, CF emerged as the only significant predictor (β = .22, P < .001) (see model 1 in table 12.6). The

positive association between CF and intention shows that children who perceive greater access to convenient facilities are more inclined to be physically active.

Step 2 - Associations between HE, SE and CF and attitude, SN, PBC and the SRBAI (path a)

Four separate regression analyses were conducted to examine associations between the environment and attitude, SN, PBC and the SRBAI. There was no significant association between the environment and attitude or PBC after controlling for gender. However CF exerted a significant effect on both SN (β = .18, P < .01) and the SRBAI (β = .24, P < .001) (see table 12.5). The positive association between CF, SN and the SRBAI shows that children who perceived greater access to convenient facilities held more positive subjective norms and a stronger physical activity habit.

Table 12.5 Regression analysis showing associations between HE, SE and CF and attitude, SN, PBC and the SRBAI (path a)

Environment	Attitude		SN		PBC		SRBAI	
	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig
CF	.09	.131	.18	.005	.08	.223	.24	< .001
HE	.08	.175	-.04	.524	.07	.259	.05	.416
SE	.11	.061	-.04	.515	.09	.104	.09	.092

Step 3 - Associations between attitude, SN, PBC, SRBAI and intention (path b)

After controlling for the environmental variables, attitude (β = .35, P < .001), SN (β = .21, P < .001), PBC (β = .15, P < .01) and the SRBAI (β = .24, P < .001) emerged as significant predictors. The final model explained 50.6% of the variance in physical activity intentions (see model 2 in table 12.6).

Step 4 - Direct (path c') and mediated effects

After controlling for attitude, SN, PBC and the SRBAI, there was no significant direct effect of any environmental variable on physical activity intentions (see model 2 in table 12.6). Sobel tests using the unstandardised betas and their associated error terms revealed that both SN (Sobel = 2.55, P < 0.01) and the SRBAI (Sobel = 3.15, P < 0.001) significantly mediated the effect of CF on intention. Together SN and the

SRBAI explained 42.9% of the association between CF and intention; however the SRBAI was the strongest mediator explaining 26.2% of the association compared to 16.7% explained by SNs. Thus children with greater access to convenient facilities held more positive subjective norms and stronger physical activity habits and were therefore more inclined to be active.

Table 12.6 Hierarchical multiple regression analysis showing total (c) and direct associations (c') between CF, HE and SE and intention, and associations between potential mediators and intention (b).

Model	Beta	Sig	R^2
Model 1: Path c			.05
Sex	0.05	.353	
CF	0.22	< .001	
HE	0.06	.295	
SE	0.01	.883	
Model 2: Paths b and c'			.51
Sex	0.04	.364	
CF	0.08	.068	
HE	0.02	.647	
SE	-0.06	.157	
Attitude	0.35	< .001	
SN	0.21	< .001	
PBC	0.15	.001	
SRBAI	0.24	.001	

Predicting MVPA

Step 1 - Associations between HE, SE and CF and MVPA (path c) – total effect

Regression of MVPA on gender, HE, SE and CF showed that 21.9% (P < .001) of the variance in MVPA could be explained by the model. Nonetheless, only HE and CF emerged as significant predictors (HE - β = .16, P < .01 and CF - β = .36, P < .001). The positive association between HE, CE and MVPA indicated that children who perceived greater access to physical activity supports in their neighbourhood or home environment reported greater amounts of MVPA.

Step 2 - Associations between HE, SE, CF, intention and the SRBAI (path a)

Results for the association between HE, SE and CF on intention while controlling for gender are presented in table 12.6. Although the total effect of CF on intention was significant (total effect [path c] - β = .22, P < .001), the direct effect was non-significant after controlling for gender, attitude, SN, PBC and the SRBAI. However effect of CF on intention was mediated by SN and the SRBAI (see step 4 of the previous analysis).

Regression of HE, SE and CF on the SRBAI are a presented in table 12.5. Results revealed that CF exerted a significant positive effect on the SRBAI (β = .24, P < .001).

Step 3 - Associations between attitude, SN, PBC, SRBAI, intention and MVPA (path b)

After controlling for gender and the environmental variables, the SRBAI (β = .23, P < .001) and intention (β = .17, P < .01) emerged as the only significant predictors of MVPA. Thus those with a strong physical activity habit and a positive intention were more likely to engage in MVPA. The final model explained 36.3% of the variance in MVPA (see table 12.7).

Step 4 - Direct (path c') and mediated effects

After controlling for attitude, SN, PBC, SRBAI and intention, gender (β = -.12, P < .01), HE (β = .13, P < .01) and CF (β = .25, P < .001) were found to exert a significant direct effect on MVPA. Thus male participants and those who perceived greater access to physical activity resources in their home and convenient facilities reported greater amounts of MVPA. Sobel tests using the unstandardised betas and their associated error terms revealed that the SRBAI significantly mediated the effect of CF on MVPA (Sobel = 2.95, P < .01). Since CF was not a significant direct predictor of intention after controlling for gender, attitude, SN, PBC and the SRBAI mediation tests in this respect were not performed. Consequently the SRBAI explained 15% of the association between CF and MVPA.

Finally attitude, SN, PBC and the SRBAI were tested for mediation by intention in the prediction of MVPA. Sobel tests using the unstandardised betas and their associated error terms revealed that intention significantly mediated the effects of attitude (Sobel = 2.50, P < .01), SN (Sobel = 2.33, P < .01), PBC (Sobel = 2.09, P <

.05) and the SRBAI (Sobel = 2.38, P < .01) on MVPA. Thus children with a positive attitude, subjective norms and perceptions of control and those with a strong physical activity habit were more inclined to be active and therefore engaged in greater amounts of MVPA. There were no significant direct effects of attitude, SN or PBC on MVPA, after controlling for gender, environment, intention or the SRBAI (see table 12.7 below).

Table 12.7 Hierarchical multiple regression analysis showing total (c) and direct associations (c') between environmental variables and MVPA and associations between potential mediators and MVPA (b).

| Model	Beta	Sig	R^2
Model 1: Path c			.22
Sex	-0.09	.069	
CF	0.36	<.001	
HE	0.16	.004	
SE	0.01	.801	
Model 2: Paths b and c'			.36
Sex	-0.12	.008	
CF	0.25	<.001	
HE	0.13	.006	
SE	-0.01	.796	
Attitude	0.07	.245	
SN	0.07	.193	
PBC	-0.03	.603	
SRBAI	0.23	<.001	
Intention	0.17	.009	
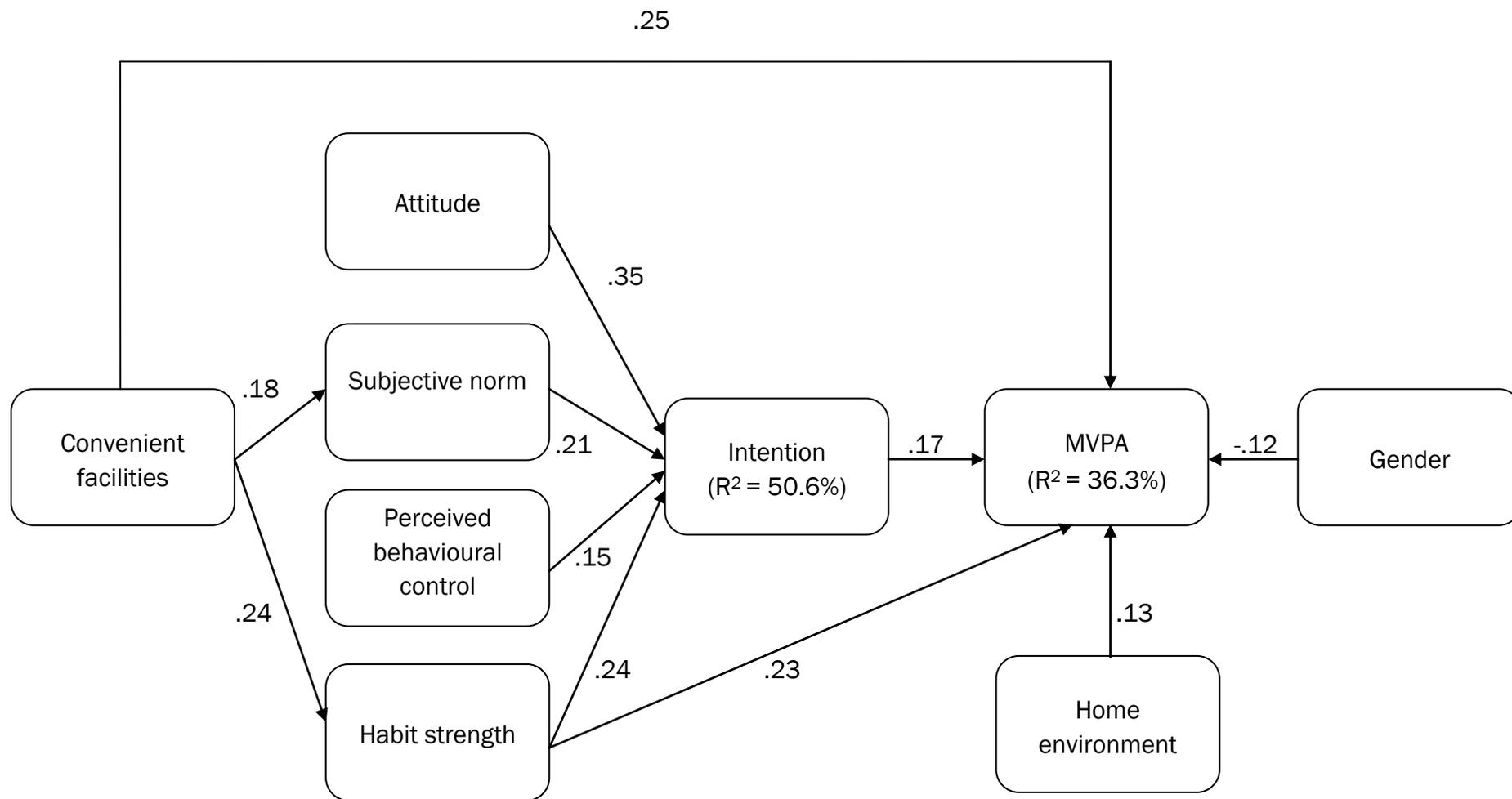
Figure 12.3 Path diagram illustrating the direct and indirect associations between the environment, cognition and habit in the prediction of MVPA in children.

12.7 Discussion

This is the first prospective study to investigate the relationship between access to convenient facilities and resources in the home and school environment and MVPA in children and potential mediation through the TPB and habit strength. A series of hierarchical linear multiple regression analyses controlling for gender found that access to physical activity resources and facilities in the HE and CF held a significant positive effect on MVPA. CF also held small but significant effect on physical activity intentions. Mediation tests following the Baron and Kenny (1986) method found that a substantial 43% of the association between the CF and intention was mediated through SNs (17%) and habit (26%), while 15% of the association between CF and MVPA was mediated through habit strength alone. A significant direct effect of CF and HE on MVPA was also found, however there was no significant direct effect of CF on intention.

Since limited information is available concerning the psychometric properties of the SRBAI in children, this study also sought to determine the reliability and factor structure of the scale using Cronbach's alpha and an EFA. Results of the EFA revealed the existence of one distinct factor, presumably behavioural automaticity, with an acceptable reliability coefficient of 0.76. Further evidence for the convergent validity of the SRBAI can be gleaned from its modest correlation with the PAQ-C (r = 0.44, P < 0.01). Given that repetition is a necessary condition for habits to develop, one would expect the SRBAI to be correlated with the PAQ-C in this way, since children who report higher levels of MVPA are likely to repeat this behaviour more frequently. Consequently, the results suggest that the SRBAI is a valid and reliable measure of habitual automaticity in relation to MVPA in children.

The most important independent predictor of MVPA in this study was CF; this was followed by habit strength, intention, HE and gender respectively. This was surprising since previous research suggests that cognitive variables (i.e. intention and habit strength) play a more important role in predicting physical activity than environmental variables. For example, Maddison et al., (2009) found that intention was the most important predictor of both self-report and objectively measured MVPA in adolescents, while Lemieux and Godin (2009) report that the most

important predictor of active commuting in students was habit strength. These variations in relative importance suggest that the contributions of the determinants vary along the lines of person and behaviour related factors and thus support the moderation hypothesis proposed by the EnRG. The results of the present study are congruent however with Davison and Lawson (2006) who demonstrated that perceived availability of recreational facilities, measured according to self-reports of both children and parents, showed consistent positive associations with children's total physical activity.

In line with the study hypotheses CF exerted a significant direct and indirect effect on MVPA. This also supports the EnRG framework which suggests that environmental factors can influence behaviour directly or indirectly via behaviour specific cognitions. The indirect effect of CF on MVPA via the SRBAI indicates that when opportunities for physical activity are easily accessible, children perceive more environmental cues that induce habit strength and habitual behavioural responses. Ease of access also plays a central role in habit formation as behavioural reoccurrence is contingent on one's ability to perform the behaviour again next time (Aarts et al., 1997). CF was also distally related to MVPA via a series of cascading mediators. For example, SN significantly mediated the effect of CF on intention and intention significantly mediated the effect of SN on MVPA. Thus when opportunities for physical activity were readily available, children held more positive subjective norms and intentions, which in turn resulted in higher levels of MVPA.

According to the TPB, access to physical activity resources and facilities should lead to enhanced perceptions of control; this was not supported. The finding that PBC does not mediate the environment – behaviour relationship has been reported before, e.g. Rhodes et al (2006; 2007) in relation to walking and Tak et al. (2011) in relation to soft drink consumption. That said, the restricted range of scores on the PBC items in the present study may have led to an underestimation of effect sizes and thus contributed to this null finding.

Also in line with the study hypotheses was the discovery that HE exerted a small but significant direct effect on MVPA. HE was not however, mediated by the TPB or by habit strength. These findings suggest that greater access to physical activity

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resources within the home may increase opportunities to be active which in turn encourages MVPA. These results are contrary to the systematic review conducted by Ferreira et al. (2007) who reported that four out of six studies found no association between home equipment and children's physical activity. The results do however support the findings of Maddison et al. (2009) who report that access to sport and recreation equipment in the home environment also had a direct unmediated association with physical activity measured via self-report.

Some researchers, in the respect Ajzen (2002a), might argue that the residual/direct effects of HE and CF on MVPA could be explained in terms of methodological flaws; however the unmediated route may simply reflect the passive influence of the environment (Giles-Corti & Donovan, 2002). For example, certain environments may facilitate incidental activities which are undertaken as part of normal daily tasks such as stair climbing or walking school.

Contrary to expectations access to resources in the SE was not significantly related to MVPA in children. These findings support the work of Durant et al. (2009) who found that access to school equipment was not related to physical activity in adolescents; although on the whole previous research examining the school environment in relation to MVPA has been inconsistent. For example, Nichol, Picket and Janssen (2009) found that students at schools with more recreational facilities reported higher levels of physical activity. The lack of support for SE in the present study maybe reflected in the measurement of general levels of MVPA, which may or may not be linked with the school environment given that children can be active outside of school[9]. Lack of support may also reflect sampling error/restriction of range which may have lead to underestimation of effect sizes. Nonetheless, restriction of range almost seems unavoidable given the likely similarity of perceptions of access from those who attend the same school. In light of this and previous research it is premature to dismiss the school environment as a potential correlate of children's MVPA. As such further research in this area is required.

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[9] In other words lack of congruence in measurement specificity may be responsible for this finding.

Another important predictor of MVPA observed in this study was the SRBAI. The results indicated that the SRBAI held both a significant direct and indirect effect on MVPA via intentions. The significant direct effect of the SRBAI on MVPA is congruent with Triandis (1977) who suggested that habit may provide an independent role in explaining behaviour from intention. Indeed, the results clearly show that habit does predict future behaviour over and above intentions suggesting that MVPA is initiated without much thought or deliberation. This finding has been reported in the literature many times before (e.g. Lemieux & Godin, 2009; Oenema, Prins, te Velde, Brug and van Empelen, 2010). The significant indirect effect of the SRBAI on MVPA via intentions suggests that children with a strong physical activity habit hold more positive intentions and are therefore more active. The finding that habit strength contributes additional variance to the prediction of intention has been reported previously in studies investigating active commuting in students (Lemieux & Godin, 2009) and sedentary behaviours among children (Kremers & Brug, 2008). It also corresponds with Wood & Neal's (2007) model of the habit goal interface which suggests that people can rely on their habits to make inferences about their goals. For example, people might infer their goals/intentions from their past behaviour, reckoning that 'I did it in the past; I will do it in the future' (Neal & Wood, 2007).

As expected, the socio-cognitive part of the model showed that intention significantly mediated the effect of attitude, SN and PBC on MVPA. Attitude emerged as the strongest predictor of intention, this is line with the 'meta-analytic review of the theories of reasoned action and planned behaviour in physical activity' conducted by Hagger et al (2002); this was followed by (habit strength) SN and PBC respectively. There were no significant direct effects of attitude, SN or PBC on MVPA. So children with a positive outlook towards physical activity, those in the habit of being active, those who believe that important people in their life want them to be active (and display the behaviour themselves) and those who feel in control of their own behaviour were more inclined to be active and therefore participated in greater amounts of MVPA. Regarding the significant, albeit rather weak contribution of intention to the prediction of MVPA, the only point that needs to be reiterated here is that the inclusion of habit strength in regression analyses

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often tends to diminish or nullify the effect of intention on behaviour (e.g. De Bruijn et al., 2008; Lemieux & Godin, 2009).

Implications

These results have several important implications for intervention strategies aimed at increasing physical activity in children. First, physical activity promotion still relies heavily on health education techniques that try to motivate people to adopt more healthy lifestyles. However, descriptive statistics in table 12.1 indicate that most children are already motivated to be active. For this reason Abraham, Conner, Jones and O'Connor (2008) suggest that interventions focusing on post-intentional or volitional processes maybe critical to prompting already motivated individuals to be active.

Second, access to CF play a crucial role in determining children's MVPA by providing opportunities for incidental activity; evidenced by the direct effect of CF on MVPA. For example, certain environments facilitate incidental activities which are undertaken as part of normal daily life such as walking to school or active play, from this perspective these behaviours may neither be planned nor habitual. For this reason Giles-Corti (2006) argues that initiatives to increase the prevalence of physical activity should be accompanied by the provision of a supportive environment. For example, future intervention strategies may consider the development of environments and policies which make physical activity unavoidable. This could, for example, be accomplished on a macro scale through government policy and urban planning (in relation to CF) or on a micro scale through parental rules (in relation to HE).

The focus of this study was on perceptions of the environment, not the objective environment per se. According to the social cognition approach physical activity will be influenced by the perceptions of an individual as by the actual characteristics of the environment in which they operate. This is because, as much as anything, perceptions are largely a function of awareness; thus it may only be if people perceive that facilities are accessible that they will actually use them (Jones & Panter, 2010). For example, children are unlikely to walk to school if they (or their parents) are unaware of safe walking trails or footpaths along which they can travel.

From this perspective then interventions that challenge perceptions people hold about their environment (convenient facilities in particular), may be as effective at changing behaviour as a physical change to the objective environment (Thirlaway & Upton, 2009). For instance, future interventions could promote behaviour by signposting opportunities or instigating psychological processes that enhance identification of physical activity relevant environmental cues. In this way identification of environmental cues may induce habit strength and habitual behavioural responses. Nevertheless, in order to achieve such awareness it is necessary to have better insight into what influences an individual's perception of their environment.

Because habit strength emerged as direct antecedent of MVPA, strengthening the habitual nature of physical activity by itself might also help to establish higher levels of behaviour. Since the results of the present study suggest that strong physical activity habits may be triggered by the presence and accessibility of convenient facilities, habit change interventions may therefore need to need to focus on strategies that incorporate such environmental cues. One way of doing this is through the use of implementation intentions – plans of action which specify where, when and how to act in future situations ('when I encounter situation X, then I will perform behaviour Y'). Remember, implementation intentions have much in common with the way habits work. The difference between habits and implementation intentions is of course, that habits develop through repetition and reinforcement, whereas implementation intentions are formed by deliberate planning (see chapter 8).

Limitations

In the present study MVPA was assessed via self-report. From a methodological point of view objective measures are usually valued more highly than subjective self-reports, since the latter are subject to social desirability bias, same source bias or self-justification. This may have led to under reporting or exaggeration of true activity levels, especially in children. Nevertheless, the PAQ-C has been validated in previous studies with Canadian children showing medium correlations with physical activity measured via accelerometry (Kowalski et al., 1997). The PAQ-C has also

demonstrated good internal consistency and test re-test reliability in children from the UK (see chapter 11), indicating that this questionnaire is a suitable measure. However, because the PAQ-C provides a general indication of children's MVPA, i.e. it does not provide time and frequency information, current UK guidelines for physical activity are not represented in the PAQ-C scores.

Because of the paucity of literature on acceptable and reliable questionnaires for measuring environmental access to physical activity in preadolescent children, the present study customized scales from the PEAPAQ. The PEAPAQ was developed using a convenience sample of 4th and 5th grade children from two elementary schools in the Midwestern United Sates. For this reason it is unclear to what extent the questionnaire is generalisable to the UK where the physical activity environment maybe very different to that found in studies based in the United States. Although the questionnaire in its original form demonstrated acceptable psychometric properties (see Erwin, 2008), the customized scales used in this study were not examined for validity and reliability. Future research would benefit from employing more robust environmental measures.

Although the focus of this study was on perceptions of the environment, Kremers at al. (2006) argue that researchers cannot rely solely on subjective measures since in the case of strong habits environmental factors are postulated to be capable of influencing behaviour without conscious awareness. On the other hand an exclusive focus on objective measures neglects that individuals observe and review their environments. However there are two important elements to bear in mind. First, it must be noted that the essential feature of habits is their automatic nature and not their unconscious character; lack of awareness is only one of the 'four horsemen' of automaticity and is thus sufficient but not necessary for a process to be qualified as a habit. Second, while most people are usually unaware of automatic processes, and *sometimes* unaware of the environmental cues which trigger habit performance, they are still able to report in a broader sense, whether or not they have access to a choice of opportunities for physical activity. Besides, the individual perception of the nature of the environment, rather than the actual environment will be critical in determining the TPB mediated route of environmental influences on behaviour (Kremers et al., 2006). Indeed research suggests that perception of the

environment seems to be more important for behavioural choices than the objective environment per se (Brug, Kremers, van Lenthe, Ball & Crawford, 2008; Jones et al., 2007).

Each of the PEAPAQ scales was environment specific; however the PAQ-C provides a measure of total activity, i.e. performed in various contexts. Consequently there is some degree of incompatibility in terms of specificity/generality between the environment, cognition[10] and behavioural measures. It is possible to increase the generality of the environment construct by means of aggregation, i.e. CF + HE + SE, however this would not provide information on which environments are important and why. Equally it may have been possible to increase the specificity of the behavioural measure by capitalising on the three factor solution that emerged from the first order factor analysis in chapter 11; however further validation of the first order factor structure is required.

Although meditational models are presumed to reflect a process or structure of events, the correlational nature of the analysis precludes us from inferring cause and effect relationships. For example, it may be that the present findings reflect an inverse cause and effect relationship, such that children who are physically active perceive more opportunities (Bandura's [1986] model of triadic reciprocal causation posits such an effect). For this reason intervention studies are now needed to further test these findings.

Over the years the causal steps approach to mediation (Baron & Kenny, 1986) has been criticised for low power, Type 1 error, not being able to address suppression effects and not addressing the central question of whether the indirect effect is significantly different from zero[11] (and in the expected direction) (MacKinnon, Lockwood, Hoffman & West, 2002; Preacher & Hayes, 2004; Shrout and Bolger, 2002). In addition, if there are multiple mediators, it is difficult to extend the causal

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[10] Items measuring TPB cognitions also relate to total activity and were not linked to specific environments. This may explain the weak and/or non-significant correlations observed between the environmental variables and determinants of intention.

[11] For this reason Sobel tests were also performed, i.e. to examine whether the effect of the IV on the DV via the mediator was significantly different from 0.

steps procedure to evaluate potential mediating variables simultaneously (e.g., MacKinnon, 2000; West & Aiken, 1997). The advantage of analysing mediators simultaneously is that one learns if mediation effects are independent of the effects of other mediators. For this reason future studies should fully explore the pathways of influence from the environment to MVPA using multiple mediator models or structural equation modelling.

A related measure of mediation is the proportion of the effect that is mediated. For example, the present study found that 15% of the association between CF and MVPA was mediated through habit strength. While such a measure is theoretically informative, Kenny (2009) argues that it is very unstable and shouldn't be computed if the total effect (c) is small.

A major limitation of this study is its failure to control for Socio-economic status, especially considering differences in the population profiles of the catchment areas for each of the schools participating in the study. For example SES is likely to influence access, the premise being that richer more affluent members of society will have greater access to convenient facilities. That said it is difficult to obtain valid and reliable information regarding Socio economic status directly from children.

Finally, the present study used a convenience sample of primary school children from the West Midlands making generalisation to the wider population difficult. The veracity of this line of research would therefore benefit by using random sampling techniques to strengthen the cross validation of the findings. Notwithstanding these limitations, this study adds to a growing body of literature by providing an illuminative view of environment – MVPA processes in children.

Conclusion

There is mounting evidence of an association between the environment and physical activity, but limited understanding about the conditions and mechanisms that explain these associations. To this end, the EnRG framework proved to be a useful tool for assessing the different pathways linking the environment and MVPA in children. Nonetheless, contrary to the EnRG in which habit strength is included as

a moderator, it appears that habit strength can also act to mediate the environment – MVPA relationship.

This study found that access to CF and resources in the HE held a significant positive effect on MVPA. CF was distally related to MVPA via the SN – intention pathway and partially mediated by habit strength. HE was unmediated by the TPB or by habit strength. The results suggest that environmental variables influence MVPA both directly and indirectly and that habit strength seems to be the most important mediator for this association. If these findings are replicated, the EnRG should be adapted in this regard.

Chapter 13

Development, implementation and evaluation of an intervention to increase physical activity in children

"Theory provides the foundation for successful interventions, and through interventions we are able to test, and so develop, theory. From theory comes intervention and from intervention comes further theory" (Rutter & Quine, 2002).

13.1   Abstract

Objective: Chapter 11 identified perceived access to convenient facilities and habit strength as key determinants of MVPA in children. The present study therefore utilized several behaviour change techniques (i.e. 'if then' plans), and persuasion strategies (i.e. awareness raising activities based on the TTM), that aimed to increase habitual physical activity and positively influence perceived accessibility of convenient facilities.

Method: One hundred and fifty eight pupils aged 9 - 11 years from 4 primary schools in the UK participated in a cluster randomised control trial. The mediating variable framework was used to assess the efficacy of the intervention as well as the roles played by habit and convenient facilities. A process evaluation was also conducted.

Results: There was a significant increase in PAQ-C scores for those in the intervention group. Perceived access to convenient facilities and habit strength did not significantly increase as a result of the intervention and did not mediate the intervention effect. There was however, some evidence that the intervention increased intention – behaviour consistency.

Conclusion: Interventions that positively affect behaviour, do not always affect the mediating variables on which they are predicated. However this does not necessarily invalidate a theory if the failure can be attributed to a limitation in study

design, measures employed or if the procedures employed to test a given mediator were ineffective

13.2 Introduction

Whilst physical activity is widely acknowledged as being beneficial to health few children are sufficiently active (Craig, Midell & HIrani, 2009). The development and evaluation of interventions to promote physical activity in children is therefore a priority.

It is unclear how successful intervention efforts have been to increase the activity levels of young people (van Sluijs et al., 2007). Published reviews have mostly dealt with obesity prevention or included only adult populations. Previous attempts to summarise the evidence in young people have mostly been narrative, did not assess the intervention effects on children and adolescents separately and did not assess the methodological quality of the studies. In addition these reviews have included studies without a control group and studies in which the promotion of physical activity was only a small part of the overall health promotion programme (van Sluijs et al., 2007).

With few exceptions (see De Bourdeaudhuij et al's. 2011 review for example), many physical activity interventions have been conducted in the US and Australia which raises questions about the applicability of these results in European countries. A dearth of high quality intervention research specifically targeting the critical period (i.e. 9 – 11 years) has also been identified (Armitage & Sprigg, 2010). What's more, many physical activity programmes have failed to utilize evidence based theory to identify key determinants of behaviour change as targets for intervention (Baranowski, Anderson & Carmack, 1998). According to Araujo-Soares, McIntyre, MacLennan & Sniehotta (2009), interventions addressing evidence-supported mediators of behaviour change are more likely to be effective as they build upon accumulative research.

Applications of theory-based interventions present an opportunity to test if an intervention successfully modifies the hypothesised determinants and if these determinants mediate intervention effects (Baranowski, et al., 1998; Michie &

Abraham, 2004). To this end intervention studies are one of the best ways to test and further refine behaviour change theory (Rothman, 2004).

The mediating variable framework proposed by Baranowski, Anderson and Carmack (1998) provides a useful guide by which to assess the status of physical activity interventions and the roles that are played by behavioural theory. Remember, mediation implies a relationship whereby an independent variable causes a change in a mediator variable which in turn causes a dependent variable. In the context of intervention research a mediator (i.e. a theory-specified determinant of behaviour) is on the path between exposure to the programme and programme effects or outcomes (Bauman, Sallis, Dzewaltowski & Owen, 2002). This implies that the mediating variable provides the mechanism through which the intervention exerts its effect. In this way including measures of proposed mediators in intervention trails will facilitate the development of behaviour change theory.

Process evaluation provides important links to understanding the mechanisms for how and why proposed theoretical constructs produce (or fail to produce) successful change and is key to refining theory and improving intervention effectiveness (Linnan & Steckler, 2002). This is in contrast to an outcome evaluation which merely establishes that an intervention has worked. Although not often studied, process evaluation involves the measurement and analysis of an intervention as it is being implemented. The reason is that if an intervention is not well implemented it may not affect the mediators so the outcomes will not be achieved. Attendance at sessions, proportion of the intended material covered by the delivery staff and the use of behaviour change materials are all important process variables (Bauman et al., 2002).

This study describes the development, implementation and evaluation of a theory based intervention to increase MVPA in children. The intervention takes an 'action orientated' approach (i.e. focuses on how to promote action rather than mere motivation) since the results of chapter 12 showed that children are already motivated to be active.

While the EnRG framework proved to be a useful tool for assessing the different pathways linking the environment and MVPA in children, it offers little guidance in

the way of intervention development. For this reason several behaviour change techniques and persuasion strategies that aimed to positively influence perceived accessibility of convenient facilities and increase habitual physical activity were identified from the literature. These included; the TTM (Prochaska & Diclemente, 1982), the Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1986), Aarts et al's. (1997) theory of habit formation and Gollwitzer's (1993) implementation intentions.

13.3   Aims and objectives

The purpose of this study is to design, implement and evaluate a school based, teacher led physical activity programme for children aged 9 – 11 years based on the model developed in chapter 12. Schools are acknowledged as the primary institution with responsibility for promoting activity in young people (Cardon & Bourdeaudhuij, 2002). They are also regarded as an ideal setting for health promotion since they offer an environment where almost all children can be reached repeatedly and continuously. Indeed, the most effective interventions for children are those carried out in school settings (Salmon, Booth, Phongsavan, Murphy and Timperio, 2007).

In order to achieve the aims set out above, the specific objectives of this cluster randomised controlled trial are:

1. To examine the impact of the intervention on levels of MVPA in children
2. Examine the impact of the intervention on perceived accessibility of convenient facilities and habit strength
3. Examine whether the effects of the intervention on MVPA are mediated by perceived accessibility of convenient facilities and habit strength.
4. Conduct a process evaluation to examine the factors that characterize the success or failure of the intervention.

13.4   Hypotheses

H_1 – Children who participate in the physical activity intervention will report significantly higher scores on the SRBAI, the CF subscale of the PEAPAQ and the PAQ-C at follow up, i.e. 10 weeks.

H_2 – The increase in SRBAI, CF subscale of the PEAPAQ and PAQ-C scores will be significantly higher for children who participated in the intervention compared to the control group.

H_3 – The SRABI and the CF subscale of the PEAPAQ will significantly mediate the effect of the intervention on PAQ-C scores.

13.5   *Intervention development and contents*

Environmental component

According to the social cognition approach physical activity will be influenced by the perceptions of an individual as by the actual characteristics of the environment in which they operate. This is because, as much as anything, perceptions are largely a function of awareness and it may only be if people perceive that facilities are accessible that they will actually use them (Jones & Panter, 2010). Therefore talking based interventions which challenge perceptions people hold about their environment may be as effective at changing behaviour as a physical change to the objective environment (Thirlaway & Upton, 2009). Indeed, conclusive evidence that simply having access to resources in the physical environment increases MVPA remains elusive (Giles-Corti & Donovan, 2002). Studies have also demonstrated that perceived environmental characteristics show a stronger and more consistent association with physical activity behaviours than those that are objectively measured (Jones et al., 2007; Brug, Kremers, van Lenthe, Ball & Crawford, 2008).

Making children more aware of the facilities and resources available to them and the ease by which these resources can be accessed is an important step in facilitating behaviour change. Therefore the environmental component of the intervention utilized several techniques to positively influence perceived access of convenient facilities based on the Processes of Change (TTM). According to the processes of change awareness raising involves finding and learning new facts, ideas and tips to support a behaviour change and can be achieved through feedback, confrontations, interpretations and media campaigns.

Several communication vehicles were used to deliver the environmental component of the intervention, these included; a short health promotion film called

'opportunities to be active in my environment' (see supplementary material), designed to provide children with tailored messages containing practical tips and visual examples of how they can utilize their environment to incorporate activity into their daily lives; a class room discussion, designed to be interactive and to stimulate awareness through discussion and feedback; and a fact finding activity called 'opportunities to be active in my environment' (see Appendix 6), designed to stimulate awareness about places to be active through active learning (table 13.1 provides a description of the behaviour change techniques and persuasion strategies used during each stage of the intervention, while table 13.2 provides a full description of the intervention components and materials).

Table 13.1 Examples of behaviour change techniques and persuasion strategies used in the intervention

Determinant	Technique (framework)	Tools and materials	Example
Environment and habit	Tailoring (ELM /TTM)	Film 1	Tailoring information to concepts the learner already has, e.g. "Chances are you already know that physical activity is good for you"
Environment	Consciousness raising (TTM)	Film 1 Class discussion Fact finding activity	Finding and learning new facts, ideas and tips to support behaviour change, e.g. raising awareness of opportunities to be active in the environment
Environment	Active learning (ELM)	Fact finding activity	Stimulation of elaboration by encouraging the learner to add something to the information to be remembered, e.g. Activity – 'places to be active in my environment'
Environment and habit	Providing information / methods to increase knowledge (ELM/Theory of habit formation)	Film 1 Film 2	Providing information about the types of activities that have clear health consequences, e.g. "activities which make you feel warm or slightly out of breath"
Habit	Increase probability of immediate satisfactory experiences (Theory of habit formation)	Film 2	Stressing short term advantages of behaviour such as fun / enjoyment, e.g."Choose an activity that's right for you... you are more likely to develop a habit if you have fun in the process"
Habit	Repetition (Theory of habit formation)	Film 2 Implementation intention activity	Encouraging behavioural repetition, e.g. "Choose an activity that's right for you and do it as often as you can"
Habit	Goal setting (TTM/Theory of habit formation)	Film 2 Implementation intention activity	Encouraging children to choose simple activities that they are able to perform successfully / setting realistic challenges
Habit	Implementation intentions (Goal related theories)	Film 2 Implementation intention activity	Plans of action to perform a particular response given a specific environmental cue, e.g. 'My if then plans'

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Habit component

Habit formation implies the establishment of stable behavioural patterns that are performed frequently without much thought or deliberation. For this reason strong habits are not vulnerable to the many ad-hoc rationalizations hassles and moods that may lead to a decision not to exercise that day or that week (Verplanken & Melkevik, 2008). Therefore strengthening the habitual nature of physical activity on its own might also help establish higher levels of activity (Kremers Dijkman, de Meij, Jurg & Brug, 2008; Verplanken & Melkevik, 2008). Despite the large amount of research and practice involving interventions to change behaviour, the idea that interventions can promote physical activity by creating habits has received little attention (Verplanken & Wood, 2006).

According to the theory of habit formation (Aarts et al., 1997), intervention programmes for the promotion of health enhancing physical activity habits should stress and include a wide variety of aspects. First they should provide information about the types of exercise behaviours that have clear health consequences. Second they should stress the short term advantages to increase the probability of immediate satisfactory experiences (as this will reinforce the need to choose the same course of action next time, thus making repetition more likely). Third, they should recommend that individuals choose a specific type of exercise behaviour they are able to perform successfully and set realistic challenges and fourth they should provide supportive environments that enable individuals to perform the type of exercise they like at any time they want.

Chapter 12 showed that convenient facilities not only enhance and support physical activity by providing opportunities; they also contribute to the development of habit. In this way environmental and habitual methods of behaviour change can be viewed as complementary approaches. Because the focus of this project was on perceptions of the environment and because changing the physical environment to support activity would probably require major structural changes, attention was paid to other strategies to improve habit strength. For example, teaching people to recognize and use environmental cues or prompts has been identified as an effective and inexpensive intervention strategy for the promotion of physical activity (Orlander & Eves, 2011). This idea is in line with Wood and Neal's (2007) synthetic

model presented in section 7.3, which suggests that people can control habit cueing 'upstream' of the behaviour, i.e. before a response has been activated. Such control arises from decisions to avoid, alter, or in this instance, promote exposure to the cue itself.

Encouraging people to make implementation intentions (see chapter 8) may be one way of establishing relevant environmental cues for physical activity and thus promoting the formation of habitual behaviour (Kremers et al., 2008). Remember, implementation intentions are formed in the post-decisional phase and are thought to ease the transition from the post-decisional to the actional phase (Bargh & Gollwitzer, 1994; Orbell & Verplanken, 2010). As such they are considered volitional aids to behaviour and in order to be effective they require a *prior intention* to be active. Numerous studies have shown the positive effects of implementation intentions for increasing physical activity (e.g., Gollwitzer & Sheeran, 2006), although few have tested their effects in preadolescent children. In one study Armitage and Sprigg (2010) tested the ability of an implementation intention based intervention to increase physical activity in a group of 6 – 10 year olds with low socio-economic status. Researchers found that implementation intentions were successful in increasing physical activity across a sustained period of time and were consistent with the idea that there are distinct motivational and volitional phases in human behaviour.

Several communication vehicles were used to deliver the habitual component of the intervention, these included; a short health promotion film called 'Habit formation and how to make 'if then' plans' (see supplementary material), designed to encourage children to develop healthy physical activity habits by providing simple advice on habit formation and the development of 'if then' plans; and an activity called 'My if then plans' (see Appendix 7), which required children to form up to 3 implementation intentions, spelling out where and when they will be active over the next 10 weeks. This timeframe was based on Lally et al. (2010) who showed that the average time taken for automaticity scores to plateau was 66 days (i.e. 10 weeks). The simple advice on habit formation was based on the Theory of Habit formation (Aarts et al., 1997) and encouraged children to choose simple activities that they could build into their daily lives, for instance walking or cycling to school,

to try a variety of different activities to find one that they enjoy, and to perform those activities as often as they can. The film also served to provide an illustrative example of a child forming an 'If then plan' which was subsequently used to support and inform the implementation intention activity.

Successful communication is a prerequisite for any behaviour change method (Bartholomew et al., 2006). Any programme that includes methods for changing determinants and behaviour should also include methods to achieve successful communication (Bartholomew et al. (2006). A popular model in this regard is the ELM. According to the ELM there are two routes through which persuasive messages are processed: the central route and the peripheral route. Central processing occurs when a message is carefully considered and can be stimulated using several motivational techniques such as tailoring and active learning. The latter is based on evidence that getting individuals to search for answers leads to better information processing and learning, followed by more change in determinants and behaviour (Bartholomew et al., 2006). Peripheral route processing on the other hand involves little systematic processing. Instead persuasive appeals using the peripheral route often rely on other characteristics of the message such as the perceived credibility of the source, quality of the way in which it is presented, the attractiveness of the source, or the catchy slogan that contains the message. To this end care was taken to ensure that the intervention materials were made relevant by tailoring the contents to the knowledge, beliefs and prior experiences of the learner and delivered by a credible source, i.e. their class teacher. Active learning strategies were also employed to enhance information processing, i.e. activity 2 – 'Places to be active in my environment'.

According to the ELM information processing can be disturbed by message complexity. For this reason steps were taken to make sure that all intervention materials were accessible to children, used minimal jargon and were easily readable. This was achieved with several simple techniques suggested by Abraham, Conner, Jones and O'Connor (2008), namely providing information in a logical order, explicit categorization i.e. telling the audience what you're about to tell them, and repetition to enhance recall. To ensure that the written information on the activity

sheets was easily readable, the FLESCH Kincaid readability test was used to assess comprehension difficulty.

Table 13.2 Description of intervention components/materials

Step-by-step guide to programme delivery

The step-by-step guide was developed to assist teachers with questionnaire administration and programme delivery. The guide was divided into three separate sections; questionnaire administration, intervention – phase 1 and intervention – phase 2. A brief summary outlining the purpose of each stage was provided at the beginning of each section followed by a logical step-by-step description of the programme components and how they should be delivered.

Film 1 – 'Opportunities to be active in my environment'

This 3 ½ minute film was designed to raise awareness concerning the availability of convenient facilities; these included leisure centres, parks and bicycle trails among others. It also demonstrated the ease by which individuals can access these facilities. To this end the film offered practical tips and visual examples of how the surrounding environment can be utilized to incorporate activity in day-to-day life. It also directed children to various local organisations and sources of information where they can find out about opportunities for physical e.g. local community or leisure centre, local paper, school notice board or online. The film also served to reinforce participants beliefs about the benefits of physical activity as well as to provide illustrative examples about the types of activities that have clear health benefits, e.g. activities which leave the participant feeling warm or slightly out of breath.

Activity 1 – Class discussion 'Places to be active in my environment'

This activity was teacher led, designed to be interactive and to stimulate awareness through discussion and feedback. No time limit was imposed on this task.

Activity 2 – Fact finding activity 'Places to be active in my environment'

This activity was designed to stimulate awareness about places to be active in the environment. Participants were asked to find and record up to 12 different places in which they could be active within a 10 minute walk or a five minute bike ride from their home, or on a route that they often walk, i.e. to or from school. Participants were encouraged to visit their local sports centre and to check the local papers or school notice board. They were also prompted to search online and to ask family and friends about the facilities they have access to locally. Participants were given 10 minutes of class time to inaugurate the activity but where then asked to complete the task as homework.

Film 2 – 'Habit formation and how to make 'if then' plans'

The purpose of this 4 minute film was to encourage the development of healthy physical activity habits by providing simple advice on habit formation and the development of 'if then' plans. The advice on habit formation stressed the importance of choosing simple activities that can be performed regularly. It also encouraged children to try a variety of different activities to find one that they enjoy, i.e. skateboarding, Frisbee and interactive dance games. The second part of the film provided an illustrative example of a child forming an 'if then' plan.

Activity 3 – My 'If then' plans

This activity required children to form up to 3 'if then' plans, spelling out where and when they will be active over the next 10 weeks. Children were specifically told to think about places they can be active within a 10 minute walk or five minute bike ride from home, or on a route they often walk.

13.6 Method

Participants

The study, called 'Get in the HABIT', was publicised in April 2010 via e-mail to schools in the West Midlands; interested schools were then contacted two weeks later by telephone during which a preliminary meeting was arranged to discuss the particulars of the project. Four primary schools agreed to take part in the study.

School statistics indicated that the majority of pupils were of White British ethnicity. The ACORN population profile for the 4 schools were as follows: School 1 – 5/N/45 hard pressed struggling families with low incomes living in small semis; School 2 – 5/P/54 hard pressed single parents living in high rise estates; school 3 – 1/A/3 wealthy achievers living in affluent areas and school 4 – 5/N/44 hard pressed struggling families with low income.

Criteria for inclusion in the study were; 1) schools should be mixed sex; 2) schools should be located within the West Midlands; and 3) schools should be maintained by the local education authority. Willing participants aged between 9 - 11 years were included in the study. Participants were excluded if they indicated that sickness or other events prevented them from doing their regular physical activities during the study period (i.e. previous 7 days, at baseline or follow up). Participants were also excluded if they were absent during phase I or phase II of the intervention. Since motivation is a pre-requisite for the use of implementation intentions, participants with a mean intention score < 3.5 were also excluded. See the CONSORT diagram below to see the flow of participants through the study.

Design

The study utilized a pragmatic cluster randomised control design with 'school' as the unit of randomization to assess the efficacy of the model developed in chapter 12. Schools were randomly allocated to either the intervention or control group by flipping a coin. Those schools allocated to the control group were offered a written report on children's self-reported MVPA in exchange for their participation. The intervention involved three discrete stages; baseline data (t1) collection, intervention implementation (t1 and t2) and follow up (t3). Participants in the

intervention group received two face-to-face sessions one week apart (t1 and t2). MVPA was assessed 10 weeks later.

Measures

Physical activity intentions: Intention was assessed using the items developed and validated for the TPB chapter 10.

Perceived access to convenient facilities: Items from the CF subscale of the PEAPAQ were used to assess children's perceptions of their access to convenient facilities.

Habit strength: Habit strength was measured using the SRBAI.

MVPA: MVPA was measured using the PAQ-C.

Process evaluation: Process evaluation data was collected to document how well the intended audience was reached (reach), the number of intended units of each phase of the intervention that was actually delivered (dose delivered), the extent to which participants were exposed to and actively engaged with the intervention (dose received) and the extent to which the intervention was delivered as planned (fidelity). The process evaluation was informed by Baranowski and Stables (2000), Linnan and Steckler (2002) and Bliss and Emshoff (2002) and involved data gathering among delivery staff using an open ended questionnaire and systematic in vivo observations using an audit tool specifically developed for the study (see Appendix 5). The audit tool itself consisted of a check sheet supported by qualitative observations and was used to assess dose delivered and fidelity. The checklist was essentially a modified version of the 'step-by-step guide to programme delivery' (see table 13.2 - intervention development and contents) and was used to produce a fidelity rating for phase I and II of the intervention.
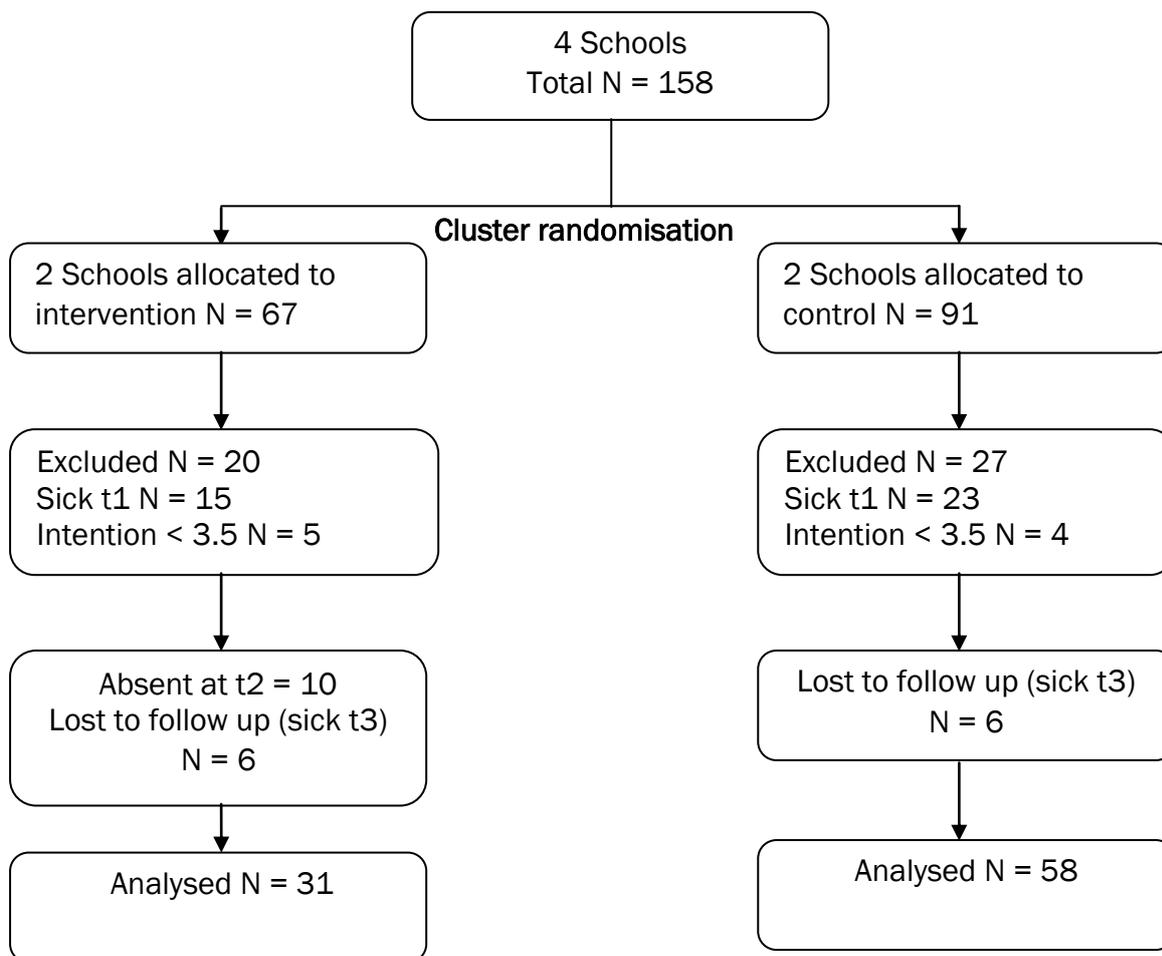
Figure 13.1 CONSORT flow diagram of participants through the intervention

Procedure

All study procedures and related documents were approved by a University ethics committee. Letters explaining the study were sent to parents and guardians and informed consent was obtained. Letters informed parents of their right to with draw their child or their child's data from study at any time. The letter also ensured confidentiality and anonymity of individual results.

Two weeks before the intervention began a meeting was scheduled with class teachers to discuss the role they would play in delivering its contents. Those who agreed to deliver the programme were given an intervention pack containing a copy of the intervention materials as well as a letter introducing the programme and a step-by-step guide to programme delivery (see Appendix 5).

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Questionnaire administration and intervention sessions were conducted in class, during lesson time in July 2010. At the beginning of the first session verbal assent was obtained from all participants. They were then asked to provide some basic demographic information before completing the PAQ-C, the CF subscale of the PEAPAQ, a measure of intention and the SRBAI. After the baseline data was collected participants in the intervention group watched a short (3 ½ minute) health promotion film called 'Opportunities to be active in my environment', after which the teacher initiated a short class discussion intended to raise awareness of places to be active nearby. This activity was designed to be interactive and to stimulate awareness through discussion and feedback. Children were free to chat with each other and were actively encouraged to provide examples of places where they could be active to the rest class.

Next participants were required to participate in a paper and pencil activity called 'Places to be active in my environment'. This activity was designed to stimulate awareness about places to be active in the environment through active learning. Participants were asked to find and record up to 12 different places in which they could be active within a 10 minute walk or a five minute bike ride from their home, or on a route that they often walk. Participants were encouraged to visit their local sports centre and to check the local papers or school notice board. They were also prompted to search online and to ask family and friends about the facilities they have access to locally. Participants began the activity in class and completed it as homework.

Phase two of the intervention was delivered one week later. The purpose of this phase was to encourage the development of physical activity habits by providing simple advice on habit formation and the development of 'if then' plans. First, children were briefly reminded about the previous week's activities, after which they watched a second 4 minute health promotion film called 'Habit formation and how to make 'if then' plans. Next, children participated in a paper and pencil activity called; 'My 'if then' plans'. Each pupil was provided with an activity sheet and asked to form up to 3 'if then' plans to incorporate additional physical activity into the next 10 week period. Throughout the session it was emphasized that all of the plans were for the children's own benefit. The feasibility of the children's 'if then' plans

was also stressed throughout the activity. On completion of the task children were asked to take their plans home with them, share them with their parents and put them somewhere where it will remind them to act.

During t1 and t2 unobtrusive systematic in vivo observations were conducted as part of the process evaluation using the audit tool developed for the study. On completion of the intervention at t2, those involved in programme delivery were asked to complete a short evaluation form detailing their thoughts and experiences of the programme. Ten weeks later at t3, all participants completed a basic demographic questionnaire, the PAQ-C, the CF subscale of the PEAPAQ, a measure of intention and the SRBAI.

Analysis

Analyses were conducted to compare those that received the intervention with those participants allocated to the control group. A series of 2 x 2 mixed analyses of variance (ANOVAs) were conducted to evaluate the effects of the intervention on perceived accessibility of CF, habit strength and general levels of MVPA. The repeated measure factor was measurements at t1 (baseline) and t3 (follow up) and the between subjects factors were condition, i.e. intervention vs. control. Post hoc t-tests were used to explore significant interactions. The analyses were conducted for the intervention and control groups separately. A priori power analysis for a 2 x 2 mixed ANOVA indicated a need to recruit a sample of 66 participants giving 80% power to detect a medium effect (0.25) with a significance level of $P = 0.05$.

Mediation analyses were conducted to test the causal hypotheses derived from the model developed in chapter 12. Remember, mediation implies a relationship whereby an independent variable causes a change in a mediator variable which in turn causes a dependent variable. Mediation analyses were conducted to assess whether the effects of the intervention on MVPA were mediated by perceived access to CF and the SRBAI measured at follow up. All mediation analyses were conducted using the Baron and Kenny (1986) method described in chapter 12. A priori power analysis using G-Power for a multiple linear regression with 2 independent variables (predictor and control, see step 3 of Baron and Kenny [1986] causal steps

approach) indicated a need to recruit a sample of 68 participants giving 80% power to detect a medium effect (0.15) with a significance level of P = 0.05.

13.7 Results

Results of the cluster randomisation resulted in 67 pupils being allocated to the intervention group and 91 pupils being allocated to the control group. In the intervention group, 15 participants at t1 and 6 participants at t2 indicated that sickness or other events prevented them from doing their regular activities during the previous 7-days and were excluded from further analysis. A further 5 participants obtained a mean score < 3.5 on the measure of intention and 10 participants were absent at t2 resulting in N = 31.

In the control group 23 participants at t1 and 6 participants at t2 indicated that sickness or other events prevented them from doing their regular activities during the previous 7-days and were excluded from further analysis. A further 4 participants obtained a mean score < 3.5 on the measure of intention and were also excluded; N = 58.

Table 13.3 shows demographic characteristics of the participants at baseline, while table 13.4 shows the descriptive statistics for participants on each of the study variables at baseline and follow up.

Table 13.3 Demographic characteristics of participants allocated to the intervention or control group

Condition	Age Mean (SD)	Gender Male / Female
Control	10.45 (.50)	27 / 31
Intervention	10.16 (.37)	14 / 17

The mean age of participants allocated to the intervention and control groups was 10.16 (SD = 0.37) and 10.45 (SD = 0.50) respectively. The intervention group consisted of 14 male and 17 female participants. Fifty five percent of the sample were 10 years old and 45% were 11 years old. The control group consisted of 27 male and 31 female participants. Eighty four percent of the control sample were 10 years old and 16% were 11 years old.

Descriptive statistics show that at baseline participants in the control group (mean = 5.91) perceived greater access to CF than those in the intervention group (mean = 5.30), however scores for those in the control group (SD = 2.41) were more widely dispersed (intervention group SD = 1.87). Mean scores and standard deviations on the SRBAI and the PAQ-C at baseline were roughly equal for the two groups.

Table 13.4 Descriptive statistics for study variables at t1 (baseline) and t3 (follow up) for participants allocated to the intervention and control group

Construct	Baseline t1		Follow up t3	
	Intervention	Control	Intervention	Control
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
CF	5.30 (1.87)	5.91 (2.41)	5.74 (1.90)	6.24 (2.32)
SRBAI	4.10 (0.75)	4.12 (0.76)	4.10 (0.76)	4.02 (0.63)
PAQ-C	3.43 (0.71)	3.54 (0.70)	3.69 (0.71)	3.26 (0.66)

Indices of normality were examined separately for each group on each of the study variables. In order to improve the normality of the distributions and to pull outliers closer to the centre of the range outlying cases were assigned a score one unit higher or lower than the next highest or lowest (non-outlying) score in the data set.

Was randomisation successful?

The two groups were compared at baseline on the following variables: age gender, CF, the SRBAI and the PAQ-C. There was a significant age difference (t(87) = 3.10, P = .003, mean difference = 0.29) between the two groups which represented a medium effect size (*d* = 0.66); there were no other differences on any of the remaining variables. Cluster randomisation was therefore successful in producing broadly equivalent groups.

Did the intervention change perceptions of the environment and habit strength?

Perceptions of access to convenient facilities and habit strength did not significantly increase as a result of the intervention.

Did the intervention change behaviour?

There was a significant difference between t1 and t2 PAQ-C scores for the both the intervention and control groups. There was a significant decrease in PAQ-C scores

from baseline (t1) to follow up (t3) for those participants in the control group (t(57) = 2.97, P = .004). The mean difference between t1 and t3 scores on the PAQ-C for participants in the control group was 0.27. The decrease in mean PAQ-C scores from 3.54 to 3.26 represents a small to medium effect size - Cohen's *d* = 0.40.

There was also a significant increase in PAQ-C scores from t1 to t3 for those participants in the intervention group (t(30) = -2.70, P = .011). The mean difference between t1 and t3 scores on the PAQ-C for participants in the intervention group was 0.29. The increase in mean PAQ-C scores from 3.43 to 3.69 represents a small to medium effect size – Cohen's *d* = 0.43.

There was also a significant difference in PAQ-C scores between the intervention and control group at t3 (follow up) (t(87) = 3.11, P = .003) (see figure 13.2). The mean difference between the intervention and control group was .45, representing a medium to large effect size – Cohen's *d* = 0.70.
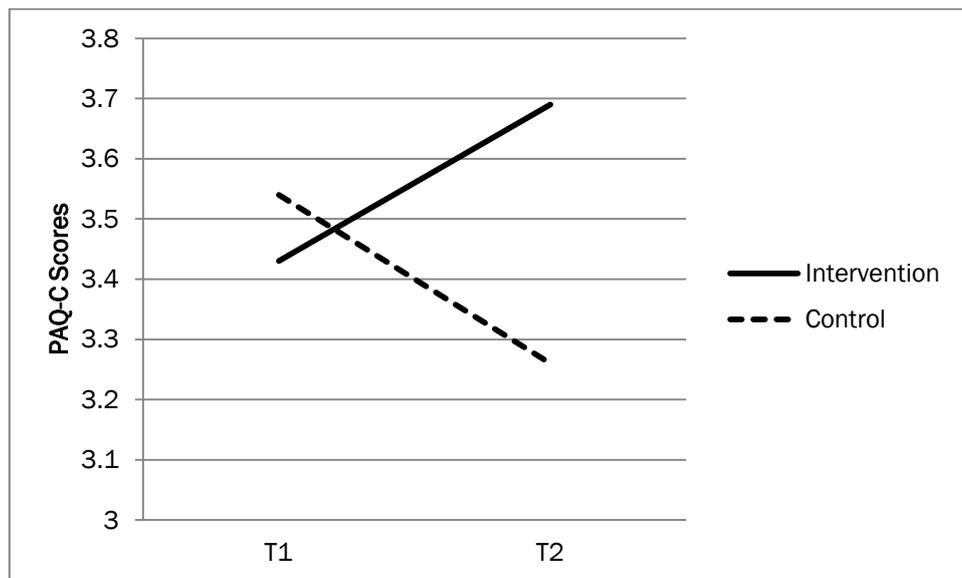

Figure 13.2 PAQ-C scores at baseline and follow up for the intervention and control group.

Did perceptions of CF and habit strength mediate the effects of the intervention on behaviour?

The effect of the intervention on PAQ-C scores at follow up (t3) was not mediated by CF or the SRBAI (t3).

Exploratory analyses

Exploratory analyses sought to examine the intervention effect (if any) on the intention – behaviour relationship. A 2 x 2 mixed ANOVA identified a small but significant ($F(1,84) = 13.64$, P < .001) decrease in physical activity intentions between baseline and follow up for both the intervention (t1 mean = 4.56, SD = .47, t2 mean = 4.32, SD = .69, *d* = 0.34) and control group (t1 mean = 4.56, SD = .47, t2 mean = 4.26, SD = .60, *d* = 0.56) representing a small and medium effect size respectively. There were no significant differences in physical activity intentions between groups at baseline or follow up.

Examination of the intention – behaviour relationship at baseline and follow up showed that intention behaviour consistency increased for both groups. At baseline intention - behaviour relations were moderate; Pearson's *r* was .44 and .45 for the control group and intervention group respectively. At follow up intention - behaviour relations remained moderate for those in the control group *r* = .49, however for those in the intervention group intention – behaviour relations were strong *r* = .67 (see table 13.5). The increase in *r* between t1 and t3 for the control group was 0.06, while the increase in *r* for the intervention group was 0.22.

At baseline intention – behaviour relations were similar for both groups. At follow up however, the difference between groups became more apparent. For example, the difference in the size of *r* between the intervention and control group increased by 0.17 over the study period, suggesting that intention – behaviour consistency grew stronger for those in the intervention group compared with those in the control group (see figure 13.3).

Table 13.5 Intention – behaviour relationship at baseline and follow up for the intervention and control group.

| Condition	I – B relationship at Baseline		I – B relationship at Follow up	
	R	P	*R*	P
Control	.44	.001	.49	<.001
Intervention	.45	.012	.67	<.001
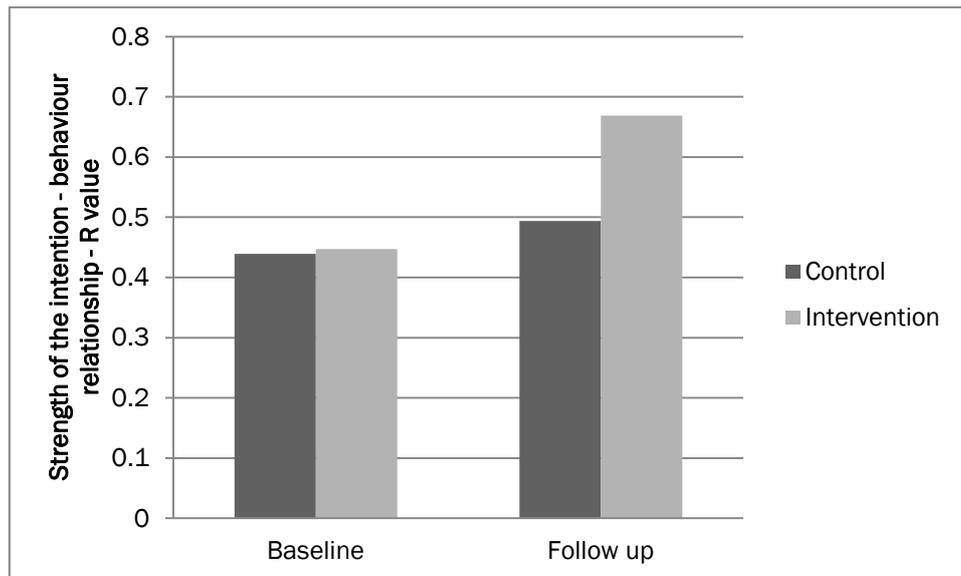
Figure 13.3 Difference in the strength of the intention – behaviour relationship between the intervention and control group at baseline and follow up

Process evaluation

Reach: The proportion of the intended target audience (i.e. after eliminating those participants who failed to meet the inclusion criteria) who attended phase I and II of the intervention was 100% (67) and 76% (47) respectively.

Dose delivered / received: In vivo observation revealed that all of the programme components in phase I and II were delivered by class teachers. All participants who attended phase I of the intervention were exposed to film 1, the class discussion and the fact finding activity. Similarly all those who attended phase II of the intervention were exposed to film 2 and the implementation intention activity. All participants who took part in the implementation intention activity provided evidence of forming at least 1 'if then' plan. However, only 13 out of 31 participants provided evidence that they had continued with, and completed the fact finding activity at home.

Fidelity: Fidelity to the programme specified in step-by-step guide was high. Overall fidelity ratings for both phase I and II of the programme were 100%. Nonetheless, it was evident that the intervention was constrained by curriculum time and that some of the delivery staff were resistant to truly interactive techniques.

Teacher evaluation: Three out of four delivery staff returned the teacher evaluation form. All of the 3 of the delivery staff indicated that they followed the step-by-step guide when delivering the programme components. Several strengths of the programme were identified. These included; the use of television/DVD as a channel of communication, i.e. "the videos were great", and helpfulness of the step-by-step guide, i.e. "clear instructions". One teacher also commented that the programme "really made children consider where they could go to exercise". Several weaknesses of the programme were also identified. For example, one teacher commented (in relation to the fact finding activity) that "many children will fail to return documents if they are sent home (returns on homework in our school are not very high)".

13.8   Discussion

The aim of this study was to design, implement and evaluate a school based, teacher led physical activity programme for children aged 9 – 11 years with the purpose of testing and refining the model developed in chapter 12. The results of this study indicated that the intervention was effective in influencing MVPA among children. This was evidenced by the significant decrease in PAQ-C scores from baseline to follow up for those participants in the control group combined with the significant increase in PAQ-C scores for those participants in the intervention group. There was also a significant difference in PAQ-C scores between the intervention and control group at follow up representing a medium to large effect size. Despite the significant increase in levels of MVPA among children in the intervention group, intervention effects could not be explained by the hypothesised determinants identified by the model developed in chapter 12, namely perceived accessibility of convenient facilities and habit strength. Examination of the intention – behaviour relationship at follow up showed that intention - behaviour consistency increased for both groups. However, the increase was much larger for those in the intervention group, suggesting that the intervention may have been successful in helping pupils to translate their positive intentions into action.

Although the intervention increased MVPA among children, it was not capable of generating change in the theoretical constructs hypothesized to mediate the

relationship between the intervention and MVPA. On the one hand initiatives designed to positively influence perceptions of the physical environment, are unlikely to be effective, if in reality, resources are unavailable. This will also have a knock on effect for the development of habit as behavioural reoccurrence is contingent on one's ability to perform the behaviour in the first place. On the other hand, it may be that the strategies and materials used in this study don't correspond to the change process suggested by the model or they may not have been suitable for use with children. For instance Implementation intentions were employed to increase habitual automaticity (see Verplanken & Orbell, 2010 for example), the idea being that they allow people to delegate control of behaviour to the environment. However, the formulation of 'if then' plans had no effect on SRBAI scores.

Perhaps then it may be possible to attribute the effectiveness of implementation intentions to the sense of commitment they engender; or as Ajzen (2005) suggests, by improving one's memory of the behavioural intention, which in turn leads to the conscious control of the critical behaviour. For example, by specifying where, when and how the behaviour will be performed, implementation intentions provide a number of specific cues that can enhance recall of the intention making it more likely that the intention will be carried out.

The results if this study correspond with previous exercise determinant research which has shown that intention-exercise relationships are generally stronger when implemental plans have been formulated (Norman & Conner, 2005b; Weidemann, Schuz, Sniehotta, Scholz & Schwarzer, 2009). Support for the notion of distinct motivational and volitional phases in behaviour can also be gleaned from these results, since the intervention improved intention-behaviour consistency without affecting the strength of the initial intention. The next step then, would be to formally test whether the intervention moderates the intention-behaviour relationship both between (i.e. intervention vs. control) and within groups (baseline and follow up). Unfortunately the small sample size in the present prevented such an analysis. According to Kenny (2009) one needs very large sample sizes over 200 to have reasonable power to detect moderator effects when one of the variables is continuous. For example, Aguinis (2004) has shown that the power of this test, i.e.

categorical moderator (intervention vs. control) and continuous causal variables (Intention and behaviour), can be very low, typically below 50% (Kenny, 2009).

Another reason why the intervention failed to generate change in SRBAI scores, may concern the amount of time it takes for habits to develop. For example, Lally et al. (2010) suggest that it takes, on average, 66 days (or 10 weeks) for automaticity scores to plateau, however the range was 18 to 234 days; indicating considerable variation in how long it takes people to reach their limit of automaticity and highlighting that it can take a very long time. It is also notable that in the Lally study exercise habits took one and a half times longer to plateau than eating or drinking habits. Consequently the study period (i.e. 10 weeks) may not have been long enough for children to establish a physical activity habit which was therefore reflected in SRBAI scores at follow up. If this is the case future interventions may need to provide continued support to help individuals perform a behaviour for long enough for it to be subsequently enacted with a high level of automaticity.

The process evaluation may also shed some light on why the intervention failed to influence perceived accessibility of convenient facilities and habit strength. For example, results suggest that while all participants received the fact finding component of the intervention, only 13 out of 31 pupils provided evidence that they had fully engaged with the activity. This may explain why the intervention failed to influence CF scores. Indeed one teacher commented that "returns on homework in our school are not very high". It was evident that the intervention was constrained by curriculum time and that some of the delivery staff were resistant to truly interactive techniques.

From a methodological perspective, the PEAPAQ and SRBAI may have been too insensitive to detect changes which may have resulted in an underestimation of intervention effects on the proposed mediators. For example, high mean scores observed on the SRBAI at baseline may render the measure unresponsive since there is little room for improvement. On the other hand, it may just be that the model on which the intervention was based incorrectly specified the mediating processes and requires further development.

Strengths and Limitations

The major strengths of this study include an explicit theoretical underpinning and clear correspondence between theoretical inspiration and adoption of particular change techniques. A further strength concerns the process evaluation which has provided important links to understanding why the intervention failed to produce change in the theoretical constructs hypothesized to mediate the relationship between the intervention and behaviour. However it is also important to note some important limitations.

Reported behaviour change can occur in the absence of actual behaviour change due to social desirability effects, particularly in those participants receiving an intervention. Thus future intervention studies which seek to modify socially desirable behaviours like physical activity should assess the impact of such bias through the inclusion of a social desirability measure.

Although ceiling effects were observed on the SRBAI, only 54% of children could be described as habitually active (i.e. they obtained a mean score of 4 [agreement] or higher). Hence there is considerable scope to improve children's physical activity habits, despite the ceiling effects observed on the SRBAI. To this end the SRBAI may not be particularly useful measure for intervention research and a more sensitive and responsive measure of children's physical activity habits should be developed.

Several authors have suggested that strongly habitual behaviours do not require much attention from intervention developers (Verplanken & Wood, 2006). Therefore one might argue that the intervention could have been better targeted, i.e. by focusing solely on non-habitual intenders. Unfortunately the sample size prevented such an analysis. However, several studies have found that even strongly habitual intenders occasionally fail to exercise. For example, Rhodes et al. (2010) report that about a quarter of habitual intenders did not translate their exercise intentions into action. Consequently, de Bruijn (2011) argues that exercise interventions should also continue to focus on those who are motivated exercisers with strong habits. Nonetheless future intervention research may wish to focus on non-habitual intenders, although these studies will need to recruit a much a larger sample than the one recruited here.

Ideally the study should have employed an active control condition as they are often considered superior to passive control conditions (Sheeran, Milne, Webb & Gollwitzer, 2005). It should have also examined the effectiveness of the specified behaviour change techniques in isolation as well as in combination. However the study design and small sample size prevented such analysis. Despite being decided statistically a priori, sample size was ultimately determined by the availability of schools (hence the convenience sample). The inclusion/exclusion criteria further reduced the sample size. Not only does the small convenience sample prohibit the generalisation of findings, it also has an adverse effect on statistical power. Adequate statistical power is important because underpowered studies are inconclusive if no effect is found. For example, MacKinnon et al. (2002) performed a simulation study in which they compared the power of different methods of mediation and found that the causal steps approach described by Baron and Kenny (1986) only demonstrated adequate statistical power when sample sizes were large, i.e. greater than 500. According to MacKinnon, the power to detect a medium effect with a sample size of 100 was only .28. With the above limitations in mind, the results of this study should be considered with caution.

Finally, although the intervention was designed to target children aged 9 – 11 years, the age range of children included in the study was 10 – 11 years. This is because the intervention was carried out late in the academic year (i.e. July), by which time most children would have had their 10th birthdays. Although the randomisation check identified a significant age difference between the intervention and control groups (representing a medium effect size), this was not considered important in view of the age range.

Conclusion

Interventions that positively affect behaviour, do not always affect the mediating variables on which they are predicated (Baranowski et al., 1998). However this does not necessarily invalidate a theory if the failure can be attributed to a limitation in study design, measures employed or if the procedures employed to test a given mediator were ineffective (Baranowksi, Klesges, Cullen & Himes, 2004; Hagger, 2011). For these reasons the intervention has been unable to provide any definitive conclusions concerning the efficacy of the model it was designed to test.

Nonetheless, it has drawn attention to several important and interesting avenues for future research. These will be discussed in chapter 14.

Chapter 14

General discussion

14.1 Summary of research findings

This project began with a brief review on the subject of physical activity and health (chapter 2). This was followed by a thorough examination of the literature regarding cognitive and environmental correlates of physical activity and an in depth review on the subject of habit (chapters 3 to 8). Bringing the expositions of the previous chapters together, chapter 9 provided an explicit rational and a formal statement of the study aims and objectives. Chapters 10 and 11 introduced the first two preliminary studies; namely the development and validation of a TPB questionnaire to assess physical activity cognitions in children and a psychometric evaluation of the PAQ-C. Chapter 12 utilized both the TPB and the PAQ-C from the previous chapters to delineate the mechanisms linking the environment and physical activity in children. Finally, chapter 13 described the development, implementation and evaluation of an intervention to increase MVPA in children with the purpose of testing and refining the model developed in chapter 12.

The literature review

Chapter 2 reviewed evidence for the role of physical activity in health promotion among children. The literature review showed that physical activity is associated with numerous health benefits for children which are predominantly seen in the amelioration of risk factors for disease, avoidance of weight gain, achieving a high peak bone mass and mental health.

Chapter 3 introduced the socio-cognitive approach and compared several key SCMs used in physical activity research; namely the HBM, PMT, SCT, TRA, TPB and the MGDB. On the basis of these comparisons both the MGDB and the TPB presented a strong case for predictive superiority, however the TPB was more parsimonious in that it used fewer constructs to explain and predict behaviour.

Chapter 4 examined the TPB in more detail and several important limitations were highlighted. For example, it was shown that the TPB does not explain all of the variance in physical activity intentions and behaviour and that it does not mediate the effect of certain 'background' variables. It was also shown that the TPB ignores the fact that we repeat most of our behaviours and that it devotes little attention to the role of habit. To this end research was presented which demonstrated that frequency of past behaviour predicts future behaviour over and above the TPB variables and that intentions are insufficient to account for the variability in behaviour when that behaviour is habitual. It was also shown that the TPB fails to recognize the importance of non-cognitive variables. Following these criticisms it was concluded that intentional control of physical activity behaviour may be more limited than the TPB assumes.

Chapter 5 reviewed the literature examining environmental correlates of children's physical activity. The most consistent positive correlates identified were; school related physical activity policies and time spent outdoors (Ferreira et al., 2006), programme/facility access and time outdoors (Sallis et al., 2000), use of a community recreation centre and lower levels of crime (Gordon-Larson et al., 2000) and school and neighbourhood characteristics (de Vet et al., 2010). It was also found that perceptions of the environment seem to be more important in the prediction of physical activity than the objective environment per se (e.g. Jones et al., 2007). Several limitations of environmental determinants research was identified including the over reliance on cross sectional designs and non-validated measures of environments and/or behaviour. It was concluded that better quality research identifying links between the environment and physical activity is needed.

Chapter 6 introduced a fairly recent approach to health promotion programming; the ecological approach, and presented two physical activity specific models; the ecological model of four domains of active living (Sallis et al., 2006) and the socio-ecological model of youth physical activity participation (Salmon, 2010). Despite accommodating for both individual and environmental accounts of behaviour several limitations of the ecological approach were identified, namely a lack specificity regarding the most important hypothesized influences and lack of information about how the levels of influence operate. The difficulties of conducting

research based on ecological models, developing measures, collecting data and conceptualising and implementing interventions at multiple levels was also discussed. The need to consider variables that are specific to each behaviour or category of behaviours was identified.

Chapter 7 provided an in depth review of habit. It was argued that habits are important to study since their repetitive nature exerts a significant cumulative effect on health; however a strong argument was made for why repetition should not be equated with habit. Four models of habitual control were presented; the direct context cueing model, motivated contexts model, implicit goals model and the model of the habit goal interface. Comparing research supporting each of these models it was concluded that habit is rigid and context cued in nature, but interfaces with goals during learning and performance. Next, the measurement of habit strength was addressed. It was argued that in terms of practicality, both the SRHI and the SRBAI were most suitable for use in self-administered questionnaires. Research was then presented which examined the additive and interactive effects of habit strength within the TPB. This research suggested that habit may provide an independent role in explaining behaviour from intention and interact with the intention-behaviour relationship. Following on from this research a Theory of Exercise habit formation was presented (e.g. Aarts et al., 1997). It was concluded that the planning of new physical activity habits should be explicitly adopted as an intervention goal.

Chapter 8 introduced the concept of implementation intentions. Convincing evidence for their effectiveness in promoting behaviour was presented, i.e. Gollwitzer and Sheeran (2006). It was suggested that implementation intentions may be an effective tool to create future habits.

Research findings

Chapter 10 introduced the first preliminary study; the development and validation of a brief TPB questionnaire to assess physical activity cognitions in children. A 20-item questionnaire was generated following a review of the literature. Based on feedback from the pre-test a second 13-item questionnaire was developed and

administered to a group of children aged 9 – 11 years from a primary school in the West Midlands (n = 105).

The TPB questionnaire was tested for both reliability and validity. Cronbach's alpha for the different scales (given their brevity) was found to be of an acceptable level (>0.60). In demonstrating evidence for both convergent validity (i.e. all corrected item total correlations > 0.30) and discriminant validity (i.e. all inter-scale correlations < 0.85) evidence for construct validity was demonstrated. Given the modest inter-item correlations between the instrumental and affective items, an EFA was employed to uncover the underlying structure of the attitude construct. Principle components analysis revealed one factor with loadings > 0.50, suggesting that attitude was best modelled as a single factor. The most significant contribution of this stage of the project was the development of a valid and reliable measure to assess physical activity cognitions in children for use in subsequent studies.

Chapter 11 examined the psychometric properties of the PAQ-C with a view to utilizing the questionnaire as the behavioural measure in subsequent studies. In order to assess clarity of wording and comprehensibility a small focus group was conducted (n = 10). Based on feedback from participants several minor modifications were made, mostly involving item wording or cultural adaptations to the activities listed in the physical activity checklist.

The questionnaire was administered to 107 children aged 9 – 11 years from a primary school in the West Midlands. Internal consistency was examined using Cronbach's alpha. Results revealed that scale reliability was acceptable α = 0.81. Two week test re-test reliability of the PAQ-C using Pearson's *r* was also conducted and found to be acceptable (*r* = 0.70). Construct validity was assessed using an EFA. Results of the EFA suggested the existence of three distinct factors which accounted for nearly 70% of the variance in scores. The results of the EFA suggested that the PAQ-C may be sensitive to the context in which the activity is performed, i.e. in school, outside of school and perhaps structured. This was consistent with previous research (e.g. Moore et al. 2007) and theorising (e.g. environmental and ecological perspectives). Despite the initial factor structure that emerged from the EFA, it was argued that the different dimensions may be

indicators of a higher order factor, i.e. total activity. To this end a second order factor analysis was conducted which revealed the presence of one distinct factor, suggesting that the first order factors are probably related to the same overarching construct. Taken together it was concluded that the PAQ-C was an acceptable tool for assessing general levels of MVPA in children.

Chapter 12 utilized both the TPB and the PAQ-C from the previous studies to delineate the mechanisms linking the environment and physical activity in children. Six hundred and twenty one pupils aged between 9 – 11 years were recruited from 4 primary schools in the West Midlands. TPB variables, perceived access to convenient facilities and resources in the home and school environment and habit strength were assessed at baseline. MVPA was assessed one week later.

Since limited information was available concerning the psychometric properties of the SRBAI, chapter 12 also sought to determine the reliability and factor structure of the scale using Cronbach's alpha and EFA. Results of the EFA revealed the existence of one distinct factor, presumably behavioural automaticity, with an acceptable reliability coefficient of 0.76. The SRBAI also converged as expected with the PAQ-C (r = 0.44). Taken together it was concluded that the SRBAI was indeed a valid and reliable measure of habitual automaticity in relation to MVPA in children.

Results of the behaviour prediction study showed that access to CF and resources in the HE held a significant direct effect on MVPA. CF also held a small significant effect on physical activity intentions. Mediation tests revealed that nearly 43% of the association between CF and intention was mediated through SNs (17%) and habit (26%) suggesting that when convenient facilities were perceived as accessible children held more positive subjective norms and stronger habits. This in turn motivated them to be more active which resulted in higher levels of MVPA. After controlling for the effects attitude, SN, PBC and habit strength, there was no significant direct effect of CF on physical activity intentions.

Mediation tests also showed that 15% of the association between CF and MVPA was mediated through habit strength alone, suggesting that when CF were easily accessible, children perceived more cues that induced habit strength and habitual

behavioural responses. Access to physical activity in the child's HE and CF were also found to exert a significant direct effect on MVPA. It was concluded that access to physical activity in the home environment and convenient facilities influence MVPA both directly and indirectly and that habit strength seems to be the most important mediator for this association.

Chapter 13 described the design, implementation and evaluation of a school based physical activity program for children. The purpose of this study was to test and refine the model developed in chapter 12. One hundred and fifty eight children aged 9 – 11 years from 4 primary schools in the West Midlands participated in the cluster randomised control trial. The mediating variable framework was used to assess the efficacy of the intervention as well as the roles played by habit and CF. A process evaluation was also conducted.

Results of the trial indicated that the intervention was effective in influencing MVPA among children; however it was not capable of generating change in the constructs hypothesized to mediate the relationship between the intervention and physical activity behaviour. There was however some evidence to suggest that the intervention may have been successful by helping pupils to translate their positive intentions into action. For example, it was suggested that the intervention (i.e. the implementation intention component) may have exerted its effect by improving memory of the initial intention (as opposed to enhancing behavioural automaticity), which in turn led to conscious control of behaviour. This would explain the increase in intention-behaviour consistency post intervention.

Several limitations concerning the study design, as well as the measures and procedures employed were identified. For this reason the intervention was unable to provide any definitive conclusions regarding the efficacy of the model it was designed to test. However it did draw attention to several important and interesting avenues for future research.

14.2   Further limitations and implications for future work

The TPB questionnaire

The development of the TPB questionnaire was based on a review of the literature and procedures suggested by Ajzen (2002b), Conner and Sparks (2005) and others. These researchers recommend that item responses are recorded on a Likert scale (anchored by strongly disagree / strongly agree) or a semantic differential scale. However, it is questionable whether young children really understand the concept of 'scales'. For example, we already know from the pre-test in chapter 10 that children had difficulty responding to the semantic differential scales and that there was a large variation in student reading levels and comprehension. Research was also presented which showed that children have difficulty in responding to negatively phrased items (e.g. Benson & Wilcox, 1981 in Weems et al. 2006; Benson & Hocevar, 1985). For these reasons future research may benefit from using pictorial representations in place of text; the ubiquitous smiley face for example, with expressions ranging from happy to unhappy.

Because the limited sample size precluded the use of more sophisticated methods of validity assessment such as CFA, convergent validity was examined using inter item and corrected item total correlations; however there are several problems associated with these techniques. First, looking for patterns of convergence in the correlation matrix can be rather subjective and unreliable (Dancey & Reidy, 2004). Another problem with inter item correlations is that they are based exclusively on the relations among manifest variables without explicitly taking the latent variable into account (Blunch, 2008). Also, in terms of the corrected item total correlations, just because the scale items appear to be related to the same construct doesn't automatically mean that construct is attitude, SN or otherwise. It may be that there is some other construct that all of the items are related to. Thus future research should seek to substantiate validity evidence further.

The PAQ-C

The second order factor analysis presented in chapter 11 provided initial evidence for the construct validity of the PAQ-C. However, factor analysis focuses on the measure itself; therefore further evidence for the construct validity of the PAQ-C in this group must be obtained using other measures. Confirmation of the first and second order factor structure is also recommended.

It is important that a measure can produce stable results when there is no reason to expect change. To this end, test re-test reliability is often employed to provide reassuring evidence that changes in scores are reliable and not due to the chance result of an unstable measure. The two week test re-test reliability of the PAQ-C reported in chapter 11 was 0.70; thus we can be relatively confident in its ability to measure consistently over time. Nonetheless, the Pearson product-moment coefficient only measures the variance of two measures from their linear relationship with one another; systematic biases are not identified. For this reason intra-class correlation (ICC) may be a more appropriate reliability statistic as it measures all forms of error (Ridley, 2005).

The flip side to test re-test reliability is responsiveness, i.e. an instruments ability to detect changes over time. In theory, a measure can have high test re-test reliability even when scores change over time (provided that individuals broadly retain their relative positions within the group). Responsiveness is an important validity test for instruments that are to be used for evaluative purposes, i.e. intervention studies that are intended to identify improvement or deterioration in physical activity scores. Common methods for evaluating responsiveness include comparing scale scores before and after an intervention using the responsiveness ration (Deyo, Diehr & Patrick, 1991), or comparing changes in scale scores with changes in other related measures that would be expected to move in the same direction as the target measure. Although validation studies have not yet explicitly examined the ability of the PAQ-C to detect changes over time, some support can be gleaned from physical activity intervention research. For example, Ernst and Pangrazi (1999) examined the efficacy of a 12 week school based physical activity intervention using the PAQ-C. Researchers found that the treatment group significantly increased their PAQ-C scores compared to a control group. This was also accompanied by a significant increase in children's 'attraction' to physical activity[12] measured using the Childrens Attraction to Physical Activity Questionnaire (Brustad, 1993). Since

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[12] Results related to attraction to physical activity were mixed. Results indicated no significant difference between treatment and control groups for boys, whereas intervention girls had significantly higher mean scores than control girls at mid test and post test.

responsiveness is considered a necessary measurement property for instruments intended for application in intervention studies, future research may wish to examine this issue in more detail.

Predicting MVPA

The focus of chapter 12 was on perceptions of the environment and the mechanisms through which they influence MVPA. To this end the study took a largely subjective approach since environmental factors were not objectively measured. The difficulty of measuring the environment using subjective measures in the case of strong habits has already been discussed, i.e. researchers cannot solely rely on subjective measures if environmental factors are postulated to be capable of influencing behaviour without individuals being consciously aware of them. However the question still remains as to whether it is really possible to access environmental structures (objectively speaking) in a way that differs from traditional subjective approaches? Even observational surveys and GIS rely to some extent on the subjectivity and perceptions of the researcher. For example, the accuracy and completeness of existing data sources as well as the geographic scale at which measures are available and aggregated will contribute to the capability of GIS based measures to discern what the environment is really like (objectively speaking). That said, multiple types of research are undoubtedly needed, including the application of both objective and subjective measures.

Perhaps one way of overcoming the deficiencies of traditional subjectivist and objectivist approaches and their associated methodologies would be to examine physical activity behaviours and habits and how they develop from the perspective of social practice theory (see chapter 6). Because social practice theory directs research attention towards action or the 'doing' of everyday practices and away from the individuals who perform them or the social structures that surround them, it implies the use of methodological techniques capable of observing what actually happens in the performance of behaviour in situ. From this perspective then, rather than relying solely on the results of questionnaire surveys which is typically the case with conventional subjectivist approaches, an ethnographic approach may be more suitable. For example, recorded observations with due attention to the context and

meaning assigned by the practitioner (obtained via key informant interviewing) may lead to richer and more subtle accounts of action in context (Hargreaves, 2011).

The focus of this project was on the physical environment and how it relates to MVPA. As a result an explicit examination of social factors was not within the remit of this project. However, physical activity is undoubtedly influenced by such factors. Activity related parenting practices and parental modelling, for example, are particular considerations especially in children. For instance, access to physical activity resources in the home environment and convenient facilities are likely to depend, to some extent, on parental rules, adequate adult supervision and safety concerns.

Access is also likely to be influenced by factors such as race, ethnicity, socio-economic status and area deprivation, as those living in deprived neighbourhoods may have fewer facilities, parks or green space and therefore have fewer opportunities for physical activity. Regrettably this study did not collect information directly from the children or their parents concerning SES or neighbourhood deprivation. It did however collect descriptive information a posteriori with regards the schools' ACORN profile; nonetheless the feasibility of using this index as a valid indicator of SES in physical activity studies with children is unknown. Not only is more evidence needed to elucidate interactions between social, demographic and environmental factors, future research should also statistically control for these variable in analyses linking accessibility and physical activity in children.

It was noted earlier that appropriate attitude measures should contain items representing both instrumental and affective components (Ajzen, 2002b). Nonetheless a higher order construct of attitude was invoked (as opposed to distinguishing between the specific components) in order to maintain the parsimony of the TPB. However some research has shown that intentions may be more closely related to affective than instrumental measures of attitudes (Lowe, Eves & Carroll, 2002; Lawton, Conner & McEachen, 2009). For example, Lowe, Eves and Carroll (2002) investigated the contribution of instrumental and affective components of attitude and found that the affective component was a much more powerful predictor of exercise intention compared to the instrumental component. What's

more after controlling for prior exercise behaviour, intention was not predictive of later exercise, although the affective component was. Given the current sample it seems likely that affective factors such as fun and enjoyment would play a much greater role in predicting physical activity than instrumental factors such as 'importance' or 'health', since a child's perceived susceptibility to heart disease or type II diabetes is likely to be small (Hay 2008, in Kremers & Brug, 2008). The implications of this are such that subsuming the differentiated components by a global higher order factor may result in potential dissociation of attitude with physical activity intentions and possibly behaviour. In other words combining instrumental and affective attitudes to form one factor may have diluted the beta weight between attitude and intention and masked a direct effect of affective attitude on physical activity behaviour.

This study presented theoretical arguments which postulated causal sequences with regard to the influence of the environment on physical activity. These arguments were supported by the results of hierarchical regression analyses. However, as acknowledged previously, this is not sufficient to imply causation. First, there are issues related to hierarchical regression analysis which suggest that structural equation modelling may be a more suitable method for assessing causation. Future research may wish to replicate the findings using structural equation modelling. Structural modelling techniques have various advantages over the regression approach, including a) having been especially developed for non-experimental data, b) testing all the relevant paths directly and c) incorporating complications of measurement error directly in the model. They were not employed in this research because they involve much more complex statistical analyses which require special training.

At its core this study is ultimately underpinned by the philosophical debate over free will and determinism. For example, the results call into question just how much free will individuals really have since behaviour was predominantly determined by habit and the environment. That said free will may motivate some behaviours by controlling exposure to the environmental cues which trigger habit performance (Wood & Neal, 2007). From an ecological perspective then, and indeed the

perspective of this thesis, causation of behaviour is widely dispersed and not lodged in one or another source.

The framing of health behaviour as the result of influences across diverse ecological layers also raises interesting questions about the role of individual responsibility for change (Sallis et al., 2008). For example, there is considerable evidence that improving access to physical activity by increasing the number of compulsory P.E classes at school increases levels of physical activity and physical fitness (Kahn et al., 2002). Thus it appears that restricting lifestyle choices can play an important role in promoting physical activity and health. However critics of such interventionist policies have argued that such measures are 'nanny statist' and an unnecessary intrusion into people's personal lives. This debate about the limits to state freedom and public health is not new (Thirlaway & Upton, 2009).

Cluster randomised control trial

Many of the limitations associated with the cluster randomised control trial were discussed in chapter 13. There are only a few additional points worth mentioning here. First, the responsiveness of the PAQ-C and the SRBAI has been discussed previously. Consistent with this discussion Bauman et al. (2006) argue that self-report instruments may not be suitable for intervention studies. These researchers argue that more detailed and extensive physical activity measures should be used when assessing the effects of physical activity programmes. To this end future research may benefit from adopting a multi-method approach to physical activity assessment, combing self-reports, proxy reports and objective measures such as accelerometry.

The degree of control over behaviour is an important element in the process of habit formation (Prochaska, 1994), since the possibility to carry out the same behaviour again next time constitutes an important link in the chain of repeated behaviour (Aarts et al., 1997). This suggests that children especially may have some difficulty establishing more complex physical activity habits such as swimming or attending an organised sport or exercise class which may depend to some extent on parental rules and adequate adult supervision. This may explain why the

intervention failed to increase habit strength given that parents ultimately control their child's exposure to more complex physical activity (habit) related cues[13]. It is also worth commenting here on the different types of activity that were measured by the PAQ-C in terms of the control that children of this age had. For example, one can assume that children would have greater control over relatively simple activities such as skipping or playing tag than compared to activities such as rowing or dry slope skiing which are subject to greater parental control.

John Hay (in Kremers & Brug, 2008) provides an interesting commentary related to the issue of control which questions the validity of habit as a suitable measure for children's physical activity. He argues that the initiation of a habit stems from the decision to do or not to do something that one is able to do and that the phrase 'able to do' is the key distinction between children and adults. Hay suggests that behaviour is only truly habitual when a) individuals are free to choose to do something that they are able to do and b) it is repeated with no apparent thought involved in the face of multiple available and possible choices. On both of these continuums however children are limited. Control is severely attenuated because children are captive to the desires of their parents, while opportunity choice is equally limited by physical capacity, socio-economic and environmental location. So although children might appear to habitually active, this might not be the result of automaticity being expressed in response to physical environmental cues but rather the expression of what a child is free to do among the opportunities available. This may explain why habit failed to mediate the environment behaviour relationship in the intervention study. According to Hay then, the consideration of habit in the context of children's physical activity requires an understanding of autonomy and opportunity choice - the conditions that both led to and allowed the 'apparent' habit to develop.

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[13] Unfortunately the data precludes from determining whether children were able to carry out their implementation intentions or not.

Finally it is possible that MVPA was affected by seasonality since baseline data was collected in the summer and follow up data was collected in the autumn. For example, Hopkins et al (2011) demonstrated the impact of seasonal changes on physical activity in a sample of 116 children (mean age – 10.7 years) between June and November. The results suggested that high intensity physical activity decreased between summer and autumn. The results of this trial are largely consistent with Hopkins et al. (2011) since there was a significant decrease in PAQ-C scores between July and September for those in the control group, suggesting that children were more active in the summer months. Conversely, there was a significant increase in PAQ-C scores for those in the intervention group between July and September, suggesting that the intervention may act to buffer adverse seasonal effects.

14.3   Contribution to the literature

On the face of it the development and validation of the TPB questionnaire presented in chapter 10 does not seem very unique. Nonetheless, Ajzen (2002b) states that in order to secure a reliable, internally consistent measure it is necessary to construct a questionnaire specific to the behaviour, time period and population of interest since different items may have to be used for different behaviours and for different research populations. Besides, according to Rhodes et al's. (2006) review of the literature; there were just three TPB studies that examined physical activity in preadolescent children. According to Armitage and Sprigg (2010), even accounting for those articles published since Rhodes et al. (2006), just one has tested the TPB in a sample that analyses the critical period, i.e. 9 – 11 years. .

Empirical support for the distinction between instrumental and affective attitudes has consistently been reported in TPB research with adults, yet no study has explicitly examined the operational construction of the attitude construct in the domain of children's physical activity. Thus in terms of making a unique contribution to the literature, chapter 10 examined the factor structure of the attitude construct in relation to children's MVPA. The results of the factor analysis suggested that children's attitudes towards physical activity were best represented by a single factor.

Until now the psychometric properties of the PAQ-C have been tested in Canadian and American children. Thus chapter 11 presented the first study to examine the psychometric properties of the PAQ-C in British youth. This study also contributed to the literature by demonstrating that the differentiated components of the PAQ-C identified in the first order factor analysis could be subsumed by a single higher order factor, presumably total activity. As such this is the first study to examine the second order factor structure of the PAQ-C. In both of these respects the study makes an original contribution to the literature.

Despite empirical evidence regarding the mediating role of cognitive factors, few studies have examined mediation of the environment - behaviour relationship by habit strength. Indeed, while mediation of the environment – behaviour relationship by the TPB and by habit strength has been explored in relation to active commuting, fruit consumption and soft drink consumption, it has not been previously explored in relation to children's MVPA.

Many studies examining habit – behaviour relations have utilized the SRHI to assess habit strength. Remember the SRHI portrays habit as the summary of the automaticity, behavioural frequency and relevance to self-identity of the focal behaviour (Gardner & Abraham, 2010) (see section 7.4). Recently however, researchers have argued that there is little evidence for self-identity as a central facet of habit. What's more it could be argued that habit effects occur because the SRHI contains items referring to the experience of past frequency which are then used to predict behavioural frequency as a criterion. In this respect then, the results from these studies may not be particularly new or insightful, since statistical associations between past and future behaviour have little explanatory value (Verplanken & Aarts, 1999; Ajzen, 2002a). The study presented in chapter 12 overcomes many of these limitations however, by employing a general measure of MVPA (i.e. the PAQ-C which does not provide frequency information) and an automaticity specific habit scale, i.e. the SRBAI. The application of the SRBAI in this respect therefore represents another novel and important aspect of this study. Chapter 12 also sought to determine the reliability and factor structure of the SRBAI. This represents yet another original contribution to the literature since

limited information is available concerning the psychometric properties of the SRBAI, especially in children.

Several reviews have been carried out in which the effectiveness of school based physical activity interventions have been summarised. However there is a dearth of high quality intervention research which has focused specifically on the critical period, i.e. 9 – 11 years. With few exceptions many of the school based interventions have been conducted in the U.S or Australia and have failed to utilize evidence based theory to identify key determinants of behaviour change as targets for intervention. Process evaluation, although important to understanding the mechanisms of behaviour change, has not often studied. Chapter 13 therefore makes an original contribution to the literature since it was the first intervention study to test the model developed in chapter 12, specifically focusing on children aged 9 – 11 years from the U.K.

Despite research and practice involving interventions to increase physical activity in children, the idea that interventions can promote behaviour change by creating habits has received little attention (Verplanken & Wood, 2006). This is largely due to the history and definition of habit, i.e. because researchers have equated habit with frequency of behaviour and thus viewed strong habits as frequent performance as opposed to automatic cueing. To this end chapter 13 presents one of the first intervention studies to explicitly adopt habituation as an intervention goal.

There is now a large body of research which has shown the positive effects of implementation intentions for increasing physical activity (e.g. Gollwitzer & Sheeran, 2006); yet only one study could be identified which tested their effects in preadolescent children (i.e. Armitage & Sprigg, 2010). In this study Armitage and Sprigg provided children with an experimenter generated implementation intention, the present study however encouraged children to form their own 'if then' plans using standard 'if then' manipulations. The present study therefore makes an original contribution to the literature since it suggests that self-generated implementation intentions are also effective for increasing MVPA in children.

In summary, this work makes an original contribution to the literature in terms of: a) providing evidence for the operational construction of attitude in the domain of

children's physical activity; b) presenting the first study to examine the psychometric properties of the PAQ-C in British youth; c) providing empirical evidence regarding the mediating role of SNs and habit strength in associations between CF and MVPA in children and employing the SRBAI as an alternative more parsimonious measure of habit; d) providing evidence for the validity and reliability of the SRBAI as a measure of habitual physical activity in children; e) conducting the first intervention study to test the model developed in chapter 12 and one of the first to adopt habituation as an intervention goal; f) providing evidence that self generated implementation intentions (combined with environmental awareness raising techniques) are effective in increasing MVPA in children.

14.4   Other future work

The separate factors resulting from the EFA in chapter 11 – 'Psychometric evaluation of the PAQ-C', if validated as such, may provide additional information on physical activity patterns and/or levels within specific behaviour settings. This is important as it permits the estimation of the relative contribution of MVPA in a particular domain to global MVPA, not to mention the possibility of examining inter-domain relationships. Moreover, according to Shepard (2003) no existing questionnaire explores the type of environment in which the individual normally undertakes physical activity. However the type of environment has particular importance in the context of motivation and habit. Indeed, providing information on the environmental setting is becoming increasingly important in physical activity research.

There is a lack of validated instruments to assess environmental factors, especially physical environments (Brug et al. 2008). What's more, perceived environment measures have generally emerged outside of the U.K; in Australia and the U.S and have been developed with adult populations. However the characteristics of the physical environment in the U.K are likely to differ from those in the U.S or Australia and may have different meanings in youth versus adult populations. Evidently there is a need for a child specific measure purposefully developed for use in the U.K. Many studies identify and measure either subjective or objective instances of the physical activity environment, but hardly any studies address them together. Future

studies should address this issue by employing multiple measures of the physical environment, e.g. self report questionnaires and GIS.

Previous research has shown that subjective measures of the environment are more strongly correlated with physical activity than objective measures (Jones et al., 2007). This finding implies that it may be important to effectively intervene on perceptions of the environment (i.e. by making individuals more aware of the opportunities in their environments) since perceptions play a role in shaping the services and recreational facilities we utilise. In order to achieve such awareness, it is necessary to have better insight into what influences an individual's perception of their physical activity environment. Another important research question revolves around the degree to which the accessibility of resources is associated with their use. However few studies have explored this issue.

Access to physical activity resources within any environmental setting can only be expected to be associated with those specific activities that can be facilitated by the accessibility of those resources and not with total activity. For example, resources and facilities in the school environment can only be expected to be associated with 'in school' or school related activity. The same holds true for resources and facilities at home or in the community. Future studies on environmental determinants of behaviour should therefore address the issue of compatibility by making sure that environmental attributes and physical activity are measured at the same level of specificity.

Another important avenue for future research concerns the differential processes by which implementation intentions facilitate participation in physical activity as well as an exploration of strategies for optimal implementation intention formation, i.e. number and specificity. Recent studies e.g. Orbell and Verplanken (2010) and De Vet, Oenema & Brug (2011) have begun to address these issues in adults; however, the underlying processes by which implemental planning facilitates physical activity and optimal strategies for implementation intention formation may be quite different in children.

14.5   Conclusion

"Changing the level of physical activity in the population is not rocket science… it is much more difficult than that" (Anon)

The way that children perceive their environment is crucial in shaping their physical activity habits. This knowledge has contributed to the protection of children's health since a sound theoretical understanding of physical activity and its determinants can provide useful guidance for promotional planners. That said, the process of planning an intervention and managing it from design through implementation to evaluation is complex, especially when the intervention involves multiple levels of influence. Despite these complexities, promotional planners must continually strive to improve the efficacy of such interventions if they are to make a significant impact on children's physical activity and in turn their health.

References

Aarts, H. and Dijksterhuis, A. (2000). Habits as knowledge structures: Automaticity in goal-directed behaviour. *Journal of Personality and Social Psychology, 78(1),* 53 – 63.

Aarts, H., Dijksterhuis, A. and Midden, C. (1999). To plan or not to plan? Goal achievement or interrupting the performance of mundane behaviours, *European Journal of Social Psychology, 29,* 971 – 979.

Aarts, H., Paulussen, T. and Schaalma, H. (1997). Physical exercise habit: On the conceptualisation and formation of habitual health behaviours. *Health Education Research, 12(3),* 363 – 374.

Aarts, H., Verplanken, B. and van Knippenberg, A. (1997). Habit and information use in travel mode choices. *Acta Psychologica, 96,* 1 – 14.

Abraham, C., Conner, M. Jones, F. and O'Connor, D. (2008). *Topics in applied psychology: Health psychology*. London: Hodder Education.

Abraham, C. and Sheeran, P. (2004). Deciding to exercise: The role of anticipated regret. *British Journal of Health psychology, 9(2),* 269 – 278.

Aguinis, H. (2004). *Moderated regression*. New York: Guilford.

Ainsworth, B., Haskell, W., Leon, A., Jacobs, D., Montoye, H., Sallis, S. and Paffenbarger, R. (1993). Compendium of physical activities: classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise, 25, 71* - 80.

Ajzen, I. (2005). *Attitudes, personality and behaviour (2nd Edn.).* Milton-Keynes: Open University Press / McGraw- Hill.

Ajzen, I. (2002a). Residual effects of past on later behaviour: Habituation and reasoned action perspectives. *Personality and Social Psychology Review, 6(2),* 107 – 122.

Ajzen, I. (2002b). *Constructing a TPB Questionnaire: Conceptual and Methodological Considerations.* Retrieved 1st November 2009 from: http://people.umass.edu/aizen/pdf/tpb.measurement.pdf

Ajzen, I. (2002c). Perceived behavioural control, self-efficacy, locus of control and the Theory of Planned Behaviour. *Journal of Applied Social Psychology, 32,* 1 – 20.

Ajzen, I. (1991). The Theory of Planned Behaviour. *Organizational Behaviour and Human Decision Processes, 50,* 179 – 211.

Ajzen, I., Brown, T. and Carvajal, F. (2004). Explaining the discrepancy between intentions and actions: The case of hypothetical bias in contingent valuation. *Personality and Social psychology Bulletin, 30,* 1108 – 1121.

Ajzen, I. and Driver, B. (1991). Prediction of leisure participation from behavioural, normative, and control beliefs: An application of the Theory of Planned Behaviour. *Leisure Sciences, 13,* 185 - 204.

Ajzen , I and Driver, B. (1992). Application of the Theory of Planned Behaviour to leisure choice. *Journal of Leisure Research, 24,* 207 – 224.

Ajzen, I. and Fishbein, M. (2005). The influence of attitudes on behaviour. In D. Albarracín, B. Johnson and M. Zanna (Eds.). *The handbook of attitudes,* 173 – 221.* Mahwah, NJ: Erlbaum.

Ajzen, I. and Fishbein, M. (2004). Questions raised by a reasoned action approach: Comment on Ogden (2003). *Health psychology, 23(4),* 431 – 434.

Ajzen, I. and Fishbein, M. (2001). Attitudes and the attitude-behaviour relation: Reasoned and automatic processes. *European Review of Social Psychology, 11, 1* – 33.

Ajzen, I., and Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour.* Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I. and Manstead, A. (2007). Changing health related behaviours: An approach based on the Theory of Planned Behaviour. In K. van den Bos, M. Hewstone, J. de wit, H. Schut and M. Stroebe (Eds.). *The Scope of Social Psychology: Theory and Applications,* 43 – 63. New York: Psychology Press.

Ajzen , I. and Timko, C. (1986). Correspondance between health attitudes and behaviour. *Journal of Basic and Applied Social Psychology, 7,* 259 – 276.

Andersen, L., Harro, M., Sardinha, L., Froberg, K., Ekelund, U., Brage, .S. et al. (2006). Physical activity and clustered cardiovascular risk in children: A cross-sectional study (The European Youth Heart Study). *The Lancet, 368,* 299 - 304.

Araujo-Soares, V., McIntyre, T., MacLennan, G. and Sniehotta, F. (2009). Development and exploratory cluster-randomised opportunistic trail of a theory based intervention to enhance physical activity among adolescents. *Psychology and Health, 24(7),* 805 – 822.

Armitage, C. and Conner, M. (2001). Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *British Journal of Social Psychology, 40,* 471 – 499.

Armitage, C. and Conner, M. (2000). Social cognition models and health behaviour: A structured review. *Psychology and Health, 15,* 173 – 189.

Armitage, C. and Sprigg, A. (2010). The roles of behavioural and implementation intentions in changing physical activity in young children with low socioeconomic status. *Journal of Sport and Exercise Psychology, 32,* 359 – 376.

Bagozzi, R. (1992). The self regulation of attitudes, intentions and behaviour. *Social Psychology Quarterly, 55,* 178 – 204.

Bagozzi, R. and Kimmel, S. (1995). A comparison of leading theories for the prediction of goal directed behaviours. *British Journal of Social Psychology, 34,* 437 – 461.

Bagozzi, R., Lee, H. and van Loo, M. (2001). Decisions to donate bone marrow: The role of attitudes and subjective norms across cultures. *Psychology and Health, 16,* 29 – 56.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

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

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37,* 122 – 147.

Baquet, G., Stratton, G. Van Praagh, E. and Berthoin, S. (2007). Improving physical activity assessment in children with high frequency accelerometry monitoring: A methodological issue. *Preventive Medicine, 44,* 143 – 147.

Baranowski, T., Anderson, C. and Carmack, C. (1998). Mediating variable framework in physical activity interventions: How are we doing? How might we do better? *American Journal of Preventive Medicine, 15(4),* 266 – 297.

Baranowski, T., Cullen, K., Nicklas, T., Thompson, D. and Baranowski, J. (2003). Are current health behaviour change models helpful in guiding prevention of weight gain efforts? *Obesity Research, 11,* 235S - 243S.

Baranowski, T. and Stables, G. (2000). Process evaluation of the 5-a-day projects. *Health education and Behaviour, 27(2),* 157 – 166.

Bargh, J. (1994). The four horsemen of automaticity: Awareness, intention, efficiency and control in social cognition. In R. Wyer and T.K. Srull (Eds.), *Handbook of Social Cognition* (Vol 1). Hillsdale, NJ: Erlbaum.

Bargh, J. (1990). Auto-motives: Preconscious determinants of social interaction. In E. Higgins and R. Sorrentino (Eds.), *Handbook of Motivation and Cognition.* New York: Guilford.

Bargh, J., Chen, M. and Burrows, L. (1996). Automaticity of Social behaviour: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology, 71,* 230 – 244.

Bargh, J., Gollwitzer, P., Lee-Chai, A., Brandollar, K. and Trotschel, R. (2001). The automated will. Non-conscious activation and pursuit of behavioural goals. *Journal of Personality and Social Psychology, 81,* 1014 – 1027.

Bargh, J. and Gollwitzer, P. (1994). Environmental control of goal directed action: Automatic and strategic contingencies between situations and behaviour. In W. Spaulding (Ed.). *Integrative views of motivation, cognition and emotion: Volume 41 of the Nebraska symposium on motivation,* 71 – 124. Lincoln, NE: University of Nebraska press.

Barker, R. (1968). *Ecological Psychology.* Stanford, CA: Stanford University Press.

Barker, R. and Schoggen, P. (1978). Measures of habitat and behaviour output. In R. Barker and associates (Eds.), *Habitats, environments and human behaviour: Studies in ecological psychology and eco-behavioural science from the Midwest psychological field station, 1947 – 1972,* 229 – 244. San Francisco: Jossey Bass.

Barnette, J. (2000). Effects of stem and Likert response option reversals on survey internal consistency: If you feel the need, there is a better alternative to using those negatively worded stems. *Educational and Psychological Measurement, 60,* 361 – 370.

Baron, R. and Kenny, D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173 - 1182.

Bartholomew, L., Parcel, G., Kok, G. and Gottlieb, N. (2006). *Intervention Mapping: A Process for Designing Theory and Evidence Based Health Education programs.* Mayfield, CA: Mountain View.

Bassett, D., Tremblay, M., Eslinger, D., Copeland, J., Barnes, J.D. and Huntingdon, G. (2007). Physical activity and body mass index of children in an old order Amish community. *Medicine and Science in Sports and Exercise, 39,* 410 – 415.

Bauman, A., Phongsavan, P., Schoeppe, S. and Owen, N. (2006). Physical activity measurement – a primer for health promotion. *Promotion and Education, 13(2),* 92 – 103.

Bauman, A., Sallis, J., Dzewaltowski, D. and Owen, N. (2002). Toward a better understanding of the influences on physical activity: The role of determinants, correlates, causal variables, mediators, moderators and confounders. *American Journal of Preventive Medicine, 23(2s),* 5 – 14.

Bem, D.J. (1972). Self-perception theory. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol.6), 1 – 62. New York: Academic Press.

Benson, J. and Hocevar, D. (1985). The impact of item phrasing on the validity of attitude scales for elementary school children. *Journal of Educational Measurement, 22,* 231 – 240.

Betsch, T., Brinkman, B., Fiedler, K. and Breining, K. (1999). When prior knowledge overrules new evidence: Adaptive use of decision strategies and the role of behavioural routines. *Swiss Journal of Psychology, 58,* 151 – 160.

Betsch, T., Fiedler, K. and Brinkman, B. (1998). Behavioural routines in decision making: The effects of novelty in task presentation and time pressure on routine maintenance and deviation. *European Journal of Social Psychology, 28,* 861 – 878.

Betsch, T., Haberstroh, S., Glöckner, A., Haar, T. and Fiedler, K. (2001). The effects of routine strength on adaptation and information search in recurrent decision making. *Organisational Behaviour and human decision processes, 93(1),* 62 – 74.

Biddle, S. and Cavill, N. (2007). *Promoting Physical Activity in Children: Review 1 – Descriptive Epidemiology.* Retrieved 6th August 2009 from: http://www.nice.org.uk/media/C7C/80/PromotingPhysicalActivityChildrenReview1Epidemiology.pdf

Biddle, S., Gorely, T., Pearson, N. and Bull, F. (2011). An assessment of self-reported physical activity instruments in young people for population surveillance: Project ALPHA. *International Journal of Behavioural Nutrition and Physical Activity, 8:1,* Retrieved 10th September 2010 from: http://www.ijbnpa.org/content/8/1/1

Biddle, S. and Mutrie, N. (2008). *Psychology of Physical Activity: Determinants, Well-Being and Interventions (2nd Ed).* Oxon: Routledge.

Biddle, S., Sallis, J. and Cavill, N. (Eds.). (1998). *Young and Active? Young People and Health Enhancing Physical Activity – Evidence and Implications.* London: Health Education Authority.

Blair, S., Clark, D., Cureton, K. and Powell, K. (1989). Exercise and fitness in childhood: Implications for a lifetime of health. In C. Gisolfi and D. Lamb

213

(Eds.), *Perspectives in Exercise and Sports Medicine, Vol.2: Youth Exercise and Sport,* 401 - 430. New York: McGraw-Hill.

Blaxter, M. (2004). *Health.* Cambridge: Polity Press.

Bliss, M. and Emshoff, J. (2002). *Workbook for designing a process evaluation*. Retrieved 16th April 2011 from: http://ebookbrowse.com/workbook-for-designing-a-process-evaluation-pdf-d13146467

Blunch, N.J. (2008). *Introduction to Structural Equation Modelling Using SPSS and AMOS*. London: Sage.

Bouchard, C. and Shephard, R. (1994). Physical activity, fitness and health. The model and key concepts. In C. Bouchard, R. Shephard and T. Stephens (Eds.), *Physical Activity, Fitness and Health,* 77 – 88, Champaign, IL: Human Kinetics.

Brandstätter, V., Lengfield, A. and Gollwitzer, P. (2001). Implementation intentions and efficient action initiation. *Journal of Personality and Social Psychology, 81,* 946 – 960.

British Heart Foundation. (2010). *Children and Physical Activity Policy Statement.* Retrieved 14th November, 2010 from: http://www.bhf.org.uk/pdf/Children%20and%20Physical%20Activity%20Policy%20Statement%20Policy%20Statement%20February%202010.pdf

Broffenbrenner, U. (1979). *The Ecology of Human Development.* Cambridge, MA: Harvard University Press.

Broffenbrenner, U. (1973). *Two worlds of childhood: U.S and U.S.S.R.* New York: Russel Sage Foundation.

Brownson, R., Hoehner, C., Brennan, L., Cook, R., Elliott, M. and McMullen, K. (2004). Reliability of two instruments for auditing the environment for physical activity. *Journal of Physical Activity and Health, 1,* 189 – 207.

Brownson, R., Hoehner, C., Day, K., Forsyth, A. and Sallis, J. (2009). Measuring the built environment for physical activity: State of the Science. *American Journal of Preventive Medicine,* 36(4 Suppl), S99 – 123.

Brug J. (2007). The European charter for counteracting obesity: A late but important step towards action Observations on the WHO-Europe ministerial conference, Istanbul, November 15-17, 2006. *International Journal of Behavioural Nutrition and Physical Activity, 4(*11). Retrieved 7th February 2011 from: http://www.ijbnpa.org/content/pdf/1479-5868-4-11.pdf

Brug, J., de Vet, E., de Nooijer, J and Verplanken, B. (2006). Predicting fruit consumption: Cognitions, intention and habits. *Journal of Nutrition Education and Behaviour, 38,* 73 – 81.

Brug, J., Kremers, S., van Lenthe, F., Ball, K. and Crawford, D. (2008). Symposium on 'behavioural nutrition and energy balance in the young'. *Environmental determinants of healthy eating: In need of theory and evidence.* A meeting of the Nutrition Society, hosted by the Scottish section, held at West Park conference centre Dundee on March 27th and 28th 2008.

Brug, J., van Lenthe, F. and Kremers, S., (2006). Revisiting Lewin: How to gain insight in environmental correlates of obesogenic behaviours. *American Journal of Preventive Medicine, 31,* 325 – 529.

Brug, J. and van Lenthe, F. (2005). Chapter 1: Introduction and Outline. In J. Brug and F. van Lenthe (Eds.). *Environmental determinants and interventions for physical activity, nutrition and smoking: A review.* Retrieved 11th January from:http://www.rivm.nl/Images/20060228%20Review%20Bewegen_tcm4-27338.pdf

Brug, J., Velde, S., Chinapaw, M., Bere, E., de Bourdeaudhuij, I., Moore, H., et al. (2010). Evidence-based development of school-based and family-involved prevention of overweight across Europe: The ENERGY-project's design and conceptual framework. *BMC Public Health,* 10:276. Retrieved 11th January 2011 from: http://www.biomedcentral.com/1471-2458/10/276

Brustad, R. (1993). Who will go out and play? Parental and psychological influences on children's attraction to PA. *Paediatric Exercise Science, 5,* 210 - 223.

Buckworth, J. and Dishman, R. (2002). *Exercise Psychology.* London: Human Kinetics.

Casperson, C.J., Powell, K.E and Christenson, G.M. (1985). Physical activity, exercise and physical fitness: Definitions and directions for health related research. *Public Health Reports, 100(2),* 126 – 131.

Change4Life: Eat well, move more, live longer. (2010). Retrieved 12th November 2010 from: http://www.nhs.uk/change4life/Pages/change-for-life.aspx?

Chatzisarantis, N. and Hagger, M. (2007). Mindfulness and the intention behaviour relationship within the Theory of Planned Behaviour. *Personality and Social Psychology Bulletin, 33,* 663 – 676.

Chinapaw, M., Mokkink, L., van Poppel, M., van Mechelen, W. and Terwee, C. (2010). Physical Activity Questionnaires for Youth: A Systematic Review of Measurement Properties. S*ports Medicine, 40(7),* 539 - 563.

Clark, E., Tobias, J. and Ness, A. (2006). Association between bone density and fractures in children: A systematic review and meta-analysis. *Paediatrics, 117*, e291 – e 297.

Cohen, D., Ashwood, S., Scott, M., Overton, A., Evenson, K. and Voorehees, C. et al. (2006). Proximity to school and physical activity among middle school girls: The trial of activity for Adolescent Girls Study. *Journal of Physical Activity and Health, 3(1S),* S129 – S138.

Conner, M. and Norman, P. (2005). Predicting health behaviour: A social cognition approach. In M. Conner and P. Norman (Eds.). *Predicting Health Behaviour (2nd Ed.).* Berkshire: Open University Press.

Conner, M. and Sparks, P. (2005). Theory of Planned Behaviour and health behaviour. In M. Conner and P. Norman, *Predicting Health Behaviour (2nd Edn.),* 170 – 222, Berkshire: Open University Press.

Connolly, K. and Martlew, M. (1999). *Psychologically speaking: A book of quotations.* Leicester, UK: British Psychological Society Books.

Corder, K., Ekelund, U., Steele, R., Wareham, N. and Brage, S. (2008). Assessment of physical activity in youth. *Journal of Applied Physiology, 105,* 977 – 987.

Courneya, K. (1994). Predicting repeated behaviour from intention: The issue of scale correspondence. *Journal of applied social psychology, 24,* 580 - 594.

Courneya, K., Conner, M. and Rhodes, R. (2006). Effects of different measurement scales on the variability and predictive validity of the 'two component' model of the theory of planned behaviour in the exercise domain. *Psychology and Health, 21(5),* 557 – 570.

Craig, R. and Mindell, J. (Eds.). (2008). *Health Survey for England 2006: Volume 2 - Obesity and Other Risk Factors in Children.* Retrieved 1st November 2009 from: http://www.ic.nhs.uk/webfiles/publications/HSE06/HSE06_VOL2.pdf

Craig, R., Mindell, J. and Hirani, V. (2009). *Health Survey for England 2008: Volume 1 – Physical Activity and Fitness.* Retrieved 15th July 2011 from: http://www.ic.nhs.uk/webfiles/publications/HSE/HSE08/Volume_1_Physical_activity_and_fitness_revised.pdf

Crocker, P., Bailey, D., Faulkner, R., Kowalski, K. and McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the Physical Activity Questionnaire for Older Children. *Medicine and Science in Sports and Exercise, 29(10),* 1344 – 1349.

Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psycometrika, 16,* 297 – 334.

Cummings, M., Becker, M. and Maile, M. (1980). Bringing models together: An empirical approach to combining variables used to explain health actions. *Journal of Behavioural Medicine, 3,* 123 – 145.

Dale, D., Welk, G. and Matthews. C. (2002). Methods for assessing physical activity and challenges for research. In G. Welk (Ed.). *Physical Activity Assessments for Health-Related Research*, 19 – 34. Human Kinetics, Champaign, Ill.

Dancey, C. and Reidy, J. (2004). *Statistics without maths for psychology.* Essex: Prentice Hall.

Davison, K. and Lawson, C. (2006). Do attributes in the physical activity environment influence children's physical activity. A review of the literature. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 1st November 2009 from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1557665

Daw, N., Niv, Y. and Dayan, P. (2005). Uncertainty based competition between prefrontal and dorsolateral striatal systems for behavioural control. *Nature Neuroscience, 8,* 1704 – 1711.

Day, K., Boarnet, M., Alfonzo, M. and, Forsyth, A. (2006). The Irvine–Minnesota inventory to measure built environments: development. *American Journal of Preventive Medicine, 30(2),* 144 – 52.

De Bourdeaudhuij, I. Van Cauwenberghe, E., Spittaels, H., Oppert, J., Rostami, C., Brug, J. et al. (2011). School based interventions promoting both physical activity and healthy eating in Europe: A systematic review within the HOPE project. *Obesity Reviews, 12(3),* 205 – 216.

De Bruijn, G. (2011). Exercise habit strength, planning and the Theory of Planned Behaviour: An action control approach. *Psychology of Sport and Exercise, 12,* 106 – 114.

De Bruijn, G. (2010). Understanding college students' fruit consumption. Integrating habit strength in the Theory of Planned Behaviour. *Appetite, 54,* 16 – 22.

De Bruijn, G., Kremers, S., De Vet, E., De Nooijer, J., Van Mechelen, W. and Brug, J. (2007). Does habit strength moderate the intention-behaviour relationship in the Theory of Planned Behaviour? The case of fruit consumption. *Psychology and Health, 22(8),* 899 – 916.

De Bruijn, G., Kremers, S., Lensvelt-Mulders, G., de Vries, H., van Mechelen, W. and Brug, J. (2006). Modelling individual and physical environmental factors with adolescent physical activity. *American Journal of Preventive Medicine, 30(6),* 507 – 512.

De Bruijn, G., Kremers, S., Schaalma, H., van Mechelen, W. and Brug, J. (2005). Determinants of bicycle use for transportation and snacking behaviour. *Preventive Medicine, 40,* 658 – 667.

De Bruijn, G., Kremers, S., Singh, A., van den Putte, B. and van Mechelen, W. (2009). Adult active transportation: Adding habit strength to the Theory of Planned Behaviour. *American Journal of Preventive Medicine, 36(3),* 189 - 194.

De Bruijn, G., Kroeze, W., Oenema, A. and Brug, J. (2008). Saturated fat consumption and the Theory of Planned Behaviour: Exploring additive and interactive effects of habit strength. *Appetite, 51,* 318 – 323.

De Bruijn, G. and van den Putte, B. (2009). Adolescent soft drink consumption, television viewing and habit strength. Investigating clustering effects in the Theory of Planned Behaviour. *Appetite, 53,* 66 – 75.

Department for Children, Schools and Families. (2008). The 2007/08 School Sport Survey. Retrieved 14th November 2010 from: https://www.education.gov.uk/publications/eOrderingDownload/DCSF-RW063.pdf

Department of Health. (2011). *Start active, stay active.* Retrieved 15th July 2011 from:http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_128210.pdf

Department of Health. (2005). Choosing *activity: a physical activity action plan.* London: Department of Health.

Department of Health. (1993). *The Health of the Nation: A strategy for Health for England.* London: HMSO.

Department of Health and Department for Children, Schools and Families. (2008). Healthy weight, healthy lives: A cross governmental strategy for England. Retrieved 15th July 2011 from: http://webarchive.nationalarchives.gov.uk/20100407220245/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_084024.pdf

DeVellis, R. (1991). *Scale Development: Theory and Applications* (Vol. 26). Newbury Park: SAGE.

De Vet, E., De Ridder, D. and De Wit, J. (2010). Environmental correlates of physical activity and dietary behaviours among young people: a systematic review of reviews. *Obesity reviews,* (5), 1 - 13.

De Vet, E., Oenema, A. and Brug, J. (2011). More or better: Do the number and specificity of implementation intentions matter in increasing physical activity? *Psychology of Sport & Exercise*, 12(4), 471 - 477.

Deyo, R., Diehr, P., and Patrick, D. (1991). Statistics and strategies for evaluation. *Controlled Clinical Trials, 12*, 142S - 158S.

Dickinson, A., and Balleine, B. (1995). Motivational control of instrumental action. *Current Directions in Psychological Science, 4,* 162 – 167.

Dietz, W. (1996). The role of lifestyle in health: the epidemiology and consequences of inactivity. *Proceedings of the Nutrition Society, 55,* 829 - 840.

Dijksterhuis, A., Bargh, J. and Miedema, J. (2000). Of men and mackerels. Attention and automatic behaviour. In H. Bless and J. Forgas (Eds.), *Subjective Experience in Social Cognition and Behaviour,* 36 – 51. New York: Psychology Press.

Dijksterhuis, A., Spears, R. and Lepinasse, V. (2001). Reflecting and deflecting stereotypes: Assimilation and contrast in impression formation and automatic behaviour. *Journal of Experimental Social Psychology, 37,* 286 – 299.

Duncan, S., Duncan, T., Stryker, L. and Chaumeton, N. (2004). A Multi-level approach to youth physical activity research. *Exercise and Sport Sciences Reviews, 32,* 95 – 99.

Duncan, M., Spence, J. and Mummery, W. (2005). Perceived environment and physical activity: A meta-analysis of selected environmental characteristics. *International Journal of Behavioural Nutrition, 2:11.* Retrieved 1st November 2009 from: http://www.ijbnpa.org/content/2/1/11

Dunn, A., Trivedi, M. and O'Neal, H. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. *Medicine and Science in Sports and Exercise,* 33, S587 - S597.

Durant, N., Harris, S., Doyle, S., Person, S., Saelens, B., Kerr, J. et al. (2009). Relation of school environment and policy to adolescent physical activity. *Journal of School Health, 79(4),* 153 – 15

Durstine, J., Grandjean, P., Davis, P., Ferguson, M., Alderson, N. and DuBose, K. (2001) Blood lipid and lipoprotein adaption to exercise: a quantitative analysis. *Sports Medicine,* 31: 1033 - 1062.

Eagly, A. and Chaiken, S. (1993). *The Psychology of Attitudes.* Fort Worth, TX: Harcourt Brace Jovanovich.

Ebbeling, C., Pawlak, D. and Ludwig, D. (2002). Childhood obesity: Public health crisis, common sense cure. *Lancet, 360,* 473 – 482.

Ekelund, E., Heian, F., Hagen, K., Abbott, J. and Nordheim, L. (2004). *Exercise to improve self-esteem in children and young people.* The Cochrane database of Systematic Reviews, Issue 1. Art.No: CD003683 DOI: 10.1002/14651858.

Emons, H., Groenenboom, D., Westerp, K. and Saris, W. (1992). Comparison of Heart rate monitoring combined with indirect calorimetry and the doubly labelled water (2H2(18)O) method for the measurement of energy expenditure in children. *European Journal of Applied Physiology, 65(2),* 99 – 103.

Ernst, M. and Pangrazi, R. (1999). Effects of a physical activity program on children's activity levels and attraction to physical activity. *Paediatric Exercise Science, 11*, 393 - 405.

Erwin, H. (2008). Test-retest reliability of a preadolescent environmental access to physical activity questionnaire. *Journal of Physical Activity and Health, 5(1),* S62 – S72.

Erwin, H., Mays Woods, A., Woods, M. and Castelli, D. (2007). Chapter 6: Children's environmental access in relation to motor competence, physical activity and fitness. *Journal of Teaching in Physical Education, 26,* 404 – 415.

Evenson, K., Eyler, A., Wilcox, S., Thompson, J. and Burke, J. (2003). Test-retest reliability of a questionnaire on physical activity and its correlates among women from diverse racial and ethnic groups. *American Journal of Preventive Medicine, 25(3S1),* 15 – 22.

Evenson, K. and McGinn, A. (2005). Test re-test reliability of a questionnaire to assess physical environmental factors pertaining to physical activity. *International Journal of Behavioural Nutrition and Physical Activity, 15, 2:7.* Retrieved 22nd July 2011 from*:* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1183237/pdf/1479-5868-2-7.pdf

Faul, F., Erdfelder, E., Lang, A. and Buchner, A. (2007) .G*Power 3: A flexible statistical power analysis program for the social, behavioural, and biomedical sciences. *Behaviour Research Methods, 39,* 175 - 191.

Ferreira, I., van der Horst, K., Wendel-Vos, W., Kremers, S., van Lenthe, F. and Brug, J. (2006). Environmental correlates of physical activity in youth – a review and update. *Obesity Reviews, 8,* 129 – 154.

Field, A. (2005). *Discovering statistics using SPSS: and sex and drugs and rock 'n' roll (2nd Edn.).* London: Sage.

Fishbein, M. and Ajzen, I. (1975). *Belief, attitude, intention and behaviour.* New York: Wiley.

Fiske, S. and Taylor, S. (1991). *Social cognition (2nd Edn.).* New York: McGraw Hill.

Floyd, D., Prentice-Dunn, S. and Rogers, R. (2000). A meta-analysis of Protection Motivation Theory, *Journal of Applied Social Psychology, 30,* 407 – 429.

Forsyth, A., Schmitz, K., Oakes, M., Zimmerman, J. and Koepp, J. (2006). Standards for environmental measurement using GIS: toward a protocol for protocols. *Journal of Physical Activity and Health, 3(1S),* S241 – S257.

Foster, C. and Hillsdon, M. (2004). Changing the environment to promote health enhancing physical activity. *Journal of Sports Science, 22,* 755 – 769.

Francis, J., Eccles, M., Johnston, M., Walker, A., Grimshaw, J., Foy, R. et al. (2004). *Constructing questionnaires based on the Theory of Planned Behaviour: A manual for health services researchers*. Retrieved 1st November 2009 from: http://people.umass.edu/aizen/pdf/Francis%20etal.TPB%20research%20manual.pdf

French, D., Sutton, S., Hennings, S., Mitchell, J., Wareham, N., Griffin, S., Hardeman, W. and Kinmonth, A. (2005). The Importance of Affective Beliefs and Attitudes in the Theory of Planned Behaviour: Predicting Intention to Increase Physical Activity. *Journal of Applied Social Psychology, 35(9),* 1824 - 1848.

Gardner, B. and Abraham, C. (2009). Measuring habit as automaticity: Development and validation of a self-report behavioural automaticity index, Poster presented at the Division of Health psychology Annual Conference, Aston University Birmingham, 9 – 11th September 2009.

Gardner, B., de Bruijn, G. and Lally, P. (2011). A systematic review and meta-analysis of applications of the Self-Report Habit Index to Nutrition and Physical Activity Behaviours. *Annuals of Behavioural Medicine* [ahead of print]*.* Abstract retrieved 3rd August 2011 from: http://www.ncbi.nlm.nih.gov/pubmed/21626256

Gauvin, L., Levesque, L. and Richard, L. (2001). Helping people initiate and maintain a more active lifestyle: A public health framework for PA promotion research. In R. Singer, H. Hausenblas and C. Janelle (Eds.). *Handbook of Sport Psychology (2nd Edn.),* 718 – 739. New York: Wiley.

Giddens, A. (1979). *Central Problems in Social Theory. Action, Structure and Contradiction in Social Analysi*s. London: Macmillan.

Giles-corti, B*.* (2006). People or places: What should be the target? *Journal of Science and Medicine in Sport*, 9, 357 – 366.

Giles-Corti, B. and Donovan, R. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science and Medicine, 54, 1793 –* 1812.

Godin, G. and Kok, G. (1996). The Theory of Planned Behaviour: A review of its applications to health related behaviours. *American Journal of Health Promotion, 11(2),* 87 – 98.

Godin, G. and Shephard, R. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Science, 10,* 141 – 146.

Gollwitzer, P. (1993). Goal achievement: The role of intentions. In W, Stroebe and M, Hewstone (Eds,), *European review of social psychology,* 141 - 185, Chichester: Wiley.

Gollwitzer, P. (1990). Action phases and mind-sets. In E. Higgins and R. Sorrentino (Eds.), *The handbook of motivation and cognition: Foundations of social behaviour* (Vol. 2), 53 - 92. New York: Guilford Press.

Gollwitzer, P. and Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology, 38,* 69 - 120.

Gomez, J., Johnson, B., Selva, M. and Sallis, J. (2004). Violent crime and outdoor physical activity among inner-city youth. *Preventive Medicine, 39,* 876 – 881.

Gordon-Larson, P., McMurray, R. and Popkin, B. (2000). Determinants of adolescent physical activity and inactivity patterns. Paediatrics, 105(6), retrieved 11th January 2011 from: http://pediatrics.aappublications.org/cgi/reprint/105/6/e83

Guillaumie, L., Godin, G. and Vézina-Im, L. (2010). Psychosocial determinants of fruit and vegetable intake in adult population: A systematic review. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 22nd July 2011 from: http://www.ijbnpa.org/content/7/1/12

Gutin, B and Owens, S. (2011). The influence of physical activity on cardiometabolic biomarkers in youths: A review. *Paediatric Exercise Science, 23(2),* 169 – 185.

Hagger, M. (2011). Understanding the mechanism of physical activity behaviour change: Challenges and a call for action. *Psychology of Sport and Exercise, 12,* 1 – 6.

Hagger, M. and Chatzisarantis, N. (2005a). *The Social Psychology of Exercise and Sport.* Berkshire: Open University Press.

Hagger, M. and Chatzisarantis, N. (2005b). First and higher order models of attitude, normative influence, and perceived behavioural control in the

Theory of Planned Behaviour. *British Journal of Social Psychology, 44,* 513 – 535.

Hagger, M., Chatzisarantis, N., Barkoukis, V., Wang, J., Hein, V., Pihu, M. et al. (2007). Cross cultural generalisability of the Theory of Planned Behaviour among young people in a physical activity context. *Journal of Sport and Exercise Psychology, 29(1),* 1 – 19.

Hagger, M., Chatzisarantis, N. and Biddle, S. (2002). A meta-analytic review of the theories of Reasoned Action and Planned Behaviour in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24(1),* 3 – 32.

Hagger, M, Chatzisarantis, N., Biddle, S. and Orbell, S. (2001). Antecedents of children's physical activity intentions and behaviour: Predictive validity and longitudinal effects. *Psychology and Health, 16(4),* 391 – 407.

Hallal, P., Victoria, C., Azevedo, M. and Wells, J. (2006). Adolescent physical activity and health: a systematic review. *Sports Medicine, 36(12),* 1019 – 1030.

Hamilton, K., and White, K. (2008). Extending the Theory of Planned Behaviour: The role of self and social influences in predicting adolescent regular moderate-to-vigorous physical activity. *Journal of Sport and Exercise Psychology, 30(1),* 56 - 74.

Handy, S. (2004). *Critical assessment of the literature on the relationships among transportation, land use, and physical activity.* Department of Environmental Science and Policy, University of California, Davis: Davis CA. Prepared for the Committee on Physical Activity, Health, Transportation, and Land Use.

Hargreaves, T. (2011). Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *Journal of consumer culture, 11,* 79 – 99.

Hausenblas, H., Carron, A. and Mack, D. (1997). Applications of the theories of Reasoned Action and Planned Behaviour to exercise behaviour: A meta analysis. *Journal of Sport and Exercise psychology, 19(1),* 36 – 51.

Hind, K. and Burrows, M. (2007). Weight-bearing exercise and bone mineral accrual in children and adolescents: A review of controlled trials. *Bone, 40,* 14 - 27.

HM Treasury. (2004). *Spending review.* Department for Culture, Media and Sport. HMSO: London.

Hopkins, N., Stratton, G., Tinken, T., Ridgers, N., Graves, L., McWhannell, N. et al. (2011). Seasonal reduction in physical activity and flow-mediated dilation in children. *Medicine and Science in Sports and Exercise, 43(2),* 232 – 238.

Hume, C., Ball, K. and Salmon, J. (2006). Development and reliability of a self-report questionnaire to examine children's perceptions of the physical activity environment at home and in the neighbourhood. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 22nd July 2011 from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1550247/

Humpel, N., Owen, N. and Leslie, E. (2002). Environmental factors associated with adult's participation in physical activity. *American Journal of Preventive Medicine, 22,* 188 – 199.

Hussey, J., Bell, C. and Gormley, J. (2007). The measurement of physical activity in children. *Physical Therapy Reviews, 12,* 52 – 58.

Iwasaki, Y., Zuzanek, J. and Mannell, R. (2001). The effects of physically active leisure on stress-health relationships. *Canadian Journal of Public Health,* 92, 214 - 218.

Jackson, C., Smith, R. and Conner, M. (2003). Applying an extended version of the Theory of Planned Behaviour to physical activity. *Journal of Sports Sciences, 21(2),* 119 – 133.

James, W. (1890). *The Principles of Psychology* (Vol.1). London: Macmillan.

Janz, K., Lutuchy, E., Wenthe, P. and Levy, S. (2008). Measuring activity in children and adolescents using self-report: PAQ-C and PAQ-A. *Medicine and Science in Sports and Exercise, 40, 4,* 767 – 772.

Ji, M. and Wood, W. (2007). Purchase and consumption habits: Not necessarily what you intend. *Journal of Consumer Psychology, 17(4),* 261 – 276.

Jones, A., Bentham, G., Foster, C., Hillsdon, M. and Panter, J. (2007). *Tackling Obesities: Future Choices – Obesogenic Environments – Evidence Review.* United Kingdom Government Foresight programme, Office of Science and Innovation: London.

Jones, A. and Panter, J. (2010). Availability and accessibility in physical activity environments. In A. Lake, T. Townshend and S. Alvanides (Eds.), *Obesogenic Environments: Complexities, Perceptions and Objective Measures,* Chichester: Wiley-Blackwell.

Kahle, L. and Beatty, S. (1987). The task situation and habit in the attitude behaviour relationship: A social adaption view. *Journal of Social Behaviour and Personality, 2,* 219 – 232.

Kelley, D. and Goodpaster, B. (2001). Effects of exercise on glucose homeostasis in Type 2 diabetes mellitus. *Medicine and Science in Sports and Exercise,* 33, S495 - S501.

Kenny, D. (2009). *Mediation.* Retrieved 15th January 2010 from: http://davidakenny.net/cm/mediate.htm

Kenny, D. (1998). *Structural Equation Modelling.* Retrieved 1st November 2009 from: http://davidakenny.net/cm/mfactor.htm#Dv

Kerr, J., Saelens, B., Rosenberg, D., Norma, G., Durant, N., Eggerman, J. and Sallis, J. (2006). *Active Where? Multi-Region Formative Research to Understand Children's Physical Activity Environments.* San Diego: Active living Research.

Khan, F., Green, F., Forsyth, J., Greene, S., Morris, A. and Belch, J. (2003). Impaired microvascular function in normal children: Effects of adiposity and poor glucose handling. *Journal of Physiology, 551,* 705 – 711.

Kahn, E., Ramsey, L., Brownson, R., Heath, G., Howze, E., Powell, K., et al. (2002). The effectiveness of interventions to increase physical activity: A systematic review. *American Journal of Preventive Medicine, 22(4S),* 73 – 107.

Kirtland, K., Porter, D., Addy, C., Neet, M., Williams, J., Sharpe, P. et al. (2003). Environmental measures of physical activity supports – perception versus reality. *American Journal of Preventive Medicine, 24(4),* 323 – 331.

Koplan, J., Liverman, C. and Kraak, V. (Eds.). (2005). Preventing childhood obesity: Health in the balance. Retrieved 22nd July 2011 from: http://www.nap.edu/openbook.php?record_id=11015&page=84

Kowalski, K., Crocker, P. and Faulkner, R. (1997). Validation of the Physical Activity Questionnaire for Older Children. *Paediatric Exercise Science, 9,* 174 – 186.

Kremers, S. and Brug, J. (2008). Habit strength of physical activity and sedentary behaviour among children and adolescents. *Paediatric Exercise Science, 20,* 5 – 17.

Kremers, S., de Bruijn, G., Visscher, T., van Mechelen, W., de Vries, N. and Brug, J. (2006). Environmental influences on energy balance related behaviours: A dual process view. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 1st November from: http://www.ijbnpa.org/content/3/1/9

Kremers, S., Dijkman, M., Meij, J., Jurg, M. and Brug, J. (2008). Awareness and habit: Important factors in physical activity in children. *Health Education, 108(6),* 475 – 488.

Kremers, S., van der Horst, K. and Brug, J. (2007). Adolescent screen-viewing behaviour is associated with consumption of sugar-sweetened beverages: the role of habit strength and perceived parental norms. *Appetite, 48,* 345 - 350.

Kremers, S., Visscher, T., Seidell, J., van Mechelen, w. and Brug, J. (2005). Cognitive determinants of energy balance related behaviours: Measurement issues. *Sports Medicine, 35(11),* 923 – 933.

Laitakari, J., Vuori, I. and Oja, P. (1996). Is long term maintenance of health related physical activity possible? *An analysis of concepts and evidence. Health Education Research, 11*, 463 – 477.

Lally, P., Jaarsveld, C., Potts, H. and Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology, 40(6),* 998 - 1009.

Landis, D., Trianndis, H. and Adamopoulos, J. (1978). Habits and behavioural intentions as predictors of social behaviour. *Journal of Social Psychology, 106,* 227 – 237.

Larun, L., Nordheim, L., Ekeland, E., Hagen, K. and Heian, F. (2006). *Exercise in prevention and treatment of anxiety and depression among children and young people.* Cochrane Database of Systematic Reviews, Issue 3. Art.No.:CD0044691. DOI:10.1002/14651858.

Lawton, R., Conner, M. and McEachan, R. (2009). Desire or reason: Predicting health behaviours from affective and cognitive attitudes. *Health Psychology*, 28, 56 - 65.

Lee, R., Booth, K., Reese-Smith, J., Regan, G. and Howard, H. (2005). The Physical Activity Resource Assessment (PARA) instrument: evaluating features, amenities and incivilities of physical activity resources in urban neighbourhoods. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 22nd July 2011 from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1262748/

Lee, C., Folsom, A. and Blair, S. (2003). Physical activity and stroke risk: a meta-analysis. *Stroke,* 34, 2475 - 2481.

Lee, I., and Skerrett, P. (2001). Physical activity and all-cause mortality: what is the dose-response relation? *Medicine and Science in Sports and Exercise*, *33*(6 Suppl), S459 - S471.

Lemieux, M. and Godin, G. (2009). How well do cognitive and environmental variables predict active commuting? *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 1st November 2009 from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2667470/

Lewin, K. and Cartwright, D. (1951). *Field Theory in Social Science.* New York: Harper.

Linnan, L. and Steckler, A. (2002). Process evaluation for public health interventions and research: An overview. Retrieved 16th April from:

http://media.wiley.com/product_data/excerpt/66/07879597/0787959766.pdf

Logan, G. (1988). Toward an instance theory of automization. *Psychological Review, 95(4),* 492 – 597.

Lowe, R., Eves, F. and Carroll, D. (2002). The influence of affective and instrumental beliefs on exercise intentions and behaviour: A longitudinal analysis. *Journal of Applied Social Psychology*, 32, 1241-1252.

Nisbett, R. and Wilson, T. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological review, 84,* 231 – 259.

Noland, M., Danner, F., De Walt, K., McFadden, M. and Kotchen, J. (1990). The measurement of physical activity in young children. *Research Quarterly for Exercise and Sport, 61(2),* 146 – 153.

MacKelvie, K., Khan, K. and McKay, H. (2002). Is there a critical period for bone response to weight-bearing exercise in children and adolescents? A systematic review. *British Journal of Sports Medicine, 36:* 250 - 257.

MacKinnon, D. (2000). Contrasts in multiple mediator models. In J. Rose, L. Chassin, C. Presson and S. Sherman (Eds.). *Multivariate applications in substance use research*. Mahwah, NJ: Erlbaum.

MacKinnon, D., Lockwood, C, Hoffman, J., West, S. and Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, *7*, 83 - 104.

Maddison, R., Vander Hoorn, S., Jiang, Y., Mhirchu, C., Exeter, D., Doery, E. Et al. (2009). The environment and physical activity: The influence of psychosocial perceived and built environmental factors. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 1st November 2009 from: http://www.ijbnpa.org/content/6/1/19

Maddux, J.E. (1993). Social cognitive models of health and exercise behaviour: An introduction and review of conceptual issues. *Journal of Applied Sport Psychology, 5,* 115 – 140.

Martin, J., Kulinna, P., McCaughhtry, N., Cothran, D., Dake, J. and Fahoome, G. (2005). The Theory of Planned Behaviour: Predicting physical activity and cardiorespiratory fitness in African American Children. *Journal of Sport and Exercise Psychology, 27(4),* 456 – 469.

Martin, J., Oliver, K. and McCaughtry, N. (2007). The Theory of Planned Behaviour: Predicting physical activity in Mexican American children. *Journal of Sport and Exercise Psychology, 29(2),* 225 – 238.

Matthews, C. (2002). Use of self-report to assess physical activity. In G. Welk (Ed.). *Physical activity assessments for health related research.* Champagin (IL): Human Kinetics, 107 – 125.

McClelland, J., McNaughton, B. and O'Reilly, R. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the successes and failures of connectionist models of learning and memory. *Psychological Review, 102,* 419 – 457.

McKenzie, T., Marshall, S., Sallis, J. and Conway, T. (2000). Leisure-time physical activity in school environments: an observational study using SOPLAY. *Preventive Medicine, 30(1),* 70 – 7.

McKinnon, R., Reedy, J., Handy, S. and Brown Rodgers, A. (2009). Measuring the food and physical activity environments: Shaping the research agenda. *American Journal of Preventive Medicine, 36(4S), S81 – S85.*

McLaren, L. and Hawe, P. (2005). Ecological perspectives in health research. *Journal of Epidemiology and Community Health, 59,* 6 – 14.

McLeroy, K., Bibeau, D., Steckler, A. and Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15,* 351 – 377.

Menon, G. (1993). The effects of accessibility of information in memory on judgements of behavioural frequencies. *Journal of Consumer Research, 20,* 431 – 440.

Michie, S. and Abraham, C. (2004). Interventions to change health behaviours: Evidence-based or evidence-inspired? *Psychology and Health, 19(1),* 29 – 49.

Miles, L. (2007). Physical activity and Health. British Nutrition Foundation *Nutrition Bulletin, 32, 314 – 363.*

Mittal, B. (1988). Achieving higher seat belt usage: The role of habit in bridging the attitude-behaviour gap. *Journal of Applied Social Psychology, 18,* 993 – 1016.

Moore, J., Hanes, J., Barbeau, P., Gutin, B., Trevino, P and Yin, Z. (2007). Validation of the Physical Activity Questionnaire for Older Children in children of different races. *Paediatric Exercise Science, 19,* 6 – 19.

Moos, R. (1980). Social-Ecological Perspectives on Health. In G. Stone, F. Cohen and N. Adler (Eds.), *Health Psychology: A Handbook.* San Francisco: Jossey-Bass.

Motl, R., Birnbaum, A., Kubik, M. and Dishman, R. (2004). Naturally occurring changes in physical activity are inversely related to depressive symptoms during early adolescence. *Psychosomatic Medicine, 66(3),* 336 – 342.

National Institute for Clinical Excellence. (2009). *Promoting physical activity, active play and sport for pre-school and school age children and young people in family, pre-school, school and community settings.* Retrieved 10th September 2009 from: http://www.nice.org.uk/nicemedia/live/11773/42883/42883.pdf

Neal, D. and Wood, W. (2007). Automaticity in situ: The nature of habit in daily life. In J. Bargh, P. Gollwitzer and E. Morsell (Eds.), *Psychology of Action, 442 – 457. Mechanisms of Human Action,* New York: Oxford*.*

Neal, D., Wood, W., Lally, P. and Wu, M. (2009). Do habits depend on goals? Perceived versus actual role of goals in habit performance. Manuscript under review, University of Southern California.

Neal, D., Wood, W. and Quinn, J. (2006). Habits – a repeat performance. *Current Directions in Psychological Science, 15(4),* 198 – 202.

Nichol, M., Pickett, W. and Janssen, I. (2009). Associations between school recreational environments and physical activity. *Journal of School Health, 79(6),* 247 – 254.

Norman, P. and Conner, M. (2005a). Predicting and changing health behaviour: Future directions. In M. Conner and P. Norman (Eds.), *Predicting Health Behaviour (2nd Edn.),* 324 – 371, Berkshire: Open University Press.

Norman, P. and Conner, M. (2005b). The Theory of Planned Behaviour and exercise: evidence for the mediating and moderating roles of planning on intention-behaviour relationships. *Journal of Sport and Exercise Psychology, 27,* 488 – 504.

Norman, G., Nutter, S., Ryan, S., Sallis, J., Calfas, K., and Patrick, K. (2006). Community design and access to recreational facilities as correlates of adolescent physical activity and body-mass index. *Journal of Physical Activity and Health, 3,* S118 - S128.

O'Connor P., Raglin, J. and Martinsen, E. (2000). Physical activity, anxiety and anxiety disorders. *International Journal of Sport Psychology, 31*, 136 - 155.

Oenema, A., Prins, R., Te Velde, S., Brug, J. and Van Empelen, P. (2010). Identifying demographic, cognitive and perceived environmental predictors of daily walking and cycling to school among adolescents. Proceedings from the *2010 Annual Conference of the International Society of Behavioural Nutrition and Physical Activity.* Retrieved 7th April 2011 from: http://www.isbnpa.org/media/pdfs/2010%20ISBNPA%20Abstract%20Book%20PDF.pdf

Ogden, J. (2003). Some problems with Social Cognition Models: A pragmatic and conceptual analysis. *Health Psychology, 22(4),* 424 – 428.

Orbell, S. and Sheeran, P. (1998). 'Inclined abstainers': a problem for predicting health-related behaviour. *British Journal of Social Psychology, 37,* 151 – 165.

Orbell, S. and Verplanken, B. (2010). The automatic component of habit in health behaviour: Habit as cue-contingent automaticity. *Health Psychology, 29(4),* 374 – 383.

Orlander, E., and Eves, F. (2011). Effectiveness and cost of two stair climbing interventions – less is more. *American Journal of Health Promotion, 25(4),* 231 - 236.

Osgood, C., Suci, G. and Tannenbaum, P. (1957). *The Measurement of Meaning.* Urbana: University of Illinois Press.

Ouellette, J. and Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behaviour predicts future behaviour. *Psychological Bulletin, 124(1),* 54 – 74.

Owen, N., Humpel, N., Leslie, E., Bauman, A., and Sallis, J.F. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine, 27,* 67 - 76.

Owen, N., Spathonis, K. and Leslie, E. (2005). Understanding and influencing physical activity to improve health outcomes. Paper presented at Walk21-VI "Everyday walking culture", The 6th International conference on walking in the 21st Century, September, 22 – 23, Zurich, Switzerland. Retrieved 22nd June 2011 from: http://www.walk21.com/papers/Zurich%2005%20Owen%20Understanding %20and%20Influencing%20physical%20activi.pdf

Paffenbarger, R., Hyde, T., Wing, A. and Hsieh, C. (1986). Physical activity, all cause mortality, and longevity of college alumni. *New England Journal of Medicine, 314,* 605 – 613.

Papas, M., Alberg, A., Ewing, R., Helzlsouer, K., Gary, T. and Klassen, A. (2007). The built environment and obesity. *Epidemiologic Reviews, 29,* 129 – 43.

Parker, D., Manstead, A. and Stradling, S. (1995). Extending the Theory of Planned Behaviour: The role of personal norm. *British Journal of Social Psychology, 34,* 127 – 137.

Perugini, M. and Bagozzi, R. (2001). The role of desires and anticipated emotions in goal-directed behaviours: Broadening and deepening the Theory of Planned Behaviour. *British Journal of Social Psychology, 40,* 79 – 98.

Perugini, M. and Conner, M. (2000). Predicting and understanding behavioural volitions: The interplay between goals and behaviours. *European Journal of Social Psychology, 30,* 705 – 731.

Petty, R. and Cacioppo, J.T. (1986). The elaboration likelihood model of persuasion. In L. Berkowitz (Ed.), *Advances in experimental social psychology,* pp. 123 – 205. New York: Academic Press.

Physical Activity Guidelines Advisory Committee (2008). *Physical Activity Guidelines Advisory Committee Report, 2008*. Retrieved 15th July from: http://www.health.gov/PAguidelines/Report/pdf/CommitteeReport.pdf

Pikora, T., Bull, F., Jamrozik, K., Knuiman, M., Giles-Corti, B. and Donovan, R. (2002). Developing a reliable audit instrument to measure the physical activity environment for physical activity. *American Journal of Preventive Medicine, 23(3),* 187 – 194.

Preacher, K. and Hayes, A. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behaviour Research Methods, Instruments and Computers*, *36,* 717 - 731.

Prochaska, J. and DiClemente, C. (1982). Transtheoretical theory: Towards a more integrated model of change. *Journal of Consultive Clinical Psychology, 19,* 276 – 288.

Public Health Agency. (2009). *It all Adds Up.* Retrieved 14th November 2010 from: http://www.getalifegetactive.com/

Reason, J. (1992). Cognitive underspecification: Its varieties and consequences, In B. Baars (Ed.), *Experimental slips and human error: Exploring the architecture of volition,* 71 – 91. New York: Plenum Press.

Reason, J. (1990). *Human error.* Cambridge, England: Cambridge University Press.

Reinaerts, E., de Nooijer, J., Candel, M. and de Vries, N. (2007). Explaining children's fruit and vegetable consumption; te contributions of availability, accessibility, exposure, parental consumption and habit in addition to psychosocial factors. *Appetite, 48,* 248 – 258.

Rhodes, R., Blanchard, C. and Hunt Matheson, D. (2006). A Multicomponent model of the Theory of Planned Behaviour. *British Journal of Health Psychology, 11,* 119 – 137.

Rhodes, R., Brown, S. and McIntyre, C. (2006). Integrating the perceived neighbourhood environment and the Theory of Planned Behaviour when predicting walking in a Canadian adult sample. *American Journal of Health Promotion, 21(2),* 110 – 118.

Rhodes, R. and Courneya, K. (2004). Differentiating motivations and control in the theory of planned behaviour. *Psychology, Health and Medicine, 9,* 205 – 215.

Rhodes, R. and Courneya, K. (2003). Self-efficacy, controllability and intention in the theory of planned behaviour: Measurement redundancy or causal independence? *Psychology and Health, 18,* 79 – 91.

Rhodes, R., Courneya, K., Blanchard, C. and Plotnikoff, R. (2007). Prediction of leisure time walking: An integration of social cognitive, environmental and personality factors. *International Journal of behavioural nutrition and physical activity,* Retrieved 2nd November 2009 from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2174941/

Rhodes, R., de Bruijn, G. and Matheson, D. (2010). Habit in the physical activity domain: Integration with intention temporal stability and action control. *Journal of Sport and Exercise Psychology, 32,* 84 – 98.

Rhodes, R., Macdonald, H. and McKay, H. (2006). Predicting physical activity intention and behaviour among children in a longitudinal sample. *Social Science and Medicine, 62(12),* 3146 – 3156.

Rhodes, R., Matheson, D. and Blanchard, C. (2006). Beyond scale correspondence: A comparison of continuous open scaling and fixed graded scaling when using social cognitive constructs in the exercise domain. *Measurement in Physical Education and Exercise Science, 10(1),* 13 – 39.

Ridley, K. (2005). *The Multimedia activity recall for children and adolescents (MARCA): Development and validation.* (Unpublished doctoral dissertation). School of Health Sciences, University of South Australia.

Rivis, A. and Sheeran, P. (2003). Descriptive norms as an additional predictor in the Theory of Planned Behaviour: A meta-analysis. *Current Psychology, 22(3),* 218 – 233.

Rogers, R. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. Cacioppo and R. Petty (Eds.), *Social Psychophysiology,* 153 – 176. New York: Guildford.

Rosenstock, I. (1974). Historical origins of the health belief model. *Health Education Monographs, 2,* 1 – 8.

Rothman, A. (2004). Is there nothing more practical than a good theory? Why innovations and advances in health behaviour change will arise if interventions are used to test and refine theory. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 1st November 2009 from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC514573/

Rowlands, A. and Eston, R. (2007). The measurement and interpretation of children's physical activity. *Journal of Sports Science and Medicine, 6,* 270 – 276.

Rutter, D. and Quine, L. (Eds.) *Changing Health Behaviour.* Berkshire: open University Press.

Saelens, B., Sallis, J., Black, J. and Chen, D. (2003). Neighbourhood based differences in physical activity: and environment scale evaluation. *American Journal of Public Health, 93(9),* 1552 – 1558.

Sallis, J., Cervero, R., Ascher, W., Henderson, K., Kraft, M. and Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health, 27*, 297 – 322.

Sallis, J., Johnson, M., Calfas, K., Caparosa, S. and Nichols, J. (1997). Assessing perceived physical environmental variables that may influence physical activity. *Research Quarterly for Exercise and Sport, 68(4),* 345 – 351.

Sallis, J. and Owen, N. (1999) *Physical Activity and Behavioural Medicine.* Thousand Oaks, CA: Sage.

Sallis, J., Owen, N. and Fisher, E. (2008). Ecological models of health behaviour. In K. Glanz, B. Rimer and K. Viswanath, *Health Behaviour and Health Education: Theory, Research and Practice, (4th Edn.).* San Francisco; Jossey-bass.

Sallis, J., Prochaska, J. and Taylor, W. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32,* 963 – 975.

Sallis, J., Strikmiller, P., Harsha, D., Feldman, H., Ehlinger, S., Stone, E. Et al. (1996). Validation of interviewer- and self-administered physical activity checklists for fifth grade students. *Medicine and Science in Sports and Exercise, 28,* 840 - 851

Salmon, J. (2010). Factors in youth physical activity participation: from psychological aspects to environmental correlates. *Research in Sports and Medicine, 18,* 26 – 36.

Salmon, J., Booth, M., Phongsavan, P., Murphy, N. and Timperio, A. (2007). Promoting physical activity participation among children and adolescents. *Epidemiologic Reviews, 29,* 144 – 159.

Salonen, J., Puska, P., Kottke, T, Tuomilehto, J. and Nissinen, A. (1983). Decline in mortality from coronary heart disease in Finland from 1969 to 1979. *British Medical Journal, 286,* 1857 – 1860.

Schatzki, T. (2001). Introduction: Practice theory. In T. Schatzi, K. Knorr Cetina and E. Von Savigny (Eds.), *The Practice Turn in Contemporary Theory.* London: Routledge.

Schultz, W., Dayan, P. and Motague, P. (1997). A neural substrate of prediction and reward. *Science, 275,* 1593 – 1599.

Schwarzer, R. (1992). Self-efficacy in the adoption and maintenance of health behaviours: Theoretical approaches and a new model. In R. Schwarzer (ed.),

Self-efficacy: Thought control of action, 217 – 243. Bristol, PA: Taylor and Francis.

Scottish Government. (2008). Healthy Eating, Active Living: An action plan to improve diet, increase physical activity and tackle obesity (2008-2011). Retrieved 12th November 2010 from: http://www.scotland.gov.uk/Resource/Doc/228860/0061963.pdf

Scottish Parliament Health and Sport Committee. (2009). *Pathways into Sport and Physical Activity.* Retrieved 14th November 2010 from: http://www.scottish.parliament.uk/s3/committees/hs/reports-09/her09-05-00.htm#17

Sheeran, P. (2002). Intention-behaviour relations: A conceptual and empirical review. In W Streobe and M. Hewstone (Eds.), *European Review of Social Psychology,* Vol. 12, 1 – 36, Chichester: Wiley.

Sheeran, P., Aarts, H., Custers, R., Rivis, A., Webb, T. and Cooke, R. (2005). The goal-dependent automaticity of drinking habits. *British Journal of Social Psychology, 44,* 47 – 63.

Sheeran, P., Milne, S. Webb, T. and Gollwitzer, P. (2005). Implementation intentions and health behaviour. In M. Conner and P. Norman (Eds.). *Predicting Health Behaviour (2nd Ed.),* 276 – 323.

Shepard, R. (2003). Limits to the measurement of habitual physical activity by questionnaires. *British Journal of Sports Medicine, 37,* 197 – 206.

Sherrill, L., Kotchou, K. and Quan, S. (1998). Association of physical activity and human sleep disorders. *Archives of Internal Medicine,* 158, 1894 - 1898.

Shrout, P. and Bolger, N. (2002). Mediation in experimental and non-experimental studies: New procedures and recommendations. *Psychological Methods*, 7, 422 - 445.

Sinha, R., Fisch, G., Teague, B., Tamborlane, W.V., Banyas, B., Allen, K. et al. (2002). Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. *The New England Journal of Medicine, 346,* 802 - 810.

Sirard, J. and Pate, R. (2001). Physical activity assessment in children and adolescents. *Sports Medicine, 31(6),* 439 – 454.

Sniehotta, F., Schwarzer, R., Scholz, U. and Schüz, B. (2005). Action planning and coping planning for long-term lifestyle change: theory and assessment. *European Journal of Social Psychology, 35*(4), 565 - 576.

Sobel, M. (1982). Asymptotic intervals for indirect effects in structural equation models. In S. Leinhart (Ed.), *Sociological methodology,* San Francisco: Jossey-Bass.

Soper, D. (2011). *The free statistics calculator website*. Online software, available: http://www.danielsoper.com/statcalc/calc31.aspx

Sparks, P. (1994). Attitudes towards food: Applying, assessing and extending the 'theory of planned behaviour'. In D. Rutter and L. Quine (Eds.), *Social Psychology and Health: European Perspectives, 25 – 46.* Aldershot: Avebury Press.

Spittaels, H., Verloigne, M., Gidlow, C., Gloanec, J., Titze, S., Foster, C. et al. (2010). Measuring physical activity-related environmental factors: reliability and predictive validity of the European environmental questionnaire ALPHA. *International Journal of Behavioural Nutrition and Physical Activity.* Retrieved 22nd July 2011 from: http://www.ijbnpa.org/content/7/1/48

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10(4),* 282 – 298.

Stokols, D. (1992). Establishing and maintaining healthy environments: Toward a social ecology of health promotion. *American Psychologist, 47,* 6 – 22.

Story, M., Giles-Corti, B., Lazarus Yaroch, A., Cummins, S., Douglas Frank, L., Haung, T. et al. (2009). Work group IV: Future directions for measures of the food and physical activity environments. *American Journal of Preventive Medicine, 36(4S),* S182 – S188.

Strategy Unit (2002). *Game Plan: a strategy for delivering Government's sport and physical activity objectives.* A joint Department of Culture, Media and Sport and Strategy Unit Report. HMSO: London.

Strath, S., Swartz, A., Bassett Jr., D., O'Brien, W., King, G. and Ainsworth, B. (2000). Evaluation of heart rate as a method for assessing moderate intensity physical activity. *Medicine and Science in Sports and Exercise, 32*(9 Suppl.), S465 - S470.

Streobe, W. and Streobe, M. (1995). *Social Psychology and Health.* Buckingham: Open University.

Sutton, S. (2002). Using Social Cognition Models to develop health behaviour interventions: problems and assumptions. In D. Rutter and L. Quine (Eds.), *Changing Health Behaviour*, 193 – 208, Berkshire: Open University Press.

Sutton, S. (1994). The past predicts the future: Interpreting behaviour-behaviour relationships in social psychological models of health behaviour. In D. Rutter and L. Quine (Eds.). *Social Psychology and Health; European Perspectives,* 71 – 88. Aldershot: Avebury.

Swinburn, B., Egger, G. and Raza, F. (1999). Dissecting obesogenic environments: The development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Preventive Medicine, 29,* 563 – 570.

Tak, N., Te Velde, S., Kamphuis, C., Ball, K., Crawford, D., Brug, J and Van Lenthe, F. (2010). The association between neighbourhood and household environmental variables and fruit consumption: Exploration of mediation by individual cognitions and habit strength in the Globe study. Proceedings from the *2010 Annual Conference of the International Society of Behavioural Nutrition and Physical Activity.* Retrieved 7th April 2011 from: http://www.isbnpa.org/media/pdfs/2010%20ISBNPA%20Abstract%20Book%20PDF.pdf

Tak, N., Te Velde, S., Oenema, A., Van der Horst, K., Timperio, A., Crawford, D. and Brug, J. (2011). The association between home environmental variables and

soft drink consumption among adolescents. Exploration of mediation by individual cognitions and habit strength. *Appetite, 56,* 503 – 510.

Tavares, L., Plotnikoff, R. and Loucaides, C. (2009). Social-cognitive theories for predicting physical activity behaviours of employed women with and without young children. *Psychology, Health and Medicine*, *14*(2), 129 - 142.

Taylor, W., Blair, S., Cummings, S., Wun, C. and Malina, R. (1999). Childhood and adolescent physical activity patterns and adult physical activity. *Medicine and Science in Sports and Exercise, 3,* 118 - 123.

Telama, R. Yang, X. Hirvensalo, M. Raitakari, O. (2006). Participation in organized youth sport as a predictor of adult physical activity: A 21- year longitudinal study. *Paediatric Exercise Science 18 (1),* 76-88.

Terry, D. and O'Leary, J. (1995). The Theory of Planned Behaviour: The effects of perceived behavioural control and self-efficacy. *British Journal of Social Psychology, 34,* 199 – 220.

Tessier, S., Vuillemin, A. and Briançion, S. (2008). Review of physical activity questionnaires validated for children and adolescents. *Science and Sports 23,* 118 – 125.

Thirlaway, K. and Upton, D. (2010). *Conceptualising lifestyle psychology.* Unpublished manuscript.

Thirlaway, K. and Upton, D. (2009). *The Psychology of Lifestyle: Promoting Healthy Behaviour.* Oxon: Routledge.

Thune, I. and Furberg, A. (2001). Physical activity and cancer risk: dose-response and cancer, all sites and site-specific. *Medicine and Science in Sports and Exercise,* 33: S530 - S550.

Towler, G. and Shepherd, R. (1991). Modification of Fishbein and Ajzen's theory of reasoned action to predict chip consumption. *Food Quality and Preference, 3,* 37 – 45.

Townsend, D. and Bever, T. (2001). *Science comprehension: The integration of habits and rules.* Cambridge, MA: MIT Press.

Triandis, H. (1980). Values, attitudes and interpersonal behaviour. In H. Howe and M. Page (Eds.), *Nebraska Symposium on Motivation, 1979: Beliefs, Attitudes and Values,* 195 – 259. Lincoln, NE: University of Nebraska Press.

Triandis, H. (1977). *Interpersonal Behaviour.* Montery, CA: Brooks/Cole.

Trost, S., Kerr, L. Ward, D. and Pate, R. (2001). Physical activity and determinants of physical activity in obese and non-obese children. *International Journal of Obesity and Related Metabolic Disorders, 25,* 822 – 829.

Trost, S., Pate, R., Sallis, J, Freederson, P., Taylor, W., Dowda, M. and Sirard, J. (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine and Science in Sports and Exercise, 34,* 350 – 355.

Trost, S., Sirard, J.R., Dowda, M., Pfeiffer, K. and Pate, R.R. (2003). Physical activity in overweight and non-overweight pre-school children. *International Journal of Obesity and Related Metabolic Disorders, 27,* 834 – 839.

Tudor-Locke, C. and Myers, A. (2001). Challenges and opportunities for measuring physical activity in sedentary adults. *Sports Medicine*, *31*(2), 91 - 100.

Van Sluijs, E., McMinn, A. and Griffin, S. (2007). Effectiveness of interventions to promote physical activity in children and adolescents: Systematic review of controlled trials. Retrieved 22nd June 2011 from: http://www.bmj.com/content/335/7622/703.full

Verplanken, B. (2006). Beyond frequency: Habit as a mental construct. *British Journal of Social Psychology, 45,* 639 – 656.

Verplanken, B. (2005). Habits and implementation intentions. In J.Kerr, R. Weitkunat and M. Moretti (Eds.). *The ABC of Behavioural Change,* 99 – 109.

Verplanken, B. and Aarts, H. (1999). Habit, attitude and planned behaviour: Is habit and empty construct or an interesting case of goal-directed automaticity? *European Review of Social Psychology, 10,* 101 – 134.

Verplanken, B., Aarts, H. and van Knippenberg, A. (1997). Habit, information acquisition and the process of making travel mode choices. *European Journal of Social Psychology, 27,* 539 – 560.

Verplanken, B., Aarts, H., van Knippenberg, A. and Moonen, A. (1998). Habit versus planned behaviour: A field experiment. *British Journal of Social Psychology, 37,* 111 – 128.

Verplanken, B., Aarts, H., van Knippenberg, A. and van Knippenberg, C. (1994). Attitude versus general habit; Antecedents of travel mode choice *Journal of Applied Social Psychology, 24,* 285 – 300.

Verplanken, B. and Melkevik, O. (2008). Predicting habit: The case of physical exercise. *Psychology of Sport and Exercise, 9(1),* 15 – 26.

Verplanken, B., Myrbakk, V. and Rudi, E. (2005). The measurement of habit. In T. Betsch and S. Haberstroh, *The Routines of Decision Making,* 231 – 247, London: Lawrence Erlbaum Associates.

Verplanken, B. and Orbell, S. (2003). Reflections on past behaviour: A self-report index of habit strength. *Journal of Applied Social Psychology, 33,* 1313 – 1330.

Verplanken, B. and Wood, W. (2006). Interventions to break and create consumer habits. *American Marketing Association, 25(1),* 90 – 103.

Viner, R.M., Segal, T.Y., Lichtarowicz-krynska, E. and Hindmarsh, P. (2005). Prevalence of the insulin resistance syndrome in obesity. *Archives of Disease in Childhood, 90,* 10 – 14.

Wallace, M., Mills, B. and Browning, C. (1997). Effects of cross-training on markers of insulin resistance/hyperinsulinemia. *Medicine and Science in Sports and Exercise,* 29, 1170-1175.

Walness, D. (2004). *Securing good health for the whole population.* London: Crown.

Wang, S., Charron-Prochownik, D., Sereika, S., Siminerio, L. and Kim, Y. (2006). Comparing three theories in predicting reproductive health behavioural intention in adolescent women with diabetes. *Paediatric Diabetes*, *7*(2), 108 - 115.

Warshaw, P. and Davis, F. (1985). Disentangling behavioural intentions and behavioural expectations. *Journal of Experimental Social Psychology, 21,* 213 – 228.

Webb, T. and Sheeran, P. (2006). Does changing behavioural intentions engender behaviour change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132,* 249 – 268.

Webb, T. and Sheeran, P. (2004). Identifying good opportunities to act: Implementation intentions and cue discrimination. *European Journal of Social Psychology, 34(4),* 407 – 419.

Weems, G., Onwuegbuzie, A. and Collins, K. (2006). The role of reading comprehension in responses to positively and negatively worded items on rating scales. *Evaluation and Research in Education, 19*(1), 3 - 20.

Weidemann, A., Schuz, B. Sniehotta, F., Scholz, U. and Schwarzer, R. (2009). Disentangling the relationship between intentions, planning and behaviour: a moderated mediation analysis. *Psychology and Health, 24(1),* 67 – 79.

Weinstein, N. (1988). The precaution adoption process. *Health Psychology, 7,* 355 – 386.

Weinstein, N. and Sandman, P. (2002). The precaution adoption process model. In K. Glanz, B. Rimmer and F. Lewis (Eds.). *Health behaviour and Health Education: Theory, Research and Practice* (3rd Edition), 121 – 143. San Francisco, CA: Jossey-Bass.

Welk, G., Corbin, C. and Dale, D. (2000). Measurement issues in the assessment of physical activity in children. *Research Quarterly for Exercise and Sport, 71,* 59 – 73.

Welk, G. and Wood, K. (2000). Physical activity assessments in physical education: A practical review of instruments and their use in the curriculum. *Journal of Physical Education, Recreation and Dance, 71,* 30 - 40.

Welsh Assembly Government. (2006). *Food and Fitness Implementation Plan.* Retrieved 12th November 2010 from: http://www.healtheschool.org.uk/teachers/school-food-fitness-policy-e.pdf

Wenche, D., Holmen, J., Kruger, O. and Midthjell, K. 2004. Leisure Time Physical Activity and Change in Body Mass Index and 11-Year Follow-Up Study of

9,357 Normal-Weight Healthy Women 20–49 Years Old. *Journal of Women's Health*, 13, 55 – 62.

Wendel-Vos, W., Droomers, M., Kremers, S., Brug, J. and van Lenthe, F. (2007). Potential environmental determinants of physical activity in adults: A systematic review. *Obesity Reviews,8(5),* 425 – 440.

West, S. and Aiken, L. (1997). Toward understanding individual effects in multicomponent prevention programs: Design and analysis strategies. In K. Bryant, M. Windle and S. West (Eds.). *The science of prevention: Methodological advances from alcohol and substance abuse research.* Washington DC: American Psychological Association.

Westerkerp, K. (1999). Assessment of physical activity level in relation to obesity: current evidence and research issues. *Medicine and Science in Sports and Exercise, 31* (Suppl. 11), S522 – S525.

Whelton, S., Chin, A., Xin, X. and He, J. (2002). Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Annals of Internal Medicine,* 136: 493 - 503.

Wing Kwan, M., Bray, S. and Martin Ginis, K. (2009). Predicting physical activity of first-year university students: An application of the Theory of Planned Behaviour. *Journal of American College Health, 58(1),* 45 - 55.

Wood, W. and Neal, D. (2007). A new look at habits and the habit-goal interface. *Psychological review, 114(4),* 843 – 863.

Wood, W., Tam, L. and Guerrero Witt, M. (2005). Changing circumstances, disrupting habits. *Journal of Personality and Social Psychology, 88(6),* 918 – 933.

Wood, W., Quinn, J. and Kashy, D. (2002). Habits in everyday life: Thought, emotion and action. *Journal of Personality and Social Psychology, 83,* 1281 – 1297.

World Health Organisation (2011). 10 Facts on Physical Activity. Retrieved 13th September 2011 from:
http://www.who.int/features/factfiles/physical_activity/en/index.html

World Health Organisation (1998). *Health Promotion Glossary.* Retrieved 1st
November 2009 from:
http://www.who.int/hpr/NPH/docs/hp_glossary_en.pdf

World Health Organisation. (1986). *Young people's health – a challenge for society.*
World Health Organisation technical report series 731. Retrieved 7th
February 2011 from: http://whqlibdoc.who.int/trs/WHO_TRS_731.pdf

Yang, X., Telama, R., Leskinen, E., Mansikkaniemi, K., Viikari, J. and Raitakari, O.T.
(2007). Testing a model of physical activity and obesity tracking from youth
to adulthood: The cardiovascular risk in young Finns study. *International
Journal of Obesity, 31(3),* 521 - 527.

Yang M., Yang, M., Shih, C. and Kawachi I. (2002). Development and validation of
an instrument to measure perceived neighbourhood quality in Taiwan.
Journal of Epidemiology and Community Health, 56(7), 492 – 496.

Physical Activity Questionnaire

The aim of this questionnaire is to find out what **you** think about physical activity. By physical activity we mean activities like sports or dance that make you sweat or make your legs feel tired or games that make you breathe hard like tag, skipping, running, climbing and others. Please read each question carefully and respond using the words below the numbers. To answer, circle the number that matches how you feel.

Example

Being physically active over the next 7 days would be **easy**:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

If you think that being physically active over the next 7 days would be **fairly** easy you would answer the question by circling number 4, however if you think it would be **very** easy you would answer by circling number 5.

Please write your name, today's date, your age and class and tick whether you are a boy or a girl.

Name: _____   Date: _____

Age: _____   Class: _____

Sex: Boy ☐   Girl ☐ (Please tick)

1. Being physically active over the next 7 days would be **healthy**:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

2. Most people who are important to me like family, friends and teachers **want** me to be physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

3. I am in **control** over whether I am physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

4. Being physically active over the next 7 days would be **enjoyable**:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

5. I **intend** to be physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

6. Most people **like me** will be physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

7. Being physically active over the next 7 days would be **pleasant**:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

8. **It is up to me** whether I am physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

9. Being physically active over the next 7 days would be **fun**:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

10. I will **try** to be physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

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11. Being physically active over the next 7 days would be **important**:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

12. Most people who are important to me like family, friends and teachers **will** be physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

13. I **plan** to be physically active over the next 7 days:

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

Physical Activity Questionnaire

We are trying to find out about your level of physical activity over **the last 7 days** (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard like tag, skipping, running, climbing and others.

Remember:
1. There are no right and wrong answers— this is not a test
2. Please answer all the questions as honestly as you can — this is very important

1. Physical activity in your spare time: Have you done any of the following activities **in the past 7 days** (last week)? If yes, how many times? (Mark only one circle per row).

	No	1-2	3-4	5-6	7 times or more
Skipping	○	○	○	○	○
Rowing/canoeing	○	○	○	○	○
Roller skating/rollerblading	○	○	○	○	○
Tag	○	○	○	○	○
Walking for exercise	○	○	○	○	○
Bicycling	○	○	○	○	○
Jogging or Running	○	○	○	○	○
Group Exercise	○	○	○	○	○
Swimming	○	○	○	○	○
Cricket	○	○	○	○	○
Dance	○	○	○	○	○
Football	○	○	○	○	○
Badminton	○	○	○	○	○
Skateboarding	○	○	○	○	○
Rugby	○	○	○	○	○
Hockey	○	○	○	○	○
Volleyball	○	○	○	○	○
Basketball	○	○	○	○	○
Ice Skating	○	○	○	○	○
Snow/dry slope skiing	○	○	○	○	○
Ice hockey	○	○	○	○	○
Other:					
_____	○	○	○	○	○
_____	○	○	○	○	○

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only).

        I don't do PE ○
        Hardly ever ○
        Sometimes ○
        Quite often ○
        Always ○

3. In the last 7 days, what did you do most of the time at *break*? (Check one only).

        Sat down (talking, reading, doing schoolwork) ○
        Stood around or walked around ○
        Ran or played a little bit ○
        Ran around and played quite a bit ○
        Ran around and played hard most of the time ○

4. In the last 7 days, what did you normally do at *lunch* (besides eating lunch)? (Check one only).

        Sat down (talking, reading, doing schoolwork) ○
        Stood around or walked around ○
        Ran or played a little bit ○
        Ran around and played quite a bit ○
        Ran around and played hard most of the time ○

5. In the last 7 days, on how many days *right after school*, did you do sports, dance or play games in which you were very active? (Check one only).

        None ○
        1 time last week ○
        2 or 3 times last week ○
        4 times last week ○
        5 times last week ○

6. In the last 7 days, on how many *evenings* did you do sports, dance or play games in which you were very active? (Check one only).

None	○
1 time last week	○
2 or 3 times last week	○
4 or 5 times last week	○
6 or 7 times last week	○

7. On the last weekend, how many times did you do sports, dance or play games in which you were very active? (Check one only).

None	○
1 time	○
2 - 3 times	○
4 - 5 times	○
6 or more times	○

8. Which *one* of the following describes you best for the last 7-days? Read *all five* statements before deciding on the *one* answer that describes you.

A. All or most of my free time was spent doing things that involve little physical effort ○

B. I sometimes (1-2 times last week) did physical things during my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) ○

C. I often (3-4 times last week) did physical things in my free time ○

D. I quite often (5-6 times last week) did physical things in my free time ○

E. I very often (7 or more times last week) did physical things in my free time ○

9. Mark how often you did physical activity (like playing sports, games, doing dance or any other physical activity) for each day last week .

	None	Little bit	Medium	Often	Very often
Monday	○	○	○	○	○
Tuesday	○	○	○	○	○
Wednesday	○	○	○	○	○
Thursday	○	○	○	○	○
Friday	○	○	○	○	○
Saturday	○	○	○	○	○
Sunday	○	○	○	○	○

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one).

Yes ○

No ○

If yes, what prevented you?

_____

My Physical Activity Environment

The aim of this questionnaire is to find out about the things you have in your home or at school which might help you to be physically active. It also asks about places to be active within a 10 minute walk or a 5 minute bike ride from your home.

Example

Home Environment
Please put a tick against the items or things you have access to in your home.

_____ ✓ A) Garden or yard area
_____ B) Basketball / netball hoop
_____ C) Bicycle
_____ ✓ D) Dog

If you have a back garden and a dog you would answer the question by placing a tick in the space next to "Garden or yard area" and "Dog".

Home Environment
Please put a tick against the items you have access to in your home.

_____ A) Garden or yard area	_____ J) Roller-skates/rollerblades
_____ B) Basketball / netball hoop	_____ K) Sports equipment (balls,
_____ C) Bicycle	rackets, skipping ropes)
_____ D) Dog	_____ L) Swimming pool
_____ E) Pogo Stick	_____ M) Trampoline
_____ F) Running shoes (trainers)	_____ N) Other:_____
_____ G) Scooter	_____ O) Other:_____
_____ H) Brothers or sisters	
_____ I) Skateboard	

Convenient facilities

Below is a list of places where you could be physically active. Please put a tick against all those places which are within a 10 minute walk from your home.

_____ A) Basket ball / netball court

_____ B) Playing field

_____ C) Public park

_____ D) Playground

_____ E) Leisure centre

_____ F) Athletics track

_____ G) Skate park

_____ H) Swimming pool

_____ I) Tennis courts

_____ J) Walking trails

_____ K) Other: _____

_____ L) Other: _____

School Environment

Please put a tick against the items you have access to in your school.

_____ A) Playground

_____ B) Sports hall

_____ C) Climbing frame, swings, monkey bars or slides

_____ D) P.E (physical education)

_____ E) Playing field

_____ F) Athletics track

_____ G) School sports teams

_____ H) Sport or exercise equipment

_____ I) Swimming pool

_____ J) Tennis courts

_____ K) Other: _____

_____ L) Other: _____

My Physical Activity Habits

We are trying to find out about your physical activity habits. By physical activity we mean activities like sports or dance that make you sweat or make your legs feel tired or games that make you breathe hard like tag, skipping, running, climbing and others. Please read each question carefully. To answer, circle the number that matches how you feel.

Example

Physical activity is something…

1. I do often

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

If you are very active you would answer by circling number 4 or 5, but if you are not very active you would circle number 1 or 2.

Physical activity is something…

1. I do automatically.

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

2. I do without having to consciously remember.

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

3. I do without thinking.

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

4. I start doing before I realize I'm doing it.

1	2	3	4	5
Strongly disagree	Disagree	Neither	Agree	Strongly agree

Appendix 5: Step-by-Step Guide to Programme Delivery and Audit Tool

Get in the HABIT: Step-by-step guide to program delivery

Phase 1 – Collect baseline data and deliver stage 1 of the intervention. This stage aims to increase knowledge and awareness of physical activity opportunities in the environment. This stage takes approximately half an hour to complete.

1. Before administering the questionnaire.
   - Ensure quite class room conditions.
   - Set up white board and over head projector (if applicable) with an electronic copy of the questionnaire – CD provided. This acts as a useful visual aid.
   - Make sure children have access to a pencil and a rubber.

2. Administer questionnaire pack (this should take approximately 15 minutes).
   - This should contain My Physical Activity Habits, My Physical Activity Environment, My Physical Activity and My Physical Activity Plans.
   - Get children to fill in their name, date of birth and sex on the cover sheet in the spaces provided. It is very important that children provide accurate demographic information so that we can match their baseline data with their follow up data. Although participants will be identifiable their responses will remain confidential.
   - Explain that whilst filling out the questionnaire there is to be no talking with others, but if there is something they don't understand they should put up their hand and ask for help.
   - When administering the questionnaire make sure that each question is properly explained, read and completed before pupils move on to the next question.

My Physical Activity Habits

- Read the instructions aloud whilst using the OHP and whiteboard as a visual aid (if applicable). This includes the instructions on how to complete the questionnaire (which are located at the top of the answer sheet) and each individual question and choice of possible answers.

- Make sure that children understand the target behaviour , i.e. "Sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard like tag, skipping, running, climbing and others. You could ask pupils to provide their own examples to the class to ensure that they understand.

- Run through the example exercise with pupils until you feel confident that they understand how to complete the questionnaire. In addition to the example provided you could ask them which number they would circle if physical activity is something they don't do very often or not at all.

My Physical Activity Environment

- Read the instructions aloud whilst using the OHP and whiteboard as a visual aid (if applicable). This includes the instructions on how to complete the questionnaire and each individual question and choice of possible answers.

- Run through the example exercise with pupils until you feel confident that they understand how to complete the questionnaire.

My Physical activity

- Read the instructions aloud whilst using the OHP and whiteboard as a visual aid (if applicable).

- This includes the instructions on how to complete the questionnaire and each individual question and choice of possible answers.

My Physical Activity Plans

- Read the instructions aloud whilst using the OHP and whiteboard as a visual aid (if applicable). This includes the instructions on how to complete the questionnaire and each individual question and choice of possible answers.

- Run through the example exercise with pupils until you feel confident that they understand how to complete the questionnaire.

Make a few final checks

- Ask children to go through their answer sheet and check that they have answered **all** of the questions (particularly Q1. and Q9 on the 'My Physical Activity Questionnaire').

- Collect the answer sheets in. Whilst doing this quickly check to see that all of the questions have been answered (including demographic information on the cover sheet). The evaluation staff can help you do this.

3. Show film 1 (approximately 4 minutes).

4. Initiate short class discussion (approximately 5 minutes)

- Initiate class discussion about what places/facilities or clubs are available nearby, i.e. within a 10 minute walk or 5 minute bike ride from the children's homes or perhaps on a route they walk regularly, i.e. on the way to/from school.

5. Awareness raising activity (5 – 10 minutes)

    - Provide each pupil with an activity sheet and ensure that they write their full name in the space provided. Ask children to apply enough pressure when writing to ensure that the top sheet causes pigment from the carbon paper to make a similar mark on the copy.

    - Read the instructions and start the activity in class but get children to finish as 'home work' to encourage them to ask parents, check local papers etc. for opportunities to be active.

    - Explain that this 'homework' will provide the basis for next week's activity. Therefore they will need to bring their activity sheets with them for phase 2 of the intervention.

Phase 2 –Deliver stage 2 of the intervention. This stage aims to encourage healthy physical activity habits by providing simple advice on habit formation and the development of 'if then' plans which help to identify good opportunities to be active. This stage takes approximately 20 minutes to complete.

1. Briefly remind children about last week's film and activity.

2. Collect the carbon copy of last week's activity sheet. This is important as it provides us with a record of attendance at this stage of the intervention. It also allows us to examine the extent to which participants actually engaged with the intervention and/or used the materials.

3. Show film 2 (approx 4 minutes).

4. Initiate formation of 'if then' plans (5 – 10 minutes)
    - Provide each pupil with an activity sheet.
    - Ensure that they write their full name in the space provided.
    - Read the instructions and encourage children to make up to three 'if then' plans.

- Emphasize the feasibility of their 'if then' plans.

- Stress that their activities should be scheduled so that they are convenient for them and should not interfere with other activities.

- Remind children not to solely rely on cues such as after school – what about the summer holidays?

- Get children to remove the top sheet of their 'if then' plans and take it home with them, share it with their parents and put it somewhere where it will remind them to act, i.e. fridge door.

- Collect the carbon copy of the 'if then' plans activity sheet. This is important as it provides us with a record of attendance at this stage of the intervention. It also allows us to examine the extent to which participants actually engaged with the intervention and/or used the materials.

Remember, persuasion attempts should be presented as choices by highlighting the ease with which change can be managed and by focusing on what people can do rather than telling them what they should do. Keep this in mind when delivering the intervention.

Activity: Places to be active in my environment

Look for places to be active near you. What sorts of things are within a 10 minute walk or a 5 minute bike ride from your home or on a route that you often walk? Visit your local sports centre or check the local papers to see what's available in your area. Maybe your school has a notice board which promotes local clubs. Why not ask family and friends about the activities they enjoy locally? You can find all sorts of active places near you at the Active Places website. To visit the website go to: www.activeplaces.com

Places to be active in my environment:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

Activity: My 'if then' plans

An easy way to build physical activity into your everyday life is to make simple 'if then' plans. 'If then' plans spell out **what** type of activity you will do, **when** you will do it and **where**. For example, you might form an 'if then' plan to go swimming at your local pool every Saturday at 1.30pm.

Example

If it is _____Saturday_____ (when) at _____1.30pm_____ (what time)

Then I will _____go swimming_____ (what type of activity)

_____at my local swimming pool_____ (where).

You can make up to 3 'if then' plans. When making your 'if then' plans think about places to be active near you. What sorts of things are within a 10 minute walk or a 5 minute bike ride from your home or on a route you often walk?

My 'if then' plans:

1. **If it is** _____ (when) at _____ (what time)

   Then I will _____ (what type of activity)

   _____ (where)

2. **If it is** _____ (when) at _____ (what time)

   Then I will _____ (what type of activity)

   _____ (where)

3. **If it is** _____ (when) at _____ (what time)

   Then I will _____ (what type of activity)

   _____ (where)