Physical activity in natural environments: Importance of environmental quality, landscape type and promotional materials.

Submitted by Lewis Roland Elliott to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Health and Wellbeing in March 2016

I certify that all materials in this thesis which are not my own work have been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature: ………………………………………………

Abstract

Physical inactivity and disconnection from natural environments threatens human health. However, research has demonstrated that natural environments potentially support health-enhancing physical activity which could confer greater physical and mental health benefits than physical activity in other types of environment. This thesis approached the study of physical activity in natural environments through three related pieces of research. Firstly, an experimental study was carried out to explore how the presence of litter in beach environments affected psychophysiological responses to exercise. Responses to exercise did not differ in littered and clean conditions but there was evidence that order effects influenced findings. Visual attention to the two scenes differed, but did not mediate differences in psychophysiological responses. Secondly, analysis of a national dataset was undertaken to explore the form and quantity of physical activity conducted within natural environments in England. A series of linear regressions revealed that higher-intensity physical activities occurred in countryside environments, but more total energy expenditure occurred in coastal environments. Thirdly, a quantitative content analysis of brochures which promote recreational walking in natural environments was conducted which investigated their use of persuasive behavioural messages. These brochures omitted behavioural techniques which may be effective at motivating inactive individuals to walk. Extending this, an online survey tested whether improving brochure content heightened intentions to walk in natural environments. By designing content based on the theory of planned behaviour, the intentions of inactive individuals to undertake walking in natural environments were increased. The findings

from this thesis demonstrate that the protection of natural environments is vital for preserving and promoting active recreation and could contribute to population-level increases in physical activity with theory-based promotion in the future.

Acknowledgements

A PhD, as I have come to realise, is an arduous trek through a dense jungle of bewilderment. The fact that I have come through it relatively unscathed is a testament to the help and support of numerous people. Firstly, my supervisors. To Mat White, for noticing my potential almost 8 years ago, encouraging me to apply in the first place, and for introducing me to a research area which I continue to find fascinating each day. Your help through the PhD has been enormous and I am sincerely looking forward to working together more in the future. Secondly, to Adrian Taylor, whose passion and enthusiasm for his own research area inspires me to develop my career in a similar way. Thank you for always challenging my thinking and for continuing to support me after your move to Plymouth. To my wonderful colleagues at the Psychology Applied to Health group and the wider medical school. Firstly, Charles Abraham for letting me study there in the first place and for your advice on the behaviour change aspects of my work. To Samuel, Sadiq, Jason, Jess, Krystal, Stacey, Leanne, Myles and the rest of the medical school people (too many to name!) for being great friends throughout. Mostly thank you to my office mates who were there for the long-haul: Jeff, Ola, Sam, and Christin. I'll miss the fundamental questions, the coffee and your company immensely. I think we'll all miss the jingles. To my colleagues at the Sport and Health Sciences department. Many of you helped me in various ways but particular thanks to Sam Vine, Lee Moore, and Greg Wood for help with the eye-tracking. Mostly, thank you to Marcela Haasova, Li-Juan Jie, and Luke Goggins for being great company in the office and for the frequent kick-arounds when we needed a break. Thank you to Stephen Herbert, Erica Wayman, and Hazel Thomas at

Natural England for providing me with a great placement. Thank you to the rest of my Exeter housemates and friends: Bas, Damian, Kate, Pizza, Emily, Charlie, Lauren, Sam, Izzy, Matt and John (and everyone I've forgotten) for providing me with the relief from work that I so often needed. Thanks must also be extended to the hundreds of thousands of people that have responded to the MENE survey, everyone who walked on treadmills for me, and the hundreds that completed my online survey. You are the stars of this thesis.

Lastly I want to thank my family. To my dad whose penchant for nautical living and insistence that my brother and I watch the nature programmes on a Sunday afternoon when I was younger have no doubt played a bigger role in my choice of topic than I realise. To my brother for always being someone to look up to and have a laugh with whenever I'm home. To my mum whose love and care from the word go have made me the person I am today; without you helping me through education, home life and everything in between, this thesis would never even have been a concept let alone a reality. I can't thank you enough. Finally to my amazing fiancée Anne-Marie who really has lived and breathed the day-to-day ups and downs of this PhD with me, and has been a saint especially in the last two years while we have been living together. To take an example, there must have been a period of about six weeks where I came back home every night to moan about moderated mediation models that I simply could not get my head around. At the end of those six weeks, you still listened and cared about everything I had to say. That kind of patience is just one of many reasons why I feel so privileged to call you my fiancée. Thank you for everything.

List of Contents

List of Tables

List of Figures

List of Appendices

Statement of candidate's contributions to co-authored papers

Two of the four studies contained within this thesis have been written up as manuscripts for publication. One of these has been published and one is currently undergoing revision after its first peer review. As explained below, the substantial contribution to co-authored papers was made by the candidate. In the thesis, these two chapters have been adapted to better reflect the narrative of the thesis as a whole, and as such are not direct translations of the manuscripts used for publications.

Paper 1: Chapter 4

Elliott, L. R., White, M. P., Taylor, A. H., & Herbert, S. (2015). Energy expenditure on recreational visits to different natural environments. *Social Science & Medicine, 139,* 53-60.

The second empirical chapter presented in this thesis (Chapter 4) was published in August 2015 in *Social Science & Medicine.* The candidate formed the research questions, analysed the data and wrote the manuscript. Mathew White and Adrian Taylor advised on the overall research questions, provided assistance with data analysis and edited the manuscript. Stephen Herbert is the statistician associated with the organisation from which the data was sourced and made contributions to the analysis of data.

Paper 2: Chapter 5

Elliott, L. R., White, M. P., Taylor, A. H., & Abraham, C. (under revision). How do brochures encourage walking in natural environments? A content analysis. *Health Promotion International.*

The third empirical chapter presented in this thesis (Chapter 5) was submitted to *Health Promotion International* in September 2015. It received its first completed peer review in February 2016 and is currently under revision for resubmission to this journal. The candidate collected the study's materials, developed the coding taxonomy and corresponding coding manual, analysed the data and wrote the manuscript. Mathew White and Adrian Taylor assisted with the development of the idea and the coding taxonomy, and edited the manuscript. Charles Abraham assisted with reliability analysis, provided advice on the analytical strategy and also edited the manuscript.

Glossary of terms and abbreviations

Term/abbreviation	Definition
Affect	A broad psychological construct referring to mental states that involve evaluative feelings (e.g. feeling good or bad, liking or disliking something)
Affect circumplex	A model which represents the structure of affective experience in a two-dimensional, 360° space
Affective activation	A characteristic of all affective states referring to how ‘alert,’ ‘aroused,’ or ‘worked-up’ one feels
Affective valence	A characteristic of all affective states referring to how ‘good’ or ‘bad’ one feels
Affordance	The possibility of an action on an object or environment
BCT	Behaviour change technique
BHF	British Heart Foundation
BMI	Body mass index
CAATSPEC	Content analysis approach to theory-specified persuasive educational communication
CALO-RE	Coventry, Aberdeen & London – Refined taxonomy (a taxonomy of behaviour change techniques)
DBP	Diastolic blood pressure
Dwell time	The total duration of fixations and saccades
Fixation	When gaze is focused on a particular point in visual space for a minimum duration of 150 milliseconds
FAS	Felt arousal scale
FS	Feeling scale
GIS	Geographic information system
GPS	Global Positioning System
Health-enhancing physical activity	Physical activity which is practiced at a moderate-intensity for at least 10 minutes at a time

Light-intensity physical activity	Physical activity with an energetic cost between 1.6 and 2.9 metabolic equivalents of task
LSOA	Lower-layer super output area
MABP	Mean arterial blood pressure
MENE	Monitor of Engagement with the Natural Environment survey
MET	Metabolic equivalent of task
Metabolic equivalent of task	The ratio of work metabolic rate to the resting metabolic rate. One metabolic equivalent of task is equivalent to a standard resting metabolic rate of 3.5ml O2 $kg^{-1} \cdot min^{-1}$ (3.5 millilitres of oxygen consumption per kilogram of body weight of the individual per minute engaged in the activity)
MET minutes/hours	The minutes/hours engaged in an activity with consideration to the number of metabolic equivalents of task (METs x duration)
Moderate-intensity physical activity	Physical activity with an energetic cost between 3.0 and 5.9 metabolic equivalents of task
MVPA	Moderate-to-vigorous intensity physical activity
Natural environment	This thesis adopts Natural England's Monitor of Engagement with the Natural Environment definition of natural environments which is, "open spaces in and around towns and cities, including parks, canals and nature areas; the coast and beaches; and the countryside including farmland, woodland, hills and rivers" (Natural England, 2015)
NICE	National Institute of Health and Care Excellence
OR	Odds ratio
PA	Physical activity
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure
PRS	Perceived restorativeness scale
Psychophysiology	The branch of physiology that is concerned with the relationship between mental and physical processes

QALY	Quality-adjusted life year
RCT	Randomised controlled trial
Restorative environment (restorativeness, restoration)	Refers to the psycho-evolutionary idea that certain environments elicit positive affect and consequently reduce physiological arousal. Alternatively, it refers to the cognitive idea that certain environments hold effortless attention through containing interesting sensory properties which in turn enables directed attention to replenish (attention restoration)
RMR	Resting metabolic rate
RPE	Rate of perceived exertion
Saccade	A rapid movement of the eye between fixation points
SES	Socio-economic status
SBP	Systolic blood pressure
SMD	Standardised mean difference
Stroop task	Neuropsychological test. Participants are exposed to repeated trials where a written name of a colour differs from the colour of the word itself. Participants are tasked with naming the colour of the word. It has been primarily used to measure selective attention, but is also widely used as a stressor task to induce physiological arousal
UKNEA	United Kingdom National Ecosystem Assessment
Vigorous-intensity physical activity	Physical activity with an energetic cost above 6.0 metabolic equivalents of task
WHO	World Health Organisation

1. Introduction

1.1 Problem statement

The important role that physical activity (PA) plays in the physical and mental health of humans is not a new idea. Eminent medical scholars such as Hippocrates and Galen wrote extensively on the benefits that PA can have on a range of ailments millennia ago (Berryman, 2012). Yet in the modern era, over a quarter of European adults are estimated to be inactive, imposing economic costs to the European economy of over €80 billion per year (International Sport and Culture Association, 2015). An expanding body of research demonstrates that increased sedentary time is associated with greater risks of diabetes, cardiovascular disease, all-cause mortality, and depression (Katzmarzyk, Church, Craig & Bouchard, 2009; Wilmot et al., 2012; Teychenne, Ball & Salmon, 2010). A parallel body of research suggests that higher levels of PA are associated with lower risks of similar health conditions (Warburton, Nicol & Bredin, 2006).

One reason for the transition towards increasingly sedentary lifestyles is because growing urbanisation and technological advancement has led to daily life and work conditions that no longer require human physical exertion (Eaton & Eaton, 2003; Kohl et al., 2012). The urban population of the world has grown from 746 million in 1950, to 3.9 billion in 2014, with 73% of Europe being classed as urbanised (United Nations, 2014). Growing urbanisation is associated with loss and degradation of natural environments (Tzoulas et al., 2007). This is important because exposure to and contact with the natural environment provides numerous physical and mental health benefits. These benefits can be produced through improvements in air quality (e.g. reductions in particulate matter), increases in social contact (e.g. increased interactions with neighbours), and reductions in stress (e.g. affective and cognitive restoration; Hartig, Mitchell, de Vries & Frumkin, 2014).

Natural environment's benefits to human health can also work through increased PA (Hartig et al., 2014). This implies that the conservation of the natural environment might be important in promoting PA. Indeed, a number of reviews have identified that access and contact with natural environments is associated with higher levels of PA (Calogiuri & Chroni, 2014; Gladwell, Brown, Wood, Sandercock & Barton, 2013; James, Banay Hart & Laden, 2015; Lee & Maheswaran, 2010; Ward Thomspon, 2013). General exposure to natural environments can have positive mental health benefits (Gascon et al., 2015; McMahan & Estes, 2015) which has led to a lot of review studies which identify that conducting PA in a natural environment may add to the health benefits of PA alone (Barton & Pretty, 2010; Bowler, Buyung-Ali, Knight & Pullin; Gladwell et al., 2013; Thompson Coon, Boddy, Stein, Whear, Barton & Depledge, 2011). Despite this growing amount of research, a number of issues remain which prevent the recognition of natural environments as a valuable public health resource for promoting PA.

The overall aim of this thesis was to examine three issues which currently prevent natural environments from being more highly recognised as vital public health resources. The three issues examined are methodologically distinct but all attempt to enhance the appreciation of natural environments as important spaces for the promotion and elicitation of PA. Chapter 2 reviews literature on the separate and combined health benefits of PA and exposure to natural environments before reviewing evidence on: (a) how degradation of natural environments might negatively affect the experience of PA; (b) how different types of natural environment contribute differently to PA attainment; (c) how PA in natural environments is currently promoted and; (d) how the promotion of PA in natural environments could be improved via the use of theoretical explanations of behaviour change. Chapter 3 employs a controlled laboratory experiment to examine the psychophysiological effects of exposure to littered and clean natural environments whilst exercising. Chapter 4 analyses a secondary public dataset to investigate how different natural environments contribute differently to energy expenditure. Chapter 5 uses quantitative content analysis to examine how PA in natural environments is promoted through recreational walking brochures. Chapter 6 uses an experimental survey design to observe how enhancing brochures with persuasive techniques might increase intentions to be physically active in natural environments for less active populations. Finally, Chapter 7 discusses the theoretical and practical contributions these studies make, presents a modified framework for researching the connections between PA and the natural environment, and reviews general limitations associated with the work.

2. Literature review

2.1 Chapter overview

This chapter begins by defining physical activity (PA) and exploring its benefits to physical and mental health in humans. The chapter then proceeds to discuss the idea that exposure to natural environments also produces physical and mental health benefits, and thus combining the two could have an additive effect. The literature review then explores four methodologically distinct but conceptually related questions concerning PA in natural environments. The first deals with aesthetic and visual qualities and how these might affect the outcomes of PA in natural environments. The second concerns relationships between natural environment access and visitation and PA participation. The third looks at recent research to investigate how PA in natural environments is best promoted. The last section examines how the promotion of PA in natural environments could be improved by discussing the role of theoretical explanations of behaviour change.

2.2 Physical activity

This thesis will subscribe to the World Health Organization (WHO) definition of physical activity (PA) which is, “any bodily movement produced by skeletal muscles that requires energy expenditure,” (WHO, 2010). PA is distinct from exercise in that whilst they both result in energy expenditure and are correlated with physical fitness (i.e. attributes such as cardiorespiratory endurance), exercise is planned and structured with the intention to improve or maintain fitness, whilst PA could be incidental e.g. energy expended by walking for transport purposes or by undertaking housework (Casperson, Powell & Christenson, 1985).

It is important to distinguish between intensities of PA in order to understand how they may produce different health consequences. Sedentary activity involves energy expenditure at the level of 1.0 to 1.5 metabolic equivalents of task (METs) and may often refer to sitting behaviours e.g. 1 MET refers to the energy cost of sitting quietly and can be expressed in terms of oxygen uptake as $3.5 mL \cdot kg^{-1} \cdot min^{-1}$ (Ainsworth et al., 2011; Pate, O'Neill & Lobelo, 2008). Light-intensity PA refers to activities such as standing, walking slowly and lifting lightweight objects and incurs energy costs of around 1.6 to 2.9 METs (Pate et al., 2008). Moderate-intensity PA refers to an energy cost of around 3.0-5.9 METs and examples include brisk walking (3 mph), dancing, and undertaking effortful housework (Department of Health and Human Services, 2008). Vigorous-intensity PA includes running at 6 mph or playing football and incurs energy costs of 6 METs or greater (Department of Health and Human Services, 2008).

Where this thesis makes reference to health-enhancing PA, it is referring to PA of at least moderate-intensity, practiced for at least 10 minutes at a time (WHO, 2010). Where the thesis refers to PA guidelines, it is referring to the World Health Organisation's guidelines for maintaining health amongst adults aged 18-64; that is, undertaking at least 150 minutes of moderate-intensity aerobic PA throughout the week in bouts of at least 10 minutes, or 75 minutes of vigorous-intensity PA, or an equivalent combination of moderate- and vigorous-intensity PA (WHO, 2010). Whilst muscle-strengthening activity on at least 2 days per week also forms part of these guidelines, this is not included in the operational definition of PA guidelines this thesis subscribes to as these are not the sorts of PA that natural environments typically support (see section 2.6).

2.2.1 Physical health benefits of physical activity

Physical inactivity is seen as a modifiable risk factor for a host of physical health conditions. Warburton et al., (2006) undertook a narrative review of evidence regarding the protective effects of PA in the primary (preventing a disease before it occurs) and secondary (mitigating the impact of a disease after it has occurred) prevention of premature death. Specifically, the authors focused on the role of PA in the prevention of all-cause mortality, cardiovascular disease, type 2 diabetes mellitus, some cancers, hypertension, obesity, and osteoporosis (as well as depression, for which the relevant literature is scrutinised more closely in section 2.2.2). The authors suggest a linear relationship between levels of PA and risk of premature death; the more PA one attains, the lower the risk. They further conclude there is decisive evidence on the relationship between PA attainment and the primary and secondary prevention of cardiovascular disease. Similar conclusions were drawn with respect to type 2 diabetes mellitus although the types and intensities of PA which were adequate for primary or secondary prevention could not be determined. They also found that PA protected against the development of breast and colon cancers, but there was less conclusive evidence regarding its potentially beneficial effects on mitigating health problems arising from having such cancers. There was also compelling evidence that PA is important in preventing loss of bone mineral density and osteoporosis particularly in postmenopausal women. However there was only limited evidence for its effectiveness in alleviating the negative health consequences of osteoporosis. Overall, the review lends support for PA particularly in the primary prevention of a number of physical health conditions. However, the unsystematic collection of evidence could lead to biased findings prompting the need for more systematic reviews of health benefits along with meta-analyses establishing unbiased risk reduction rates of various physical health conditions from practicing PA. Furthermore, the frequency, intensity, duration and type of PA needed for protective effects need to be better established.

In a systematic review and meta-analysis, Nocon, Hiemann, Müller-Riemenschneider, Thalau, Roll and Willich (2008) aimed to evaluate the protective effects of PA on primary prevention of cardiovascular and all-cause mortality using large cohort studies as evidence. Thirty-three studies met the authors' inclusion criteria with follow-up periods ranging from 4 to 20 years. Most of these reported models adjusting for other common predictors of mortality and 15 reported results for parsimonious models (usually age-adjusted only). The meta-analysis of almost 900,000 individuals aged 16 to 88 revealed pooled absolute risk reductions of 35% for cardiovascular mortality and 33% for all-cause mortality (risk reductions were compared between the least and most active population subgroups). For both outcomes, objective PA assessments predicted larger risk reductions than subjective assessments. For all-cause mortality, parsimonious models predicted larger risk reductions than fully-adjusted models. Whilst comparisons between the most and least active population subgroups was not always methodologically homogenous (most studies reported three PA subgroups – low, moderate and high levels of PA – but some reported four or five), including studies that only compared three subgroups had minimal effects on overall risk reductions. Therefore, PA can be said to have meaningful effects on the primary prevention of cardiovascular and all-cause mortality. These effects have also been supported by a more recent review (Li & Siegrist, 2012).

A review by Jeon, Lokken, Hu and Van Dam (2007) investigated the effects of moderate-intensity PA on primary prevention of type 2 diabetes. Ten prospective cohort studies comprising over 300,000 participants and over 9,000 incidences of type 2 diabetes were included. Five of these solely investigated the role of walking. In a similar way to the previous review, the highest categories of moderate-intensity PA attainment were compared with the lowest in order to compute risk reductions. The highest moderate-intensity PA attainment category had a reduced risk of around 31%. After controlling for body mass index (BMI), the risk reduction was approximately 17%. The studies which only looked at walking found similar risk reductions: 30% overall and 17% after controlling for BMI. While the studies included may be limited by lack of adjustment for attainment of PA of other intensities, strengths included low attrition rates, and no evidence of publication bias. Therefore, attainment of moderate-intensity PA can be said to have significant protective effects over the development of type 2 diabetes. Importantly, this review also suggests that walking, independent of other activity, can have comparable protective effects.

A review and meta-analysis by Monninkhof et al. (2007) included cohort and case-control studies investigating the role of leisure time PA in the primary prevention of breast cancer. Again, risk reductions were computed by comparing the lowest with the highest PA attainment subgroups. Eight of 17 cohort studies reported decreased risks of over 20%, with the remainder reporting no association. Risk reduction associated with the higher quality cohort studies ranged from 21 to 39%. Fourteen of 28 case-control studies yielded a risk reduction ranging from 23 to 65%. Such risk reductions were most true of postmenopausal breast cancer; premenopausal breast cancer reduction risks were indecisive. While the most effective quantities of PA for reducing breast cancer risk are unclear, this review does suggest that there is reasonable evidence that PA conducted in leisure time has protective effects over the development of breast cancer.

A further review on the primary prevention of colorectal cancers from leisure-time PA used a similar method to the previous reviews (Harriss et al., 2009). The review included 15 cohort studies from 14 articles. For men, the uppermost level of leisure-time PA attainment was associated with a 20% risk reduction in colon cancer; women experienced a 14% reduction. Reviews of studies observing effects on rectal cancer yielded no significant risk reductions for men or women. Dose-response analyses revealed linear associations; the more leisure-time PA achieved, the lower the risk of colon cancer for both genders. Maximally adjusted models tended to yield similar risk reductions to parsimonious models, suggesting the effects of leisure-time PA on colon cancer risk are not confounded by other factors. However, the review highlighted the need for more studies utilising objective PA estimates. Thus, the review concluded that self-reported leisure-time PA was associated with meaningful protective effects of developing colon, but not rectal, cancer.

Wendel-Vos et al., (2004) conducted a systematic review concerning the effects of PA on the primary prevention of stroke. The authors extracted both case-control studies and cohort studies concerning the effects of both leisure-time and occupational PA on the primary prevention of stroke. In a departure from the above meta-analyses, the authors' meta-regression used three activity categories for comparison: high activity, moderate activity, and inactivity. In terms of total stroke (ischaemic and haemorrhagic), moderate occupational and leisure-time activity was associated with absolute risk reductions of 36% and 15% respectively compared to inactivity. High levels of occupational activity reduced the risk of ischaemic stroke by 23% compared with moderate activity and by 43% compared with inactivity. High levels of leisure-time activity reduced the risk of total stroke by 22%, ischaemic stroke by 21%, and haemorrhagic stroke by 26% compared with inactivity. European studies demonstrated stronger risk reductions than those conducted in the USA (53% compared to 18%). There was little evidence for publication bias regarding total stroke (Egger's test: p=.9) and haemorrhagic stroke (p=.3), and only some evidence regarding ischaemic stroke (p=.1). Limited numbers of studies on both occupational activity and haemorrhagic stroke limits the acceptability of the risk reductions. Also, the amount of PA being conducted in each study differed meaning that the cut-offs represented different amounts of PA for each study; this makes it difficult to determine the most effective quantity of PA for primary prevention of stroke. Furthermore, adjustments for confounds made in different studies varied; some included many risk factors and others were much more parsimonious. Thus the pooled result includes some confounding. Nonetheless, it can be concluded that higher levels of PA have protective effects over the development of stroke, especially when concerning leisure-time PA and ischaemic stroke.

This brief overview of systematic reviews and meta-analyses has found that, generally, higher quantities of PA are associated with greater risk reductions of a host of physical health conditions. Specifically, higher levels of PA were associated with primary prevention of cardiovascular disease and all-cause mortality. Higher quantities of leisure-time PA were associated with lower risk of ischaemic stroke, colon cancer and postmenopausal breast cancer. Moderate-intensity PA and walking were associated with lower risk of type 2 diabetes. This overview is by no means exhaustive as comparable reviews have found similar effects regarding primary prevention of hypertension (Whelton, Chin, Xi & He, 2002), osteoporotic hip fractures (Moayyeri, 2008), and lung cancer (Tardon et al., 2005). The main limitations involved with such studies are that the sufficient intensity and duration of PA for primary prevention of the diseases is unclear. However, there is some evidence that moderate-intensity activities such as walking may be sufficient (e.g. Jeon et al., 2007). Some included studies also fail to adjust for confounding risk factors which would likely reduce the significance of the risk reductions, but as some of the reviews suggest (e.g. Nocon et al., 2008), maximally adjusted models still yield clinically meaningful risk reductions. Most reviews employ a method separating individuals in the cohorts into categories comparing the highest and lowest PA attainment. Because all cohorts are different, these categories represent different average levels of PA i.e. the highest PA category in one study may conduct very different amounts of PA to the highest category in another study. Again, this makes the quantity of PA sufficient for prevention difficult to determine. Most studies used self-report measures of PA rather than objective measures (e.g. accelerometers). Whilst objective measures of PA yield lower estimates than self-report, systematic differences between groups are generally not found (Troiano, Berrigan, Dodd, Mâsse, Tilert & McDowell, 2008), thus we would not expect risk reductions to differ between PA categories. Despite these limitations there is much evidence to suggest that more PA attainment of whatever type, intensity or duration plays a significant role in the primary prevention of physical health conditions. Its promotion is therefore a public health priority.

2.2.2 Physical activity, neurodegeneration and mental health

Further benefits of PA concern its effect on neurodegenerative diseases and mental health conditions. In a review of 16 prospective cohort studies including 163,797 non-demented participants at baseline and 3,219 at follow-up, Hamer & Chida (2009) sought to establish the protective effects of PA on the development of neurodegenerative diseases. In a similar way to reviews on physical health conditions, the lowest PA attainment category was compared to the highest. The authors found absolute risk reductions of 28% for dementia, 45% for Alzheimer's disease, and 18% (an insignificant reduction) for Parkinson's disease. The authors suggest these risk reductions likely result from enhanced vascular health (particularly cerebral circulation) which is an important risk factor for neurodegenerative diseases. The review is limited in similar ways to the reviews above. The PA categorisation means that actual

PA attainment in the highest and lowest categories is not the same across studies. Studies also varied in terms of the number of confounds controlled for and the length of follow-up and the review is unable to determine an optimal quantity of PA for protecting against neurodegeneration.

Bize, Johnson & Plotnikoff (2007) reviewed 14 studies of different methodologies concerning the relationship between PA and quality of life. Half of these were cross-sectional and the rest were either randomised controlled trials (RCTs), cohort studies or a mixture of cross-sectional and longitudinal designs. PA was assessed in 13 different ways and quality of life was usually assessed by variations on the SF-36 questionnaire. The heterogeneity of designs and measures precluded quantitative synthesis. Cross-sectional evidence demonstrated consistent positive relationships between PA and quality of life with the largest study finding a 60% lower chance of “having 14 or more unhealthy days” in the previous month if you met PA guidelines compared to being inactive. Three cohort studies reported positive associations between leisure-time PA attainment and quality of life whilst RCTs yielded mixed results. As cross-sectional evidence dominates this topic, the direction of the PA-quality of life relationship cannot be determined. More cohort studies are needed in order to definitively state that increasing PA leads to increases in quality of life.

A review of 30 prospective longitudinal studies examined the effect of PA on the development of depression (Mammen & Faulkner, 2013). The presence of depression was ascertained either through cut-off points on self-report measures or through physician’s diagnosis or antidepressant prescription and

PA was measured subjectively in all but one study. Twenty-five of the studies supported the hypothesis that PA is preventive in the onset of depression. Four studies focussed exclusively on walking and three found that walking protected against future depression. Two high-quality studies found that even low levels of walking were associated with decreased risks of depression by up to 60%. Furthermore, some studies demonstrated that fewer than 150 minutes of moderate-intensity PA was still associated with a reduced risk of future depression. Despite this, heterogeneity in PA measures makes dose-response relationships difficult to establish and many studies did not control for important potential confounds which change over time such as psychosocial factors which may affect both PA and depression.

PA has also been investigated as a means of treating depression. Cooney et al., (2013) reviewed 39 clinical trials examining the use of PA as treatment for depression. Thirty-five trials which compared an exercise group with a no-treatment or control intervention yielded a pooled standardised mean difference (SMD) of -0.62 (95% CI -0.81, -0.42) favouring a moderate clinical effect of exercise. Meta-analysing the 6 highest quality studies, the pooled SMD was not significant. Meta-analysing 8 trials with longer-term follow-ups yielded a small effect in favour of exercise. Trials whose comparison group was psychological therapy or pharmacological treatment found no significant differences, though there were not many trials of this nature. Ekkekakis (2015) has criticised the methodology associated with this review. For example, the authors included studies which did not implement their proposed protocol accurately, meaning that the pooled SMD reflects trials where, for instance, aerobic PA was intended to be delivered, but what was actually delivered were light-intensity sitting exercises. Cooney et al., (2013) also excluded studies using assisted walking, tai-chi, qigong and yoga, when there is no a priori reason for not classing these activities as exercise. They also excluded studies of postnatal depression, but provided no justification as to why. They further changed their protocol to examine only trial arms with the largest quantity of PA, when this may not be the optimum amount for treating depression. Ekkekakis (2015) reanalysed the data addressing these, and other, limitations and found a pooled SMD of -0.90, indicating a much larger effect of exercise upon depression.

Holley, Crone, Tyson & Lovell (2011) reviewed 12 quantitative and 3 qualitative studies concerning 3 to 20 week PA interventions to enhance the psychological well-being of people living with schizophrenia. Ten of these used aerobic PA interventions, 4 anaerobic PA, and one was unspecified. Measures of psychological well-being were diverse. In total, 356 adults were included in the narrative synthesis. Most studies supported the hypothesis that PA interventions improve psychological well-being in people living with schizophrenia. For example, studies reported improvements in self-esteem, a sense of self and purpose, motivations to ‘get up in the morning’, self-image and body-image, social competence, and cooperation with health professionals. As well as being unable to determine an optimal amount of PA for enhancing psychological well-being, the lack of homogeneity with regards to measuring psychological well-being makes it difficult to draw definite conclusions about PA’s potentially beneficial effects. Indeed a further review found that although PA interventions increased levels of exercise, they did not affect neither positive nor negative symptoms of schizophrenia (Pearsall, Smith, Pelosi & Geddes, 2014).

Wang, Wang, Wang, Li, & Zhou (2014) conducted a systematic review of long-term exercise interventions and their effect on abstinence, withdrawal symptoms, anxiety and depression related to substance use disorders. Specifically they reviewed 22 RCTs concerning people aged over 18 who were addicted to nicotine, alcohol, or illicit drugs. Interventions ranged from 10 days to 6 months. Exercise interventions were both aerobic (jogging, walking etc.) or non-aerobic (yoga, qigong etc.) and the nature of control groups were mixed (daily life, cognitive behaviour therapy etc.). Meta-analysis revealed that at follow-up, exercise groups were more likely to abstain from substance use (OR=1.69, $p<.001$), and less likely to experience withdrawal symptoms (SMD=-1.24, $p<.05$), anxiety (SMD=-0.31, $p<.001$) and depression (SMD=-0.47, $p<.01$) related to substance use. Effects on illicit drug use were stronger than for alcohol and nicotine. All intensities of exercise training produced similar results, and all length of follow-up periods also produced similar results. Whilst heterogeneity and clinical relevance of the outcomes measures in the studies limit applicability to clinical treatment, this study suggests that long-term exercise interventions can mitigate some of the negative effects of substance use, especially for illicit drugs. Moreover, as with other research in this section, moderate-intensity exercise appears to be sufficient in producing these effects.

Haasova et al (2013) conducted a systematic review and meta-analysis of the effects of acute PA on cigarette cravings. Specifically, the authors included studies with within- or between-subjects designs which recruited temporarily abstinent smokers (at least 2 hours prior) to either a PA condition or a sedentary control condition. Cigarette cravings had to have been measured with at least one of two standardised measures (‘strength of desire’ or ‘desire to smoke’) and participants were required to not be using any pharmaceutical aids for smoking cessation. In a two-stage[a], random effects, individual participant data meta-analysis, the effects of short duration PA on ‘strength of desire’ in 15 studies yielded a pooled SMD of -1.91 indicating a significantly reduced ‘strength of desire’. In a comparable model observing ‘desire to smoke’ in 17 studies, a pooled SMD of -2.03 was found indicating an even stronger effect of PA on this measure of cigarette cravings. Variations on these meta-analyses, including using one-stage models and only examining moderate-intensity PA, produced similarly significant pooled reductions in cigarette cravings. Whilst the authors acknowledge that the study reporting the highest baseline cravings also had the largest effect sizes (indicating a ceiling effect), they note that other studies with high baseline cravings did not produce comparable effect sizes and therefore ceiling effects are unlikely to be responsible for the results. The authors also note that the reductions in craving from the review are similar to those associated with nicotine replacement therapy. Thus, this review demonstrates that acute PA, even at moderate-intensity, can reduce cigarette cravings as much as conventional treatments. A further narrative synthesis of studies reviewing techniques for modifying impulses for unhealthy eating has found that acute PA could also be an

[a] Deriving effect sizes and associated statistics for each primary study first, before pooling results using standard meta-analysis techniques. In contrast, a one-stage individual participant data meta-analysis uses all data from all primary studies collectively for deriving an effect size.

effective strategy for reducing food cravings (Van Beurden, Greaves, Smith & Abraham, in press). That the effects of acute PA on multiple impulsive behaviours (smoking, unhealthy eating) have been established suggests that PA may produce a general neurobiological response which regulates impulsive processes. For example Van Rensburg, Taylor, Bennattayallah & Hodgson (2012) highlight the insula (a limbic structure) as potentially important, whilst Smith and Lynch (2012) consider a number of neurotransmitters, such as dopamine, norepinephrine and glutamate, to potentially be responsible for this response. Alternatively, in the longer-term, PA may foster more global self-esteem (McAuley, Mihalko & Bane, 1997) which may lead to less desire to smoke, snack, or undertake other unhealthy behaviours.

There is also much evidence suggesting that acute bouts of exercise may have beneficial short-term effects on mental health indicators. Hamer, Taylor & Steptoe (2006) reviewed 15 RCTs concerning nearly 500 participants which examined the effect of acute aerobic exercise on blood pressure responses to psychosocial stressors. Specifically, RCTs had to first employ an acute aerobic exercise task or sedentary control condition. After which, systolic (SBP) and diastolic (DBP) blood pressure were measured before, and during exposure to a psychosocial stressor task. The authors were interested in the differences in SBP and DBP changes. Most studies employed the Stroop task as a stressor whilst others used mental arithmetic, cold pressor and public speaking tasks. Following exercise, the authors found a 3.7 millimetres of mercury (mmHg) pooled reduction in SBP, and a 3.0 mmHg pooled reduction in DBP, from before to during the stressor task (compared to the sedentary control condition). SBP denotes pressure in the arteries when the heart muscle contracts and DBP denotes the pressure in the arteries between heartbeats, therefore these reductions reflect significantly less pressure in the arteries overall. Importantly, significant effects were found even after exercise at moderate intensities. Whilst less artificial stressor tasks are warranted to generalise the implications to real life, this review demonstrates that acute exercise of moderate intensity can attenuate stress-related blood pressure responses.

At a more fundamental level, which may go some way to explaining many of the above findings, undertaking PA inherently involves affective responses. ‘Affect’ is defined as “the most basic or elementary component of all valenced (positive or negative, pleasant or unpleasant) responses, including, but not limited to, emotions and moods” (Ekkekakis, Hall & Petruzzello, 2005). Whereas emotions warrant a cognitive appraisal of a stimulus, affect (e.g. pleasure or displeasure) is a component of emotion. Moods, by contrast, are longer lasting emotions and might be about “nothing specific or about everything” (Ekkekakis, 2013, p.43-46; Frijda, 2009, p.258).

In a review of the effect of acute aerobic exercise on affect, Ekkekakis, Parfitt and Petruzzello (2011) found that, generally, the intensity of exercise was inversely associated with positive affect; the more intense an activity, the less positive affect one obtains from doing it. Exercise approaching physiological thresholds (ventilatory, lactate, or the onset of blood lactate accumulation) was associated with improvements in affect, but exceeding these, there is evidence of a decline in positive affect. As an example, in four experimental studies, Ekkekakis et al., (2000) found that walking at a moderate intensity for 10-15 minutes was associated with more activated pleasant feelings during the walk and less activated pleasant feelings after resting. These findings were consistent across different samples, settings and across different measures of the affect circumplex (Yik, Russell & Barrett, 1999). The affect circumplex is a model which represents the structure of affective experience in a two-dimensional, 360° space (Russell, 1980). One dimension represents pleasure to displeasure and the other represents the degree of arousal (see Figure 2.1).

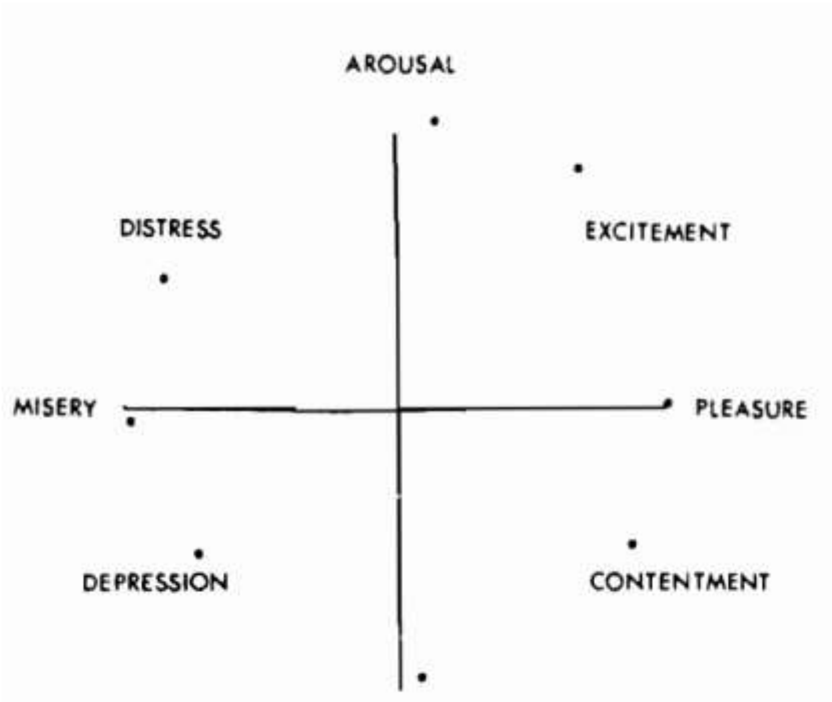


Figure 2.1 The original depiction of the affect circumplex with various affective states noted (Russell, 1980).

The circumplex is a model which is advocated as a sound alternative to state-based measures when measuring affect in exercise for four reasons: a) its targeting of ‘basic affect’ as opposed to higher-order mood or emotional states; b) its dimensionality offers much measurement scope (as opposed to state-based measures which are limited to interventions targeting changes in those moods or emotions specifically); c) it is domain-general and thus unlikely to be biased towards positive evaluations of, for example, aerobic activities compared to sedentary activities, and; d) it has its foundations in psychological theory, thus allowing a deductive approach to affect measurement (Ekkekakis & Petruzzello, 2002). One way of operationalising the affect circumplex is through measuring affective valence (often measured by the feelings scale; FS; Hardy & Rejeski, 1989) and affective activation (often measured by the felt arousal scale; FAS; Svebak & Murgatroyd, 1985).

The measurement of affect in this way is also important as it has been shown to predict future physical activity. For example Williams, Dunsiger, Ciccolo, Lewis, Albrecht and Marcus (2008) had participants complete a graded submaximal exercise test and found that higher scores on the FS, when they achieved a heart rate indicative of moderate-intensity, predicted more minutes of physical activity 6 and 12 months later. Further research confirmed these results even when only using a 10 minute, moderate-intensity treadmill walking task (Williams, Dunsiger, Jennings, & Marcus, 2012). A subsequent review of 24 studies looking at this relationship confirmed that positive changes in basic affect during moderate-intensity exercise predicted both self-reported and objective future physical activity behaviour (Rhodes & Kates, 2015).

In summary, PA can be beneficial in the primary prevention of Alzheimer's disease and depression and in the treatment of depression and substance use disorders. There is weaker evidence that it may enhance psychological well-being in people living with schizophrenia and lead to better quality of life more generally. Acute bouts of PA can attenuate stress-related blood pressure responses and reduce cravings for smoking and unhealthy eating. More generally, acute PA can lead to more pleasant, more activated affect during exercise and more pleasant, less activated affect after recovery from exercise. This indicates that PA has pronounced effects on the foundations of mental health which may go some way to explaining the effects of PA on depression, quality of life, and psychological well-being for example. Generally, the evidence base for the effects of PA on mental health is weaker than that for physical health. There are multiple reasons for this such as the reliance on subjective outcome measures which may be prone to bias, the heterogeneity in ideas of how to measure aspects of psychological health, and the fact that because the research inherently traverses disciplines, it is still in its infancy relative to studies of physical health. Subjective measures of psychological constructs are however, important for policy. Often, objective measures are unavailable for measuring aspects of mental health and moreover, subjective measures of, for example, well-being, may have societal importance (Dolan & White, 2007). As with physical health, the appropriate quantity (frequency, intensity, duration, type) of PA for improving mental health conditions and their symptoms is often unknown making recommendations difficult. Despite these limitations with the literature, a promising finding is that in both acute and chronic studies, moderate-intensity exercise appears to be sufficient in mitigating negative symptoms and enhancing positive aspects of mental health. This is important as moderate-intensity exercise promotion has been suggested as the most efficacious strategy for addressing population level physical inactivity (Ogilvie et al., 2007).

2.2.3 Physical inactivity and walking as a public health strategy to target it

From the evidence above, it is clear that undertaking the quantities of PA that are recommended in guidelines (WHO, 2010) can prevent and ameliorate a number of physical and mental health conditions, as well as produce positive affective responses that may foster future PA. However, the presence of population-level physical inactivity (defined as people not meeting established PA guidelines) is widespread. Using health surveys from the four home nations of the UK, the British Heart Foundation (BHF) claim that in 2012, 67% of English male adults and 55% of English female adults self-reported meeting recommended PA guidelines (Townsend, Wickramasinghe, Williams, Bhatnagar & Rayner, 2015). Rates of PA in Scotland are comparable to this whilst Northern Irish and Welsh rates are considerably lower. PA is consistently higher for males and declines with age and with equivalised household income for both genders. However, in a previous report using objective accelerometer measured estimates from the 2008 Health Survey for England, only 6% of men and 4% of women met the PA guidelines (30 minutes of moderate-intensity PA on at least 5 days a week) at the time of measurement (Townsend, Bhatnagar, Wickramasinghe, Scarborough, Foster & Rayner, 2012). This suggests that people may report considerably more PA than they actually undertake, although it is worth noting that systematic differences between ages and genders remain relatively unchanged when observing objective estimates. In summary, national statistics suggest that many members of the population currently do not achieve the amounts of PA that are sufficient for maintaining health and protecting against physical and mental health conditions, and that the situation may be considerably worse when using objective levels of PA compared to self-reported levels. .

Globally, inactivity is predicted to be responsible for over 5.3 million premature deaths per annum, 6% of the burden of disease from coronary heart disease, 7% of the burden from type 2 diabetes, and 10% of the burden from both breast cancer and colon cancer (Lee et al., 2012). Based on these statistics, reducing global inactivity by 25% would avert 1.3 million deaths (Lee et al., 2012). In the UK, inactivity costs the economy around £1 billion annually (Scarborough, Bhatnagar, Wickramasinghe, Allender, Foster & Rayner, 2011). The scale of physical inactivity and its impact on health and economic burdens has lead scholars to suggest that behavioural science interventions alone cannot increase population-level PA; instead, policy level and environmental approaches are also needed (Kohl et al., 2012). To achieve effective population-level approaches, we need to know what types of moderate-intensity PA people are most likely to undertake and what everyday environments and contexts facilitate undertaking them.

Using the 2008 Health Survey for England, Bélanger, Townsend and Foster (2011) analysed the PA profiles of 4,750 English adults who met the PA guidelines at the time. Specifically, they were interested in the proportion of time they spent undertaking eight different categories of activities which contributed to moderate-to-vigorous PA attainment. Of all activities, walking (both leisure-time and transport based walking) contributed the most to women of all ages' moderate-to-vigorous PA attainment. For men, walking contributed to moderate-to-vigorous PA attainment for four of six age groups. In the two age groups where it did not (35-44, 45-54) it was second only to occupational PA. Sports (team and individual), leisure pursuits (dancing, fishing etc.) and outdoor pursuits (skiing, backpacking etc. but not outdoor walking) contributed very little to everyone's PA over the age of 24. Whilst, the self-report nature of PA in this study means that estimates of moderate-intensity activity are probably higher than that which is actually achieved, it still demonstrates that adults in most cases believe walking to be their most often undertaken activity.

Walking has been described as "a rhythmic, dynamic, aerobic activity of large skeletal muscles that confers the multifarious benefits of this with minimal adverse effects. Walking is the nearest activity to perfect exercise" (Morris & Hardman, 1997; p.328). The fact that walking contributes the most to national levels of moderate-intensity PA attainment is important as walking, independent of other types of PA attainment has been shown to be protective against a number of physical and mental health conditions. Hamer and Chida (2008) reviewed 18 prospective cohort studies with over 450,000 people free of cardiovascular disease at baseline and nearly 20,000 at follow-up. People in the highest walking category were 0.69 times less likely to develop cardiovascular disease; a significant risk reduction was observed even at lower walking levels equivalent to recommended PA guidelines.

A further review has confirmed that walking improves aerobic fitness by 10.5% and reduces SBP and DBP in the long-term by three and two percent respectively (Murtagh, Nichols, Mohammed, Holder, Nevill & Murphy, 2015). Thus, walking, independently of other forms of PA, improves risk factors for cardiovascular disease, and therefore the risk of developing cardiovascular disease. In another review, Robertson, Robertson, Jepson and Maxwell (2012) reviewed eight RCTs concerning walking interventions for depression compared with no treatment, usual care, or other treatment (e.g. cognitive behavioural therapy) control groups. The pooled SMD for depressive outcome measures at the end of the interventions was -0.86 indicating a large effect of walking exercise on depressive symptoms. The relatively large effect sizes held even when sub-analysing outdoor and indoor walking interventions separately. Stanton and Reaburn (2014) extended this review to suggest that the appropriate quantity of walking for alleviating depressive symptoms amounted to supervised, 30-40 minute moderate-intensity walking exercise three times a week for at least nine weeks. These reviews demonstrate that walking at a moderate-intensity, independent of other types of PA can confer some of the physical and mental health benefits listed in sections 2.2.1 and 2.2.2. A large proportion of the population are able to walk, and it is perhaps the most accessible and safest PA with the least barriers (Morris & Hardman, 1997); thus its importance for elevating the PA levels of the most sedentary cannot be overstated (Ogilvie et al., 2007).

2.3 Health effects of exposure to natural environments

Concern about the loss of the natural environment from increasing urbanisation, resource exploitation and climate change has prompted research on the health benefits of contact with natural environments. For the purposes of this thesis, natural environments are defined as “all green open spaces in and around towns and cities as well as the wider countryside and coastline” (Natural England, 2015, p.5). Whilst the natural environment presents a number of threats to human health such as natural hazards and infectious agents, it also provides a number of “ecosystem services” which promote human health and wellbeing. There have been a number of reviews on this topic in recent years which will be briefly summarised.

In a narrative review, Grinde and Patil (2009) provided an overview of research on visual perception of natural environments and its impact on health and well-being. They concluded that interacting with natural environments, therapeutically using them, viewing them passively, or adding plants to indoor environments, had generally positive effects on measures of health and well-being. In a scoping review, McSweeney, Rainham, Johnson, Sherry and Singleton (2014) investigated indoor exposure to nature and found a number of reported health benefits from doing so including decreases in physiological stress indicators, increased comfort, improved mood, higher self-rated quality of life and better cognitive performance. In a random effects meta-analysis of the effect of passive contact with natural environments on positive and negative affect, McMahan and Estes (2015) reviewed 32 studies comprising 2,356 participants and found moderate increases in positive affect and small but consistent decreases in negative affect following nature exposure compared to exposure to urban environments, neutral stimuli or abstract art. In a review of cross-sectional and longitudinal studies of residential green space exposure, Gascon et al., (2015) concluded that there was only limited evidence of long-term beneficial mental health effects of residential greenness, and insufficient evidence on the comparable benefits of residential blue space (coasts and inland waterways). In a multidisciplinary review, Mantler and Logan (2015) found positive associations in the literature between various levels of natural environment exposure and restoration from stress and cognitive depletion as well as associations between environmental degradation and poor mental health.

These reviews are generally consistent in that they propose that exposure to nature in a multitude of forms promotes good mental, and sometimes physical, health. The reviews could be summarised as pertaining broadly to two methodologies. The first uses controlled studies to determine the psychological benefits of acute nature exposure in comparison to exposure to urban or other stimuli (see section 2.5). The second tries to establish associations between access to green space (e.g. proximity to parks, land cover in a neighbourhood) and measures of health or well-being (see section 2.6). The first methodology uses artificial tasks which may not generalise to real life or to longer-term health benefits. The second suffers from being unable to determine causality, i.e. does proximity to parks lead to better health, or do more healthy people choose to seek residence closer to green spaces. Although some studies now employ longitudinal designs allowing for more inference about causation (e.g. the longitudinal studies reviewed by Gascon et al., 2015), many limitations of primary studies remain. For example, Mantler and Logan (2015) question the quality of their included studies, McMahan & Estes (2015) note the lack of large sample sizes in RCT designs, and Gascon et al., (2015) recognise that type 1 errors are likely in many studies as they fail to control for multiple comparisons.

Hartig et al., (2014) summarise the multitude of ways that the natural environment can positively affect health. The model presented in Figure 2.2

summarises the main pathways by which they propose that the natural environment, and more specifically *contact* with the natural environment, can positively affect health. Firstly, the presence of types, amounts and qualities of the natural environment at a macro level can improve air quality thereby enhancing health. Indirect exposure to natural environments (e.g. viewing it on a screen or through a window) can lead to better health through alleviating stress or producing a restorative experience. The presence of natural environments can also facilitate contact with natural environments which can also lead to better health through exposure to good air quality or through stress reduction. It can also elicit social contact (e.g. with family and friends) which can lead to better psychological health for example. Finally contact with natural environments can elicit PA which contributes to all the health benefits noted in sections 2.2.1 and 2.2.2. All these services that contact with natural environments can provide can all interrelate as well e.g. PA can reduce stress; social contact can facilitate PA. It is this PA pathway that is the focus of this thesis and the literature review turns to the health benefits of undertaking PA in natural environments as opposed to urban or indoor environments in section 2.3.1.

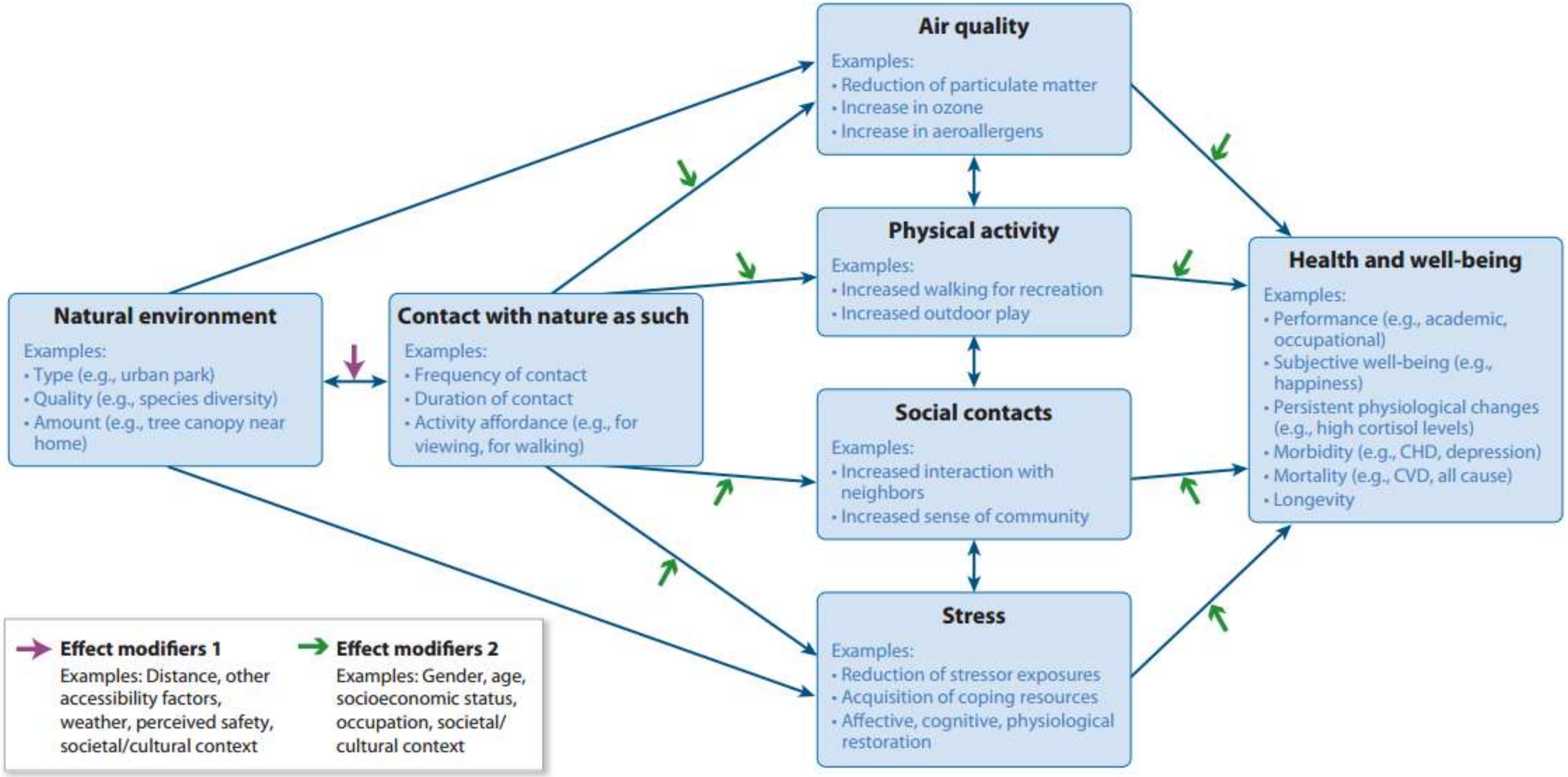


Figure 2.2 Pathways through which the natural environment can affect the health of large segments of the population (Hartig et al., 2014).

The above health benefits, are however, just one of a number of “ecosystem services” provided by natural environments that can contribute to human well-being. The Millennium Ecosystem Assessment process of the United Nations (Millennium Ecosystem Assessment, 2003) set out an ecosystem services framework which is a formal method of describing and categorising the relationships between natural ecosystems and human well-being. Ecosystem services are “the benefits people obtain from ecosystems” (Millennium Ecosystem Assessment, 2003, p.49) and comprise four types: provisioning services (e.g. food and water), regulating services (e.g. flood and disease control), supporting services (e.g. nutrient cycles and water cycles; the basic infrastructure of organic life), and cultural services (e.g. environmental settings like parks and beaches and the opportunities they provide such as recreation, aesthetic experiences and spiritual experiences).

The Millennium Ecosystem Assessment lists six categories of cultural services (Millennium Ecosystem Assessment, 2005). The first is cultural identities which represent the overall current relationship between humans and the natural environment. For example, for rainforest dwellers, agricultural practices are a way of life whereas for Arctic countries this could be fishing. For western countries, natural environments may be seen more as a recreational space. Thus, cultural identities are shaped by natural environments, and current ways of living shape the meanings given to natural environments. The second is heritage values which represent cultural ties to the past. For example natural environments preserve historical artefacts e.g. Neolithic and Bronze age European stone tombs have been preserved by the conservation of natural environments. More simply, heritage values could be captured in trees which have existed for centuries. The third is spiritual services which represent religious and spiritual inspiration derived from ecosystems. For example the river Ganges holds huge religious importance for Hinduism. In a more mundane sense, natural environments may provide everyday spaces for reflection and restoration. The fourth is inspiration services which represent the use of natural environments as a focal point for arts, poetry, folklore etc. The fifth is aesthetic services representing the appreciation of natural environments for their scenic value. The last is recreation and tourism services representing the use of natural environments for recreational opportunities (e.g. watersports, bird watching) or for tourism activities (e.g. seaside holidays).

Following on from this, the UK published its own analysis of the UK's natural environment in terms of its benefits to society (the UK National Ecosystem Assessment; UKNEA, 2011). In this, cultural ecosystem services are defined differently (Church, Burgess & Ravenscroft, 2011). Firstly, they differentiate cultural ecosystem 'goods' and cultural ecosystem 'services'. Services refer to the interactions between environmental spaces and cultural practices. For example, parks provide spaces for PA, and the practice of PA in turn affects the park. Cultural goods refer to the benefits that are derived from this interaction and are akin to the 'services' listed in the Millennium Ecosystem Assessment. Religious, heritage and recreation/tourism goods remain in the UKNEA's conceptualisation of the benefits of cultural ecosystem services. However, the UKNEA also define health goods such as the physical and mental health benefits derived from exposure to, or interactions with, the natural environment. The UKNEA also lists education and ecological knowledge as another 'good' derived from the cultural ecosystem services. These refer to the benefits of outdoor learning experiences in natural environments such as increased connectedness with nature, increased knowledge of natural processes, but even influences on behaviour and cognition in school children. It is important to consider in the following section then, that PA in natural environments may not be solely an exercise-related or health-related experience, but may satisfy a number of needs for individuals such as learning more about the natural environment, experiencing connections with heritage or history, and also satisfying religious or spiritual needs. All these cultural ‘goods’ could be contributing to human health and well-being as well as the direct health benefits that are brought about by PA.

2.3.1 Health benefits of exercising in natural environments

Using natural environments for PA has historical roots which can be traced back to Greco-Roman times. Ward Thompson (2011) recounts Virgil’s epic poem *The Aeneid* which describes the mythological afterlife, the Elysian Fields, in the following way:

> “Some exercise their bodies in a grassy gymnasium,
> compete in sports and wrestle on the yellow sand.” (Kline, 2002, Book VI, p. 628–678).

While this is an imagined landscape, it demonstrates how the provision of PA opportunities is essential in idealised natural environments. In 19th century Britain, walking in urban green spaces was part of public health objectives to enhance health and promote fitness (Carpenter, 2013). Urban greenspaces were then considered municipal services with the rise of the biomedical model, but returned to the public health focus with the rise of sedentary behaviour and obesity (Carpenter, 2013). Thus, the recent research attempting to establish the additive benefits of being active in green space has an historical public health context. Since some of the benefits of being in contact with natural environments and being physically active are the same (e.g. PA and exposure to natural environments can both affect mood), it is reasonable to suggest that there may be additive benefits of being active in natural environments over being active in other types of environment.

Barton and Pretty (2010) meta-analysed ten field studies with pre-post designs conducted at the University of Essex in order to determine what amount of PA in natural environments was necessary for enhancing mental well-being. The ten studies used acute (5 minutes to whole day) PA sessions which ranged from gardening and farming to walking, cycling and sailing. They took place in a variety of natural environments, comprised 1,252 participants in total and included a diverse array of populations such as young offenders, students and members of a mental health charity. All studies used the Rosenberg self-esteem scale to measure self-esteem before and after the intervention, and the profile of mood states questionnaire to measure mood before and after the intervention. Taken together, the overall effect size for change in self-esteem was d=0.46[b], and for total mood disturbance (a composite measure of all mood

[b] Cohen's *d*. This statistic reflects the pooled intervention effect estimate. That is, the weighted average of the combined individual intervention effects. In this review, the inverse variance method was used to assign weights to each study. Larger studies with smaller standard errors were given more weight than smaller studies with larger standard errors. This was in order to reduce potential imprecision with the pooled effect. Accepted (though arbitrary) rules of thumb with Cohen's *d* are such that 0.2 represents a small effect, 0.5 a medium effect, and 0.8 a large effect.

states in the profile of mood states questionnaire), *d*=0.54, indicating moderate effects of exercising in natural environments.

Subgroup analyses by duration of intervention revealed that for both self-esteem and mood, the greatest changes came from 5 minutes duration; fewer significant changes occurred from 10-60 minutes, but there was a rise again for whole day interventions. The effect of exercise in natural environments was greatest with light-intensity exercise and declined with intensity, whereas both light and vigorous intensity exercises altered mood the most. Both self-esteem and mood seemed to be most altered when the PA took place in waterside environments as opposed to other types of green space. Furthermore, those with mental health problems appeared to benefit more from the interventions. The authors therefore concluded that short-duration, light-to-moderate intensity physical activities in natural environments are sufficient at enhancing self-esteem and mood, and that exposure to waterside environments and having pre-existing mental health difficulties may augment such effects.

A strength of this review is that it goes beyond many others by trying to determine a sufficient amount of PA in natural environments for enhancing mental well-being. However, the studies it comprises have many methodological limitations. Firstly the Rosenberg self-esteem scale is a global measure of self-esteem (relating to the self as a totality), rather than a measure of specific self-esteem (relating to facets of the self; Rosenberg, Schooler, Schoenbach & Rosenberg, 1995). Global self-esteem is better related to stable constructs like psychological well-being than to specific behaviours (Rosenberg et al., 1995) and may therefore be an inappropriate measure for assessing well-being changes in the studies.

Furthermore, the use of the profile of mood states questionnaire has never been psychometrically evaluated in the context of exercise (Ekkekakis & Petruzzello, 2000, 2001a; 2001b) in the same way that measures reflecting the affect circumplex have (Ekkekakis & Petruzzello, 2002, see also section 2.2.2). Thus, it is unclear whether this questionnaire actually measures exercise-induced affective changes. The lack of control groups (either sedentary or in other environments) also limits one's interpretation as to how beneficial PA in natural environments is over passive activity in natural environments or PA in other environments. Many of the interventions also involved group activity which may have been responsible for the effects observed (Ekkekakis, Hall, Van Landuyt & Petruzzello, 2000). Although it was not the aim of the article, a systematic approach to identifying research on this topic may have better elucidated the benefits of PA in natural environments. It is therefore difficult to draw definitive conclusions from this meta-analysis about the benefits of undertaking PA in natural environments.

Bowler et al., (2010) conducted a systematic review which attempted to synthesise findings that compared short-term exposure to natural environments with short-term exposure to synthetic environments (urban or indoor). Specifically, studies had to compare the same activity in each environment and had to measure an aspect of health or well-being before and after the exposure (with the exception of studies investigating athletic performance or environmental hazards). Twenty-five studies from 24 articles met the inclusion criteria and 19 of these compared physical activities in natural and synthetic environments. Most studies recruited university students or physically active individuals. Thirteen studies employed a crossover trial design, seven were

RCTs and the remaining five were observational studies which had self-selecting groups exposed to the natural or synthetic conditions.

Whilst the authors did not separately meta-analyse only the studies involving PA, taking all studies together, there were many pooled effect sizes which implied a benefit of natural environments over synthetic environments after the interventions including many affective outcomes such as anger, fatigue and sadness. Analysing change scores revealed that post-exposure differences in outcome variables were driven by positive changes in those variables in the natural environment conditions, and thus they were not a result of negative changes in the synthetic conditions. The studies in this review frequently did not collect health and well-being measures during exposure which makes it difficult to determine how much exposure to natural environments is necessary to induce changes. Furthermore, most studies involved young, active populations so it is difficult to generalise what kinds of experience may be beneficial to other populations. Nonetheless, for these populations, we can conclude that acute exposure to natural environments, usually through walking or running, can have beneficial effects on various health and well-being outcomes.

A further review which looked exclusively at PA interventions included eleven trials comparing exercise in outdoor natural environments with exercise in indoor environments (Thompson-Coon et al., 2011). Six were within-subjects designs, four were between-subjects and one was a survey of outdoor and indoor exercisers. Similarly to Bowler et al., (2010), most studies involved relatively young and active participants. All interventions consisted of single acute sessions of exercise and all measured mental well-being after the intervention. Due to heterogeneity of designs and outcome measures, qualitative synthesis was employed. Seven studies compared walking in the two types of environment with six demonstrating some significant affective benefit of walking outdoors compared to indoors. These benefits usually pertained to mood states e.g. feelings of energy, pleasure, vitality were higher after the outdoor walk and feelings of frustration, depression and tension were lower. Three studies compared running in the two types of environment and all used physically active participants; only one of these studies demonstrated a benefit of the outdoor environment on affect. In this study, participants felt less depressed, angry, hostile and fatigued following the outdoor run. One study employed a survey design and the results showed a greater degree of mental restoration after acute PA in forests compared to indoor environments. Two studies demonstrated that intentions to repeat the activity were higher when undertaking PA outdoors. The authors concluded that there was, “some evidence that physical activity in an outdoor natural environment may bring additional positive effects on measures of mental wellbeing that are not seen when participating in similar physical activity indoors.”

Many of the limitations of the included studies are similar to those included in Bowler et al.’s (2010) review. For example, it was impossible to tell how long the affective benefits lasted and the heterogeneity of outcome measures prevented a meta-analysis. It is also unclear as to the clinical relevance of changes in the mood states. Additionally, the authors identified that most studies were subject to bias and potential confounding; whilst it may not have been possible to blind participants to conditions, experimenters administering the outcome measures could have been blinded to the aims of the study. As with Bowler et al., (2010), the sustained benefits of longer-term participation in outdoor versus indoor exercise interventions is unknown. Again, it can therefore be cautiously concluded that acute exercise sessions in outdoor natural environments are more beneficial for mental well-being than acute exercise sessions in indoor environments.

These reviews demonstrate that there is general consensus among acute PA studies that exercising in a natural setting is more beneficial to various measures of mental well-being than exercising in an urban or indoor setting. The relationship appears to be additive (exposure to nature adds to the benefits of PA) rather than synergistic (greater benefit than their combined individual benefits). Despite these promising findings, the quality of available evidence is generally weak with many primary studies failing to minimise risks of confounding or bias. The measures used to evaluate mental well-being in the studies within these reviews are heterogeneous and thus difficult to synthesise as representing similar constructs. Crucially, only one study within these reviews employed the affect circumplex as their model of affect (Focht, 2009). This study found that brief walks in outdoor environments resulted in greater improvements in affective valence and activation immediately following walking, compared to laboratory environments. This is important because, as previously discussed, state-based measures may not capture the full range of affective states possible from experiencing exercise (Ekkekakis & Petruzzello, 2000; 2001a; 2001b). In contrast, measures of the core valence and activation dimensions of the affect circumplex do possess this ability (Ekkekakis & Petruzzello, 2002). While some of the studies in the reviews do use measures based on the affect circumplex, these are frequently still state-based and also devoid of the ability to be repeatedly administered throughout exercise in the same way that measures of valence and activation (e.g. FS and FAS) are able to be (Ekkekakis & Petruzello, 2002).

Furthermore, these studies fail to explain why PA in natural environments leads to more favourable outcomes than PA in other types of environment. One possible explanation is that exercise in natural environments may induce immersion in the activity that may yield a number of positive psychological benefits (so-called ‘flow’ states; Csikszentmihalyi, 1990). One such benefit is noted by Jackson and Marsh (1996) who suggest that a transformation of time can occur during exercise such as an activity being over noticeably quickly. Many studies have demonstrated that flow states are likely to arise whilst being physically active (Jackson & Eklund, 2002, Jackson & Marsh, 1996; Marsh & Jackson, 1999; Kawabata & Mallett, 2011) and are associated with greater increases in positive affect (Asakawa, 2004; Rogatko, 2009). In one study examining postmenopausal women’s responses to cycling exercise in different simulated natural environments, perceived exercise time was significantly lower when exposed to coastal environments compared to when they were exposed to a blank wall (White, Pahl, Ashbullby, Burton & Depledge, 2015). However, differences in perceived exercise time when exposed to greenspace environments or urban environments (compared to a blank wall) were not significant. Thus, whilst exercise may induce the sense that time is passing quickly, the type of environment a person is exposed to whilst exercising may augment or diminish such an effect. It may also be that whilst exposed to natural environments, participants experience more physiological restoration or attention restoration (see section 3.1 for a discussion of this).

2.4 Research questions for the present literature review

The remainder of the literature review focuses on three distinct exploratory questions concerning PA in natural environments. The first question to be explored concerns how the aesthetic and visual quality of natural environments is related to PA participation and outcomes. The second is how contact with different natural environments relates to PA participation. The third question transcends the model by focusing on the promotion of PA in natural environments. Specifically, assuming that contact with natural environments elicits PA and leads to additional beneficial outcomes over and above PA in other environments; it investigates how PA is currently promoted in natural environments. The final research question concerns how the promotion of PA in natural environments could be improved. The aim when exploring each of these questions is to identify where gaps in knowledge exist, and form four distinct research questions for the remainder of the thesis.

2.5 How do aesthetic qualities, visual attractiveness, and physical attributes of natural environments affect physical activity participation?

In a scoping review of literature examining how outdoor spaces can be designed to elicit PA, Ward Thompson (2013) concludes, "If one of the goals for public health is to increase the amount of physical activity people choose to engage in, then walking for recreation is one area with great potential; and the evidence suggests that the aesthetic quality of environments may play a key role in eliciting or inhibiting this physical activity" (Ward Thompson, 2013, p.92). 'Aesthetic' in this context refers to multisensory experiences of environments. Much past research verifies this assertion. Humpel, Owen and Leslie (2002) systematically reviewed quantitative studies examining the relationship between attributes of the physical environment (not necessarily the natural environment) and PA. Studies were excluded if they were only descriptive or if they conflated psychological barriers with physical attributes. Nineteen studies were included of which 16 examined perceived attributes and four used objective attributes (one study used both). Only five studies explicitly looked at aesthetic attributes, but all found significant associations with their respective outcome variables. For example, less aesthetically pleasing environments were associated with less self-reported walking; enjoyable scenery was associated with more leisure-time moderate-to-vigorous activity; and a lack of scenery was associated with being sedentary for rural women. A methodologically similar review (Owen, Humpel, Leslie, Bauman & Sallis, 2004) found that three out of four studies demonstrated significant associations between aesthetic pleasantness and walking for recreation. Three studies also found associations between neighbourhood aesthetics and 'total walking' (including transport and recreation).

Whilst aesthetic qualities alone sometimes do not predict PA or walking participation as strongly as individual or social determinants (Giles-Corti & Donovan, 2002), they nonetheless exert a significant influence and are potentially more amendable (Sallis, Bauman & Pratt, 1998). With this cross-sectional research it is impossible to rule out reverse causality. It could be that aesthetic qualities do not elicit PA or walking, but that more active people or more regular walkers choose to move to neighbourhoods, or are willing to visit locations, with the qualities that enable them to be active. However, considering that infrequent users of greenspace are more likely to report visit motivations associated with 'biophysical qualities' (Dallimer et al., 2014), it could well be the case that, at least with natural environments, aesthetically pleasing qualities may elicit more PA.

Similar research has also been undertaken in relation specifically to natural environments (rather than all physical environments). For example, Giles-Corti et al., (2005) conducted environmental audits of over 500 public open spaces in Perth, Australia and also conducted nearly 2000 interviews with adults from the same area. Visual attractiveness of the public open spaces was defined by a composite score. This score was created firstly by asking focus groups to define important attributes of open spaces. Then, a panel of urban planners ranked the importance of these to create weights for each attribute. The authors demonstrated that very good access to large attractive public open spaces was associated with a 50% higher likelihood of achieving high levels of walking[c], suggesting that the open spaces may be used for PA when they are more attractive. However the creation of the attractiveness score is questionable. It resulted in greater weight being placed on attributes such as very good presence of shade and good irrigation of lawns; these are not necessarily of the most importance to the open space's users. The attributes given the most weight are also indicative of the Australian context of the study and such features may not have importance for urban planners in other countries.

More recently, research has investigated whether physical attributes affect the likelihood of walking *to* natural environments. Sugiyama et al., (2015) sampled 1,465 Australian adults from a pre-existing survey who reported whether they walk to public open spaces for the purposes of recreation. They were interested

[c] Defined as six or more self-reported sessions of walking (of all types) a week totalling 180 minutes or more.

in the relationship between walking to a public open space and 19 different physical attributes[d]. These attributes were located in 354 open spaces larger than 2 acres and not further than 1.6km from participant's addresses and were audited by trained assessors. After adjusting for size, the authors found that walking *to* a public open space was positively associated with the open space having gardens, walking paths, water features, wildlife and dog-related facilities. This is important as it demonstrates that the associations between walking and physical attributes of open spaces are unlikely to be the result of a residual confound, but because physical attributes of open spaces drive walking *towards* them and thus could account for why there is such a relationship. However, it may have been that attributes of the route to the open space drove walking behaviour rather than attributes of the open space itself, and such attributes were unaccounted for in the analysis.

Such contentions surrounding aesthetic qualities, visual attractiveness, and physical attributes have been bolstered by qualitative research. McCormack, Rock, Toohey and Hignell (2010) systematically reviewed 21 qualitative studies on the characteristics of urban parks associated with park use and PA. They included any study reporting at least one qualitative research method, that examined urban parks exclusively or in addition to other recreational environments, and that examined park-based PA in any form. They excluded studies if they focused on specific walking routes, or sports fields. Also, studies had to include discussion of qualities and attributes of parks. Twenty-one

[d] Sports fields, recreational facilities (skate park, fitness track etc.), playgrounds, at least 100 trees, gardens, grassed areas, walking paths, water features (lakes fountains etc.), wildlife, amenities (picnic tables, drinking water etc.), other infrastructure (kiosk, toilets etc), lighting, disorder (graffiti, evidence of vandalism etc.), parking, dog-related facilities (water, exercise area etc.), off-leash area for dogs, adjacent destinations (shops, pubs etc.), next to a beach or river, and next to major roads.

studies met these inclusion criteria. Fourteen of these investigated aesthetic attributes. Graffiti and vandalism negatively affected park use and PA although litter, uncleanliness and dog fouling also had negative impacts on people’s aesthetic assessments of parks (usually visual). The presence of wildlife was both positive and negative for different demographics of park users. Wildlife discouraged dog walkers from park-based PA as they feared encounters between their dogs and the wildlife. Children’s fear of some types of wildlife also discouraged them from park-based PA. However, wildlife also encouraged some children to walk as they were curious about investigating animal’s nesting and feeding behaviour. Other positive aesthetic and physical attributes affecting park use and PA were trees, bushes, gardens, grass, flowers, water features, air quality and pleasant smells. The authors note that the rigour involved in the included studies was generally weak and thus, the findings of this review may be subject to biases by the authors of the primary studies. They also note a dearth of research using *in situ* methods or mixed methods, although more recent research has begun to address this using GPS tracking supported by qualitative ‘go-along’ interviews where the researcher walks with the participant through a natural environment (Bell, Phoenix, Lovell & Wheeler, 2015a, 2015b).

From this cross-sectional and qualitative research, it is clear that aesthetic qualities, visual attractiveness and physical attributes of natural environments predict PA and walking in local neighbourhoods. There is some indication that this relationship may be causal too; these may encourage people to undertake PA. Additionally, there is some evidence that ’biophysical qualities’ or physical attributes of natural environments predict the *use* of those environments for PA (Dallimer et al., 2014; Sugiyama et al., 2015). Whilst the conceptualisation and measurement of visual attractiveness, aesthetic quality, and physical attributes etc. varies from study to study and particularly on the context in which the study is carried out, there are regularities in the findings. For example, natural features (water, grass, trees) often seem to be positively associated with PA behaviour. There are mixed findings regarding unpleasant features like graffiti and litter although these tend to be underrepresented in studies compared to pleasant features. A further possibility is that the presence of visually unpleasant features in natural environments undermines the health benefits accrued through exposure to natural environments or the additive benefits of being physically active in natural environments. This is important as in the UK, the quality and accessibility of salutogenic environments generally decreases as income deprivation increases (Pearce, Richardson, Mitchell & Shortt, 2010) meaning that for some people, poorer quality greenspace may be the only natural environment they can easily access. The review will now turn to evidence from landscape research which suggests that this could be the case.

2.5.1 The effects of visual attractiveness of natural environments on preferences, affect, and restorativeness

There has been some evidence from photographic rating studies that preferences and perceived restorativeness of natural scenes decreases when the environment is degraded in some way. Restorativeness generally refers to an environment's ability to relieve stress or restore depleted directed attention resources (see section 3.1. for a full discussion). Wilson, Robertson, Daly & Walton (1995) took eight photographs of waterscape environments and manipulated each one to have either a form of degradation present (tires, algal blooms, surface foam etc) or not. A sample of 105 undergraduates saw one version of each photo and they were asked how much they liked the scene on a 7-point scale. They were also asked an image-specific question pertaining to the degradation in the scene or the desirability of the scene for recreational activity. Participants were free to view photos for as much or as little as they wanted and viewing time was recorded. With all photos, the degraded versions yielded significantly lower ratings of liking, although viewing time was unaffected. Of five photographs which were assigned questions about desire for recreation, the non-degraded versions of three were significantly preferred for recreation, while another difference was marginal ($p<.06$), and one insignificant. The results therefore indicate that degraded waterscapes are less preferred generally and for recreational activities. The results may not be surprising, but they do provide validation of the photographic rating method. However, the study is limited in a number of ways. Firstly, different numbers of participants saw each photo so the average preference of the two versions of photos is not directly comparable. Secondly, some of the rating scales lack empirical validation; all questions were asked on 7-point scales but sometimes had response options that did not merit a 7-point response (e.g. 1=no to 7=yes; 1=0% to 7=100%). It is therefore difficult to interpret what the average scores on such items represent.

In a similar methodology, Wyles, Pahl, Thomas & Thompson (2015) recruited 40 undergraduates to a photographic rating study where they manipulated the tidal state of 12 photos of beach scenes (low tide, high tide) and the presence of litter (clean, littered). Photographs were rated for restorativeness (see section 3.1) and the likelihood that the participant would spend time there. Beaches at low tide were preferred and perceived to be more restorative than beaches at high tide. Clean beaches were preferred and perceived to be more restorative than littered beaches. Furthermore, there was an interaction such that tidal state had a large effect on perceived restorativeness when the beach was clean but a smaller effect when the beach was littered (i.e. the cleanliness of the beach appears to play a larger role in influencing perceived restorativeness than tidal state). In two subsequent studies, the authors manipulated the type of litter present on photographs of beaches (clean, seaweed, fishing-litter, and public-litter). Photographs were consistently rated lower in terms of preference and perceived restorativeness if they contained fishing- or public-litter. They also elicited more unpleasant feelings (as measured by the FS) and higher levels of activation (measured by the FAS). Of course, the laboratory nature of both this and the study by Wilson et al., (1995) mean that the restorative benefits associated with the pictures in the studies may not reflect the restorativeness of actual littoral environments. As more sensory cues are triggered in real environments (olfaction, thermoception), it could be that effects of degradation are washed out by the restorativeness associated with other sensory experiences. As participants in all of Wyles et al's (2015) studies were recruited from participation pools based in Plymouth, it is also possible that exposure to coastal environments (Plymouth being a coastal city) was commonplace among this sample and thus differences between scenes on ratings of restorativeness were more marked than they may be in a more representative population.

Nonetheless, these two studies demonstrate that the presence of degradation in photographs of littoral natural environments can negatively affect preferences for recreation and ratings of perceived restorativeness. Both studies therefore suggest that any psychological benefits gained from natural environments could be diminished by the presence of degradation. These are important findings as it has been previously established that ratings of preference, restorativeness, and ‘scenicness’ are higher in environments containing aquatic elements than any other type of natural environment (Seresinhe, Preis & Moat, 2015; White, Smith, Humphryes, Pahl, Snelling & Depledge, 2010). The former study found that scenic ratings of over 200,000 photographs on a public dataset in the UK were highest when the proportion of blue pixels in a photograph (usually representing water or sky) was highest. The latter study systematically manipulated the proportions of urban space, green space, and blue space in photographs into thirds, and found that photographs constituting two thirds blue space and one third green space were more preferred, associated with more positive affect (measured by a version of the FS), associated with higher perceived restorativeness and associated with a willingness to pay more money for a room with that view. As preferences for clean aquatic environments are the highest of any natural environment, it follows that when these environments are degraded, it should have the largest impact on measures of preference.

Despite these largely consistent results from primary studies employing photographic rating methods, all of them use passive (or sedentary) exposures to natural environments as their procedure. In a real world context, such environments would often be encountered actively (e.g. through recreational walking). Considering that PA in natural environments appears to lead to better mental well-being than PA in urban or indoor environments (Bowler et al., 2010; Thompson-Coon et al., 2011), there are two competing hypotheses regarding how PA in natural environments of lesser visual attractiveness may affect these psychological gains: Firstly, the psychological effects of the PA may ‘wash out’ any negative effects of the visually unattractive environments by exerting a stronger influence than the characteristics of the environment. Alternatively, the psychological effects of the PA may be diminished because the visual unattractiveness of the environment negatively impacts the experience more than the PA enhances the experience. The next section explores these possibilities.

2.5.2 The effects of visual attractiveness of natural environments on outcomes of physical activity

From the literature reviewed so far, we know that the best quantities of PA for increasing pleasure tend to be short-duration (Ekkekakis et al., 2000), moderate-intensity (Ekkekakis et al., 2011), exercises conducted in natural settings which often involve walking (Bowler et al.,2010; Thompson-Coon et al., 2011). This enjoyable PA may be caused by changes in time perception, psychophysiological restoration from stress or directed attention restoration. Therefore, this section specifically examines how this form of exercise is affected when participants are exposed to natural environments of better and worse visual attractiveness.

The only controlled study that I am aware of which looked at this issue was conducted by Pretty, Peacock, Sellens & Griffin (2005). In this study, the authors recruited 100 undergraduates and employees of a British university to one of five possible groups. Each group undertook 20 minutes of exercise on a treadmill. The speed of the treadmill could be adjusted so that the participants were always exercising at a level of ‘fairly light’ intensity (12 on the RPE scale). During the exercise, participants either saw: a) a blank wall (acting as a control group); b) a set of photographs of visually pleasant urban environments; c) a set of photographs of visually unpleasant urban environments; d) a set of photographs of visually pleasant rural environments or; e) a set of photographs of visually unpleasant rural environments. There were 30 photographs per photograph condition and these were rated as one of the four categories by a prior panel of 50 people (95% of the panel had to agree on a categorisation for the photo to be included). In all photograph conditions, the photographs appeared in a randomised order. Before exercise, measures of blood pressure, self-esteem (Rosenberg self-esteem questionnaire), and mood (profile of mood states questionnaire) were administered. The psychological measures were administered once again immediately after exercise with blood pressure again being measured after a 5 minute resting period.

When subjects were exposed to pleasant rural scenes, there was a significantly greater reduction in resting systolic blood pressure from before until after the exercise compared to all four other conditions. This was also true of mean arterial blood pressure. For both of these measures, the other four conditions did not significantly differ from one another. Exposure to pleasant rural scenes also fostered greater reductions in diastolic blood pressure compared to the urban and control conditions. Self-esteem appeared to increase more for people exposed to either pleasant condition or the control groups although there were no significant differences between groups which the authors attribute to high baseline self-esteem scores. The authors then separately analysed the six mood criteria defined by the profile of mood states questionnaire. The pleasant rural and pleasant urban scenes were associated with reductions in tension-anxiety scores and improvements in vigour-activity scores. Pleasant urban scenes also elicited reductions in three other mood states.

The authors concluded that exposure to unpleasant environments during exercise diminishes physiological and psychological effects of exercise. In contrast, the authors concluded that exposure to pleasant environments fosters more positive changes in mood and, for pleasant rural environments, larger reductions in blood pressure. The authors also concluded that greater improvements in self-esteem appear to be associated with exposure to pleasant scenes (although this appears to be a descriptive conclusion as the improvements, though greater, were not significantly different from the control group).

There are a number of limitations with this study however. Firstly, the authors analysed ten outcome variables (three blood pressure measures, one self-esteem measure and six mood measures) without any actions to protect against the inflation of the alpha level. This effectively raises the chance of a type 1 error from 5% to 50%, and thus the probability that any result is due to chance is just as likely as the probability that it is not. Secondly, the sample size of 20 participants per group may not equate to adequate statistical power; effects which may have statistically large effect sizes may be deemed to be non-existent i.e. increasing the chances of a type 2 error. Unfortunately, effect sizes are not reported so it is impossible to tell where such cases may exist. Thirdly, their unpleasant rural stimuli contained objects such as burnt-out cars or buildings in disrepair, which are infrequent forms of degradation compared to items such as litter. Such vivid imagery in the unpleasant scenes may be responsible for the diminished improvements in outcome measures when everyday natural environments may contain less marked degradation. Furthermore, pleasant urban stimuli sometimes contained large proportions of natural elements, so it could well be the natural features of pleasant urban scenes that are responsible for the positive mood changes identified within this condition. Finally, as already discussed, the employment of state-based outcomes measures may not be valid in the context of exercise (for a discussion, see sections 2.2.2, and 2.3.1). For example, it is difficult to hypothesise how the different environmental conditions should affect the ‘confusion-bewilderment’ mood pair of the profile of mood states questionnaire. The use of the self-esteem measure may also not be valid in this context (see section 2.3.1). Taken together these criticisms limit how much this study contributes to knowledge of how degradation affects the psychophysiological outcomes of PA in natural environments. While the authors did not aim to investigate why the presence of pleasant or unpleasant features of natural environments might cause different psychophysiological outcomes, this nonetheless remains an unanswered question. One possibility could be that the different types of environment are differently restorative and this leads to different psychophysiological outcomes.

2.5.3 Gaps in knowledge

Aesthetic attributes, visual attractiveness and physical attributes of physical and in particular, natural, environments are associated with participation in PA and more specifically recreational walking. While this is well established, it is less well known whether these affect the outcomes of PA in natural environments. Research has demonstrated that viewing degradation in littoral environments adversely affects preferences, restorativeness and affect, but there is insufficient evidence that these findings translate to active scenarios. The one study that did investigate this is limited by its methodology and thus the need for a study which addresses those weaknesses and which investigates the mechanisms by which such effect may occur, is warranted.

This is a timely endeavour considering the impact of degradation on the UK's natural environments. Despite some improvements in cleanliness, the latest English environmental quality survey suggests that there has been no year-on-year improvement in the number of places meeting required standards for littering, with smoking materials, confectionary packets, drinks-related, and fast food-related litter being the highest contributors (Keep Britain Tidy, 2013). Sixty-three percent of recreational sites (public open spaces and public watersides) were adversely affected by confectionary packaging (Keep Britain Tidy, 2013). Degradation is a particular problem in marine environments where the global rise in plastics production means greater accumulation of anthropogenic debris on beaches, and greater dangers to wildlife from ingestion and entanglement (Obbard, Sadri, Wong, Khitun, Baker & Thompson, 2014; Thompson, Moore, vom Saal & Swan, 2009; Woodall et al., 2014; Zettler, Mincer & Amaral-Zettler, 2013). In 2014, an annual beach cleaning event found 2,457 pieces of litter per kilometre of British beach with increases in many forms of litter including plastic fragments, fishing line, and food packaging (Marine Conservation Society, 2014).

While many consider the provision of natural environments to be important in supporting PA (e.g. Lee, Jordan & Horsley, 2015) and eliciting additional health benefits over PA alone (Ward Thompson & Aspinall, 2011), little consideration is given to how these types of degradation might affect the experience of PA in natural environments. Finding this out would inform how physical activity promotion and environmental conservation efforts could be harmonised; an attractive proposition put forward by scholars in recent years (Nurse, Basher, Bone & Bird, 2010; Sandifer, Sutton-Grier & Ward, 2015). The aim of my first empirical study in Chapter 3 is to begin investigating these issues. In particular I will examine the extent to which a simulated walk along a beach is affected by the presence or absence of marine litter.

2.6 How do access and contact with natural environments affect physical activity participation?

In a scoping review of the various health benefits afforded by natural environments, James et al., (2015) acknowledged promising associations between neighbourhood greenness and obesity, mental health, birth outcomes, cardiovascular outcomes and mortality. However, out of all the health benefits, the most robust bodies of evidence they identified concerned cross-sectional literature on greenspace as a support for PA. This conclusion was drawn from 15 cross-sectional studies and one prospective study of intermediate to high quality conducted in seven countries. Although the method of finding and extracting data from studies in this review is unclear, it is clear that cross-sectional associations between greenspace and PA have been well-researched. One of the main issues with the literature which limits its usefulness is whether it is the natural environments themselves which are being used for health-enhancing PA. If they are, then the protection of natural environments is essential in order to maintain good physical and mental health of the population through PA. If they are not, then these associations are most likely confounded by a third variable such as socio-economic characteristics of the neighbourhood. There have been two dominant ways of investigating this problem, each of which will be explored now. The first involves associations with access to natural environments; the second involves associations with visits to natural environments.

2.6.1 How does access to natural environments affect physical activity participation?

Lee and Mahswaran (2011) systematically searched for primary studies and review articles on the connections between urban green spaces and health. In a subsection concerning the accessibility of green spaces, they summarise that most studies consistently report an association between the ease of accessing green space and transport or leisure-time PA attainment. Their synthesis revealed that people with the best access to green spaces are the most likely to use them, and people with the closest residential proximity were the most likely to achieve recommended PA guidelines. In an integrative review[e], Calogiuri and Chroni (2014) identified 23 articles which concluded that the ready availability of green space within people's living environment is associated with generally higher levels of PA. A further 10 studies yielded only partial associations or smaller effect sizes, while five showed no association and one showed a negative association. A further five studies showed that the positive association was strongly influenced by moderators such as the type of natural environment, type of PA or gender.

[e] Unlike a systematic review, this method allows for the identification of research with diverse arrays of methodologies.

Although most of the primary studies reviewed in these two papers suggest positive associations between access or availability of local green space and levels of PA attainment, Lee and Maheswaran (2011) conclude that most of the available evidence is weak, and there was no evidence to suggest that levels of physical inactivity could be ameliorated by adding green space to a local area. Most primary cross-sectional studies are unable to account for all potential confounds. Even though socio-economic status (which could be responsible for differences in the availability of green space) was often accounted for, this does not exclude the possibility of other residual confounds such as perceptions of green space, environmental barriers, or perceptions about safety or crime in the local area, potentially explaining the associations. Additionally, some have suggested that in some instances there is little evidence of a clear socio-economic gradient in terms of green space access. Macintyre (2007), for instance, concluded that poorer communities in Glasgow had better access to green spaces than wealthier communities, despite the more general findings of Pearce et al., (2010).

In a similar way to more general cross-sectional literature on the benefits of natural environments to health, it is difficult to know whether the studies identifying positive associations are due to selection effects. That is, does living in closer proximity to green spaces elicit more PA behaviour, or do more physically active people choose to move to places with better access to green space. As an example, dog owners may move to greener areas as there are more spaces to exercise their dog; this could therefore be responsible for such associations. Calogiuri and Chroni (2014) only identified two studies which could both rule out the effects of self-selection on the positive relationship between green space access and PA. However, longitudinal studies in the UK have identified that, controlling for both time variant and invariant factors, moving to greener or more coastal areas is associated with increases in mental health (Alcock, White, Wheeler, Fleming & Depledge, 2014; White, Alcock, Wheeler & Depledge, 2013a) and increases in PA could be responsible for such changes. Indeed, in a longitudinal study in Australia, increases in recreational PA were found after relocation to areas with better access to recreational facilities which included green spaces (Giles-Corti et al., 2013). These changes were mediated by changes in perceived attractiveness of the local area leading the authors to conclude that the presence of well-designed local green space after relocation was associated with increases in recreational PA.

To take an example of a study finding a null association between greenspace access and PA attainment, Hillsdon, Panter, Foster & Jones (2006) used a sample of 4,732 adults aged 40-70 years old from Norwich, UK and undertook a cross-sectional examination of the relationship between access to good quality urban green space (all types) and levels of recreational PA. PA was measured by asking participants in the sample the average number of times they undertook 36 physical activities in the past year and the average length of time they spent doing them. The sum of these was used to create an estimate of total hours of recreational PA per week and the authors excluded those reporting no PA at all and people reporting over 35 hours per week. Access was primarily determined by calculating the road distance between a participant's address (grid reference) and the nearest publicly accessible green space over 2 hectares in size. Other access measures included size of the nearest green space, the area of the nearest green space within 2km, and the number of greenspaces within 2km.

None of these access measures were significantly associated with hours of recreational PA. When dividing the simple road distance measure into quartiles, good access was associated with more recreational PA, but very good access was not. When adjusting for size, there were no differences between quartiles of access distance. When adjusting for both size and quality[f] people with poor access achieved more recreational PA than people with very poor access, but people with very good access achieved *less* recreational PA than people with very poor access. The authors therefore conclude that there is no consistent relationship between green space access and recreational PA attainment. They further conclude that studies which do demonstrate a positive relationship are often focused on specific types of green spaces and specific types of PA (usually walking or cycling behaviour).

However, this study did rely on self-reported PA from the last year, which while the authors report that this is valid and reliable is still prone to recall errors and response biases. They were also unable to adjust for potential confounding variables listed earlier such as perceived safety. Despite this, most evidence relies on self-reported PA and also fails to adjust for potential confounds. Considering the size of the sample and its representativeness of middle-aged adults from the community it was drawn from, it is fair to assume that this study does create doubt over the existence of a relationship between green space

[f] A 69-item tool was developed to measure quality. Research assistants visited all green spaces greater than 2 hectares in size on foot and evaluated multiple aspects of quality such as maintenance, recreational facilities, amenity provision, signage, lighting, landscape, usage, and atmosphere.

access and PA levels. While the authors suggest that positive results are restricted to certain types of green space and certain types of PA, it could also be true that inconsistency in findings is due to the fact that a lot of cross-sectional work is only able to predict PA from proximity and presence of green space, not whether it is actually visited.

2.6.2 How do visits to natural environments affect physical activity participation?

One way of investigating contact with nature and PA attainment is by drawing associations between rates of natural environment visitation and levels of PA, or investigating whether visits mediate relationships between PA and access to greenspace. Coombes, Jones & Hillsdon (2010) conducted a cross-sectional study of 6,821 residents of Bristol, UK using data from a postal survey. Respondents were asked how often they visited Bristol's parks and green spaces (from 5 times a week or more to less than once a year) and how often they did active sport for 30 minutes or more, or how often they undertook moderate exercise for 30 minutes or more or in two 15 minute sessions (from 5 times a week to never). Both of these PA measures were used to calculate whether the respondent achieved PA guidelines or not. The authors adjusted models for age, socio-economic status, self-rated health, area deprivation, and other neighbourhood levels which exerted a significant influence on the likelihood of meeting PA guidelines in a separate analysis. Both unadjusted and adjusted models revealed a statistically significant trend whereby the odds of achieving PA guidelines decreased with decreasing frequency of green space visits. Specifically, after adjustments, respondents visiting green space less than once a year were 55% less likely to achieve recommended PA guidelines compared with respondents visiting at least once a week. This suggests that PA conducted within green space may play a role in achieving PA guidelines.

White, Wheeler, Herbert, Alcock & Depledge (2014) examined a cross-section of 183,755 adults from England drawn from the 2009-2012 waves of Natural England's Monitor of Engagement with the Natural Environment Survey (MENE; Natural England, 2015). The authors were interested in the relationship between residential proximity to the coastline and the likelihood of achieving PA guidelines. The survey asked respondents to report how many days in the last week they had undertaken PA sufficient to raise their breathing rate including for recreation and transport. The authors categorised any respondent reporting 5 or more days per week as meeting PA guidelines. Coastal proximity was defined as the linear distance from the population-weighted centroid of the lower-layer super output area (LSOA) where the respondent lived. This was divided into four categories: <1km, 1-5km, >5-20km, and >20km. Respondents also reported the number of visits made to seaside towns or other seaside coastline in the last week. After adjusting for temporal variables, individual variables and the percentage of green space in the respondent's LSOA, people living within 1km of the coastline were 8% more likely to achieve recommended PA guidelines ($p<.001$) compared to people living >20km from the coast. Living 1-5km from the coastline was associated with a 4% greater likelihood ($p<.05$), whilst there was no difference between people living 5-20km and over 20km from the coast. Whether a respondent visited the coast in the last week or not mediated this relationship so that the linear gradient disappeared. This suggests that people living nearer the coast may be directly using it for PA which contributes to them more often achieving PA guidelines.

While both of these studies imply that green spaces and coastlines may be directly used for health-enhancing PA, they nevertheless still draw associations between visiting natural environments and PA and do not directly demonstrate that the environment is being used for health-enhancing PA. That is, there could reasonably exist confounding variables with obfuscate the relationship between visiting natural environments and achieving recommended PA guidelines that are otherwise unaccounted for by the authors' analysis. For example, people who are more likely to visit natural environments more often may also be more likely to visit indoor exercise facilities for PA. Regarding Coombes et al., (2010) there are methodological problems including whether recalling green space visits over the past year is subject to recall errors (see discussion of Hillsdon et al., 2006; section 2.6.1) and whether the postal survey method resulted in an unrepresentative sample of the community. These limitations were to some extent attenuated in White et al's (2014) study as participant's recall of visits only concerned the previous week and their sample was almost representative of the population of England (the methodology of the survey ensures representativeness of the whole of England); they included 97.3% of the whole sample as some cases were lacking local area data. Nonetheless, neither study can account for the quantity of PA that may have been conducted in the natural environment. It is therefore still unclear whether natural environments directly support health-enhancing PA or even light intensity activity.

One way of addressing the quantity of PA conducted in natural environments is through GPS research. That is, research which combines global positioning technology and objective PA measurement (pedometers, accelerometers) to assess whether, and what kinds of PA are practiced in natural environments.

Most studies of this kind have been conducted on children (e.g. Almanza, Jerrett, Dunton, Seto & Pentz, 2012; Wheeler, Cooper, Page & Jago, 2010). One study examined 291 American parent-child pairs equipped with accelerometers and GPS technology over the same 7-day period (Dunton, Liao, Almanza, Jerrett, Spruijt-Metz & Pentz, 2013). Specifically, they were interested in the proportion of time spent being jointly physically active (less than 50m apart at a moderate-to-vigorous intensity of 3 METs for adults and 4 METs for children) in residential locations, commercial venues, and open spaces or parks. Approximately 20% of joint moderate-to-vigorous intensity PA was conducted in open spaces with around 35% of such occurrences taking place in the pairs' neighbourhood. Open spaces also accounted for 8% of joint sedentary time (defined as less than 100 counts on the accelerometer per minute), the least of all location types. This study suggests a moderate contribution of open spaces to joint parent-child health-enhancing PA, but also the parent-child pairs are the least likely to be sedentary there too, suggesting they may be conducive to lighter-intensity activity.

In a study using exclusively adults from 5 US states, 238 were recruited and equipped with accelerometers and GPS monitors which they wore for three one-week periods (Evenson, Wen, Hillier & Cohen, 2013). In this study bouts of moderate-intensity PA were defined as over 2,020 accelerometer counts per minute for at least 10 minutes. Overall, 8.2% of all moderate activity and 9.4% of all vigorous activity was conducted in parks; the study does not report the proportion of all sedentary activity spent in parks. Of the time spent on a park visit, around 50% of time was spent being sedentary, 23% in light activity, 16% in low-moderate activity, and 12% in moderate-to-vigorous activity. As above, this study only suggests a small contribution of the natural environment to health-enhancing PA attainment, although half of the time in parks was spent undertaking some form of PA.

One criticism of studies employing this methodology is that they do not provide any better evidence of a causal effect of the environment than cross-sectional research. Chaix et al., (2013) note that such studies merely reflect the fact that the participants recruited choose to practice PA in the places that they prefer to be active in; thus there is no evidence that one environment supports PA behaviour better than any other. They also note ‘selective daily mobility’ biases where the observation of activity in an environment is devoid of context. For example, a shopping centre may be used for PA, but this is dependent on its accessibility from the previous location the individual was at and these studies rarely account for this.

The authors also note that there is often a lack of attention in such studies to the distance travelled and mode of transport used which could reasonably affect the behaviour conducted in the setting. Also, GPS studies tend to either dichotomise green space and non-green spaces, or they exclusively focus on one type of green space (e.g. Evenson et al’s (2013) focus on parks), meaning that the contribution of different natural environments (countryside, beaches etc.) to health-enhancing PA attainment is unknown. Additionally, combined GPS and accelerometry measurement on a national scale is rarely feasible (Trost, McIver & Pate, 2005) so the influence of environment on PA attainment at a population level could not be garnered with this method. Furthermore, the samples in these studies are often drawn from geographically similar (and hence, potentially demographically similar) populations (often larger urban conurbations) meaning that the contribution natural environments make to PA attainment for populations such as rural populations is unknown.

One study that has addressed some of these limitations used a cross-sectional population health survey from Scotland, UK (Mitchell, 2013). While their main research question concerned the mental health and wellbeing outcomes of PA in natural environments, the results demonstrate how some types of natural environment may more often be used for health-enhancing PA than other types of natural environment. The survey firstly determines the average number of hours per week of different types of moderate and vigorous-intensity PA such as housework, walking, sport and manual work. Secondly, the survey lists a number of locations and asks whether the respondent has used any of the locations in the last 4 weeks for any of those types of PA. The options listed were: a woodland, forest or tree covered park; an open space or park; country paths (not on tarmac); a beach/sea shore/loch/river or canal; sports fields or outdoor courts; a swimming pool; a gym or sports centre; pavements or streets in your local area; your home or garden; somewhere else; and none of these places. Regular users (at least once a week) of woodlands and forests for health-enhancing PA were at about half the risk of poor mental health of non-users and open spaces/parks were the most often used environment for health-enhancing PA (about 20% of respondents used this sort of environment at least once a week for health-enhancing PA). While local pavements, the home and private gardens were more often used for PA, the results still demonstrate that natural environments support health-enhancing PA. By the author's own admission, the most important limitation was that the study cannot take account of the quantity of PA in each environment. This is important as knowing this may reveal that longer or more intense bouts of PA are undertaken in natural environments and are therefore *more* supportive of greater quantities of health-enhancing PA than local pavements and the home/garden. To date, there have been no studies able to explore the form and quantity of PA conducted in different natural environments.

2.6.3 Gaps in knowledge

In summary, correlating access or proximity to natural environments with PA attainment does not inform upon the extent to which natural environments are actually used for PA. Correlations between the frequency of visits to natural environments and PA attainment suffer from the same issue. Research combining GPS and accelerometer data show limited contributions of the natural environment to health-enhancing PA attainment although small samples, the failure to differentiate types of natural environment from one another, and the fact that often this research is devoid of other contextual events surrounding the activity limit the conclusions which can be drawn. Some recent research using visitor surveys have provided evidence that coastal environments (White et al., 2014) and woodlands and forests (Mitchell, 2013) could contribute significantly to health-enhancing PA attainment for English and Scottish populations respectively. However, the inability to account for the type, intensity and duration of this activity still limits our understanding of the exact contributions the natural environment makes to health-enhancing PA attainment.

As has been recommended by others (e.g. Wheeler et al., 2015), research in this field needs to move beyond the urban/green dichotomy that has dominated it because no definitive statement can be made about natural environments affording physical activities if only one type or characteristic is associated with PA attainment. It is promising that studies are increasingly making the use of secondary public datasets to do so (Park, O'Brien, Roe, Ward Thompson & Mitchell, 2011). Knowing the PA affordances, and consequent health-enhancing capabilities, of a variety of natural environments will allow public health decision makers to make a more informed judgement as to where to direct scarce financial resources for the purposes of preventive medicine.

It is also imperative that the type, intensity and duration of PA conducted in natural environments are known. As detailed in section 2.2, PA needs to be of at least moderate-intensity (≥3 METs) and 10 minutes in duration in order to be considered health-enhancing (WHO, 2010). If natural environments afford sessions of PA that fall below these criteria, or if they only support types of PA that are difficult to enact for the general population (e.g. adventure sports), then their usefulness as public health resources is compromised. The MENE survey used by White et al., (2014) and also used in other articles by the authors for different purposes (White, Pahl, Ashbullby, Herbert & Depledge, 2013), contains data regarding leisure visits to different types of natural environments for a representative sample of the English population, along with data like visit durations and activities undertaken, and thus represents one way of addressing this issue. My second empirical study in Chapter 4 will use this data source to explore issues of energy expenditure associated with over 70,000 visits to different types of natural environment in England between 2009 and 2014.

2.7 How is physical activity in natural environments promoted?

If it is accepted that PA in natural environments has additive benefits over PA in other types of environment, then a crucial question is how this specific form of PA has been promoted to the population. There has been much quasi-experimental evidence that has examined whether PA in physical, and in particular natural, environments could be promoted through changes to those environments. For example, McCormack and Shiell (2011) systematically reviewed 13 quasi-experimental studies examining changes in PA for the same respondents before and after relocation to a new neighbourhood (in 4 cases), the same respondents before and after an environmental modification (in 6 cases), or different respondents before and after and environmental modification (in the remaining 3 cases). Studies were conducted in entirely western countries, with mostly middle-aged adults of both genders. PA data was mostly collected via self-report with two studies asking participants to retrospectively recall their PA behaviour before relocation. Most authors did not report whether their measures of PA were valid or reliable. GIS techniques were the most commonly used method of assessing the built environment.

Across the 13 studies there were 11 findings which indicated positive changes in PA behaviour, 16 findings which indicated null changes, and 8 findings which indicated a decrease in PA behaviour. Positive findings were most common among studies with a same sample pre-post quasi-longitudinal design (i.e. where participants retrospectively reported PA behaviour before relocation and current PA behaviour after relocation). Null or negative findings were most common among studies employing a regular same sample pre-post design (following relocation or environmental modification). Positive changes in PA behaviour could therefore have been due to participants exhibiting demand characteristics; i.e. participants guessed that the experimenters were looking for a change in PA behaviour and so retrospectively reported lower PA levels before relocation.

A recent review looked at interventions to promote PA in specifically urban green spaces rather than all aspects of the built environment (Hunter, Christian, Veitch, Astell-Burt, Hipp & Schipperijn, 2015). Studies were included if they examined changes to urban green spaces, interventions to promote use of urban green spaces, or if they combined both of these. Studies also had to have PA as their primary outcome and had to include some form of control or comparator group. Nine included studies investigated changes to the natural environment and used a mixture of quasi-experimental pre-post, post-test only, and difference in difference designs. One RCT used marketing strategies to increase green space use. Two further interventions used a combination of marketing approaches and changes to the natural environment and were a pre-post population survey design or a quasi-experimental pre-post design. Control groups tended to be green spaces which did not undergo changes (and their surrounding population), or populations which lived further away from the intervention site. Some of the issues with self-reported PA data in McCormack & Shiell (2011) are mitigated in this review as many studies employed direct observation of PA behaviour (e.g. pedestrian or bike counts).

Four of the interventions exclusively examining changes to the natural environment reported increases in PA and park usage post-intervention, but five showed null changes (in 4 studies) or a decline in PA (in 1 study). The one intervention exclusively using promotional strategies found significant increases in park-based PA post-intervention which was mostly explained by investment in signage (explained 37% change in park users, and 39% increase MET-hours expended per week per park). The two interventions using a combination of environmental changes and promotional strategies both demonstrated increases in post-intervention PA.

Despite some promising findings from these reviews that natural environments are used for PA following environmental or promotional interventions, the risk of bias in many studies was high. In most cases, there was no way of ruling out the notion that the same people who visited environments before the interventions visited more often after the intervention and were therefore responsible for increases in PA i.e. the interventions may not have attracted new users which is what would be desirable in terms of population-level PA behaviour change. Small sample sizes limit the reliability of results and the multitude of PA outcomes makes it difficult to determine whether environmental changes would result in more general changes in PA behaviour. Indeed, such heterogeneity in outcome measures precluded meta-analysis in both of the reviews.

However, it is notable that in Hunter et al.’s (2015) review, all three of the studies which employed promotional strategies exclusively, or in addition to, environmental changes, found positive impacts on PA behaviours. These communications included signage, promotional incentives, and other outreach activities (Cohen, Han, Derose, Williamson, Marsh & McKenzie, 2013); press advertisements, maps, newspaper and radio coverage, brochures distributed to local organisations and rail commuters[g], and ‘in-site’ promotion (Merom,

[g] The intervention was the construction of a ‘rail trail.’

Bauman, Vita & Close, 2003); and expansion of recreational program opportunities (e.g. dance events) and training of park and recreation staff to deliver these (Tester & Baker, 2009). This suggests that such strategies may be the most effective was of promoting PA in natural environments (or at least urban green spaces). However, the primary studies lack detail on the precise content of these promotional strategies meaning that it is unclear whether, for example, specific behavioural techniques were employed in signage which in turn encouraged more PA. Previous interventions have found that signage informed by cognitive and behavioural theories of behaviour change influences people's walking behaviour in a coastal environment (Taylor, 1994; Fiddler, 2001), but it may equally be the case that such signs in the three above studies contained no content informed by behavioural theories. Furthermore, the combination of different promotional strategies makes it difficult to unpick the effects of each one alone (except Cohen et al., 2013 who analysed this question and reported that changes to signage made the largest contributions).

2.7.1 Promoting walking in outdoor environments using brochures

Brochures were used in one of the above studies to promote PA in urban green spaces (Merom et al., 2003). Brochures represent an important way of conveying information about PA promotion in such interventions. This is because the information can be distributed to whomever the researchers choose (unlike signage for example). Newspaper, radio and other press may present information alongside the specific PA promotion which contradicts the aims of the promotional message (Berry & Latimer-Cheung, 2013). Certain kinds of brochures, such as tourist brochures, are widely read and versatile, with the capacity to deliver numerous persuasive messages to the reader (Brito & Pratas 2015).

Controlled trials that use brochures to increase PA in outdoor environments have mixed results. Pleguezuelos et al., (2013) recruited 160 patients from Barcelona with severe to very severe chronic obstructive pulmonary disorder to a randomised clinical trial after they had undergone initial rehabilitation. Seventy-three were randomised to a control group and the remaining 87 to a further rehabilitation group. The rehabilitation group undertook three sessions of exercise per week for a 12 week period at a hospital. This group were then further randomised into a group that received printed brochures about local urban walking circuits in their area or a group that only underwent the exercise rehabilitation. Patients in all groups continued with their regular pharmacological treatment as well. Nine months after the exercise rehabilitation, 54 patients remained in the control group, 34 in the rehabilitation group with added brochures, and 37 in the rehabilitation group without brochures.

The brochures were designed specifically for the study and contained 32 different routes marked on a map as well as descriptions of cultural attractions and other places of interest (see Figure 2.3 for an example). They also included details of the duration and distance of the route, the percent of slope, the difficulty of the route and possible public transport connections. The leaflet was explained to patients and reinforced at bimonthly visits. Patients in the other two groups also received bimonthly encouragement to undertake PA. Nine months after rehabilitation, and after adjustment for baseline scores, patients in the rehabilitation group who had received the brochure walked 34 minutes more per day and one more day per week than the rehabilitation group that did not receive the brochure (p<.001 for both comparisons). The control group walked significantly fewer days per week than both rehabilitation groups as well.

Figure 2.3 An example urban walking circuit brochure taken from Pleguezuelos et al., (2013).

This study demonstrates that brochures advertising outdoor walking circuits can be used to increase walking in patients with chronic obstructive pulmonary disorder over and above exercise rehabilitation alone. However, it is not clear whether the increases in walking were directly attributable to increased walking of the urban circuits advertised. That is, the brochures may have increased efficacy for walking more generally. It is notable that the brochures contained details on the difficulty, gradient, access issues etc. related to the walking circuits. Such features could help people to overcome barriers to walking.

However, Peels et al (2014) conducted an intervention with contrasting results. In this study, participants from the Netherlands over 50 years of age were randomly assigned to one of five groups. Each group was based in a different but comparable region of the country. Two groups received web-based PA information and two received print based PA information. A fifth group served as a control group. One group from each mode of delivery received additional environmental information in a brochure or online form. This consisted of information about local PA opportunities and initiatives including outdoor walking and cycling routes and sports opportunities around the individual's neighbourhood (in the web-based group this was delivered via Google Maps). A map was also given and tailored to the individual's location concerning where they could go for a walk (D. Peels, personal communication, September 26, 2014; see Figure 2.4). It also included a planner where participants could plan outdoor cycle routes for themselves (in the web-based group this was provided in downloadable form).

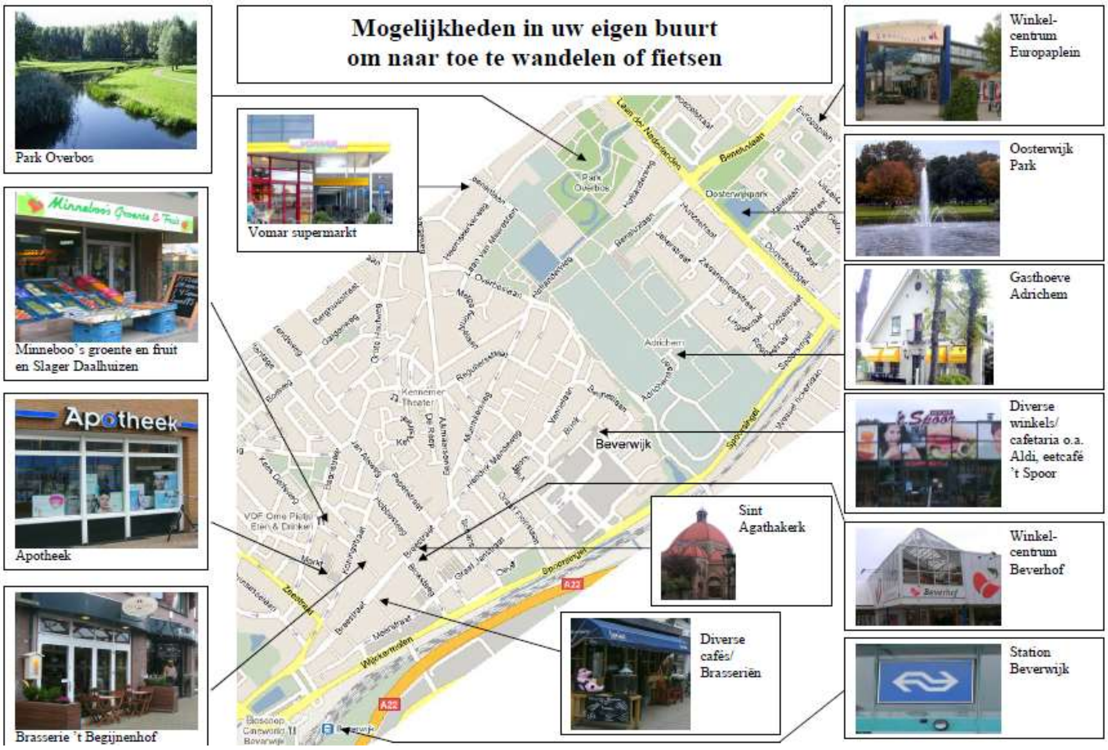


Figure 2.4 An example of a tailored map given to participants in Peels et al., (2014). The map outlines locations that the participant may like to take a walk (D. Peels, personal communication, September 26, 2014).

The printed conditions were most effective at increasing all PA outcomes (weekly minutes of PA; days of PA per week) compared to the control group, but in neither mode of delivery did additional environmental information result in higher volumes of PA than the basic intervention without environmental information. The authors suggest this may be due to information overload. The relative effectiveness of the printed condition could also be due to the higher dropout rate in the web-delivered conditions. Despite environmental information not adding to effectiveness, a parallel process evaluation found that whilst the additional environmental information did not increase appreciation of the intervention, environmental intervention components were more often used than basic intervention components (Peels et al., 2013).

Despite both interventions comparing normal PA promotion with additional environmental information on outdoor PA opportunities, different results are found. This could be due to the behavioural content contained in the environmental information in each study. A systematic review (Wilson, O'Neill, Collins and Bradley, 2015) identified the urban walking circuit arm of Pleguezuelos et al.'s (2013) trial to contain four behaviour change techniques in line with a reliable taxonomy (Michie, Ashford, Sniehotta, Dombrowski, Bishop & French, 2011). In contrast, though the basic arms of Peels et al.'s (2014) trial were constructed on evidence-based prerequisites of PA behaviour change, there was nothing to suggest the additional environmental information was informed by behaviour change theory, despite it being tailored to the individual's local area. This may explain why the results of the former intervention favour the provision of environmental information on outdoor PA opportunities. Although these interventions were conducted with specific populations, they suggest that the content of brochures could have effects on PA uptake more generally by including (or not including) different types or combinations of persuasive message designed to influence PA behaviour.

2.7.2 Gaps in knowledge

One systematic review has suggested that the best way of promoting PA in natural environments is through promotional strategies exclusively, or in combination with, environmental changes. However, the content of these promotional strategies is often unclear. Brochures represent a versatile promotional strategy with the ability to be more tightly controlled by the researchers than other forms of strategy (e.g. press advertisements). Controlled trials using brochures to promote outdoor walking in *urban* environments yield mixed results and this could be due to the presence or absence of persuasive messages within the brochures. As yet however, there have been no systematic attempts to classify the range of potential persuasive messages contained within brochures that promote PA in natural environments.

This is important as national guidance states that persuasive messages should be included in walking programmes. The National Institute for Health and Care Excellence outline a number of recommendations for promoting recreational and transport walking and cycling locally (NICE, 2012). Recommendation 6 (p.17) concerns community-wide walking programmes and states that local transport leads, local authority leisure services and other organisations with an interest in walking, "Develop walking programmes for adults who are not active enough, based on an accepted theoretical framework for behaviour change and taking into account NICE's recommendations on Behaviour change: the principles for effective interventions. Ensure groups that are likely to be the least active are encouraged to participate, by addressing issues that may act as a barrier" (p.18). They also recommend that such bodies "provide information tailored for individuals who want to go walking without joining a group or club" (p.18). Considering these local authorities are often responsible for the production of brochures promoting walking in natural environments, such brochures should be analysed to investigate whether they adhere to these recommendations.

Despite these recommendations, one content analysis of PA brochures in the USA and Canada suggests that behaviour change principles rarely inform the development of brochures promoting PA (Gainforth et al., 2011; see also section 2.8.2 and Chapter 5). Also, there may be many other reasons that natural environments may be accessed. Indeed, PA is often a secondary benefit of visiting natural environments rather than a primary purpose (Ward Thompson & Aspinall, 2011). PA in natural environments may be valued for its hedonic benefit (Downward & Dawson, 2015), or the many natural attributes that natural environments contain may be the biggest attraction for visitors (Dallimer et al., 2014). Brochures advertising recreational walking in natural environments may therefore contain a range of potentially persuasive messaging strategies relating to behaviour change or to natural features which attempt to encourage the reader to undertake PA. A way of classifying the range of potential messages is needed in order to elucidate whether brochures conform to the NICE guidelines and also to discover what other persuasive strategies are employed. Building on these observations, the aim of my third study (Chapter 5) will be to explore the content of a selection of walking brochures currently available in South West England to investigate how they encourage people to undertake walking through the messages within their text.

2.8 How could physical activity in natural environments be better promoted?

Section 2.7 and its subsections established that of all promotional strategies to try and promote PA in natural environments, brochures hold promise as a way of doing so. The question arises then of how these could be optimally designed in order to encourage more people to be physically active in natural environments. Research on how best to design the format of brochures advertising health behaviours is well established. For example, health texts utilising graphical illustrations of specific behaviours aid recall of instructions on how to perform behaviours (Kools, van de Wiel, Ruiter, & Kok, 2006). Coloured tabs and pictorials can also make for more efficient brochure searching and better comprehension (Kools, Ruiter, van de Wiel, & Kok, 2007). Headings also speed up the search for relevant information (Kools, Ruiter, van de Wiel & Kok, 2008). Thus, there are numerous stylistic features which may aid or inhibit processing and comprehension of the written text. This section does therefore not focus on the visual design of brochures, but on how their messages can be best designed in order to encourage uptake of PA in natural environments. As has already been mentioned, designing messages using established behaviour change theories is not only important for encouraging the least active to undertake PA, but is also a national recommendation (NICE, 2012).

2.8.1 The application of behaviour change theories to physical activity promotion

Arguably the most widely applied behavioural theory to the uptake of PA is the theory of planned behaviour (Ajzen, 1991). This theory is an extension of the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) as this previous theory could not account for behaviours which were outside of volitional control. The theory of planned behaviour (see Figure 2.6) proposes that the stronger one’s intention to perform a behaviour, the more likely they are to perform that behaviour. However, this behaviour can only be performed if it is under volitional control (i.e. if the person can decide at will to perform the behaviour). Indeed, most behaviours would be subject to having the appropriate resources (e.g. if you want to go to exercise in a gym, you must have the money to be able to afford a gym membership); and this is referred to as *actual* behavioural control. Intentions to perform a behaviour are made up of three components. The first is attitudes towards the behaviour. Attitudes are predicted by beliefs about the outcomes of a behaviour (e.g. if I exercise, I will improve my health) and evaluations of these outcomes (e.g. being healthy is desirable). The second is subjective norms regarding the behaviour. Subjective norms are created by descriptive normative beliefs (e.g. most other people undertake exercise, so I should too), injunctive normative beliefs (e.g. people I know think I should exercise more), and a motivation to comply with these (e.g. I want to do what others do; I want to do what the people I know think I should do). The third component is perceived behavioural control; its inclusion in the theory is the main difference form the theory of reasoned action. This can refer to internal aspects of control such as capability and confidence in performing behaviour (e.g. I feel confident I can undertake regular exercise). In this sense, the constructs is similar to Bandura's (1977; 1982) concept of self-efficacy. Alternatively it can refer to external aspects of control (e.g. I do not have enough money to exercise; I think exercising will be easy to do/difficult to do). The direct link from perceived behavioural control to behaviour in Figure 2.6 reflects the degree to which actual barriers towards the behaviour (e.g. lack of money) influence the enactment of intentions (i.e. perceived behavioural control becomes a substitute measure of *actual* behavioural control).

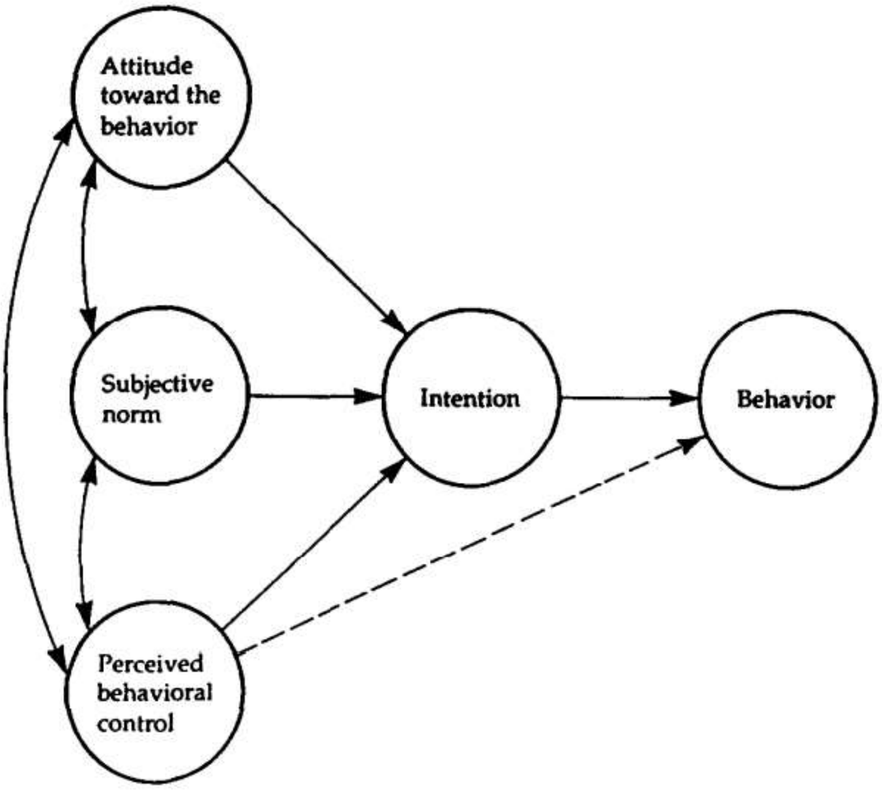


Figure 2.6 The theory of planned behaviour (taken from Ajzen, 1991).

Hagger, Chatzisarantis & Biddle (2002) undertook a meta-analytic review of the application of both the theory of reasoned action and the theory of planned behaviour applied to PA. Their aim was to test the predictive validity of the pathways proposed by the theories (i.e. how well do scores on measures of the antecedents predict scores on the measure of behaviour). Studies were included if the target behaviour was PA and they reported at least one correlation between constructs included in the theory. The authors were also interested in studies which included measures of past PA behaviour and this has been shown to independently predict all constructs. They also separated internal and external aspects of perceived behavioural control. Seventy-nine samples from 72 articles were included in analysis, 25 included measures of past behaviour. The strongest theoretically-derived associations found in the meta-analysis were between attitude and intention, then intention and behaviour, followed by perceived behavioural control and intention and then subjective norm and intention. Through path analysis with the pooled data, the authors confirmed that the theory of planned behaviour explained more variance in intentions than the theory of reasoned action did (44.5% vs. 37.27%). After adding in internal aspects of perceived behavioural control and past PA behaviour as predictors of all other constructs, 60.2% of variance in PA intentions was accounted for as well as 46.7% of the variance in PA behaviour, indicating that these are important contributions to the model. As well as this, some of the other relationships were attenuated by these additions.

This study shows that the constructs included in the theory of planned behaviour predict intentions to be physically active and PA behaviour strongly. Past PA behaviour attenuated most relationships, but the fact that all main associations between constructs remain significant even after the inclusion of past PA behaviour into the model is testament to the strength of the originally hypothesised pathways. From this evidence one could infer that creating messages promoting favourable attitudes towards PA, raising subjective norms for PA, and raising perceived behavioural control/self-efficacy for PA would create stronger intentions for PA. Including such messages in brochures promoting PA in the natural environment might therefore be effective.

In an effort to harmonise techniques from a range of behavioural theories that could be written into health promotion texts, Abraham (2012) created a taxonomy of techniques that can boost intentions and prompt action for a range of health behaviours. This taxonomy was closely related to the CALO-RE taxonomy of techniques deigned to help people change PA and dietary behaviours (Michie et al., 2011). Specifically there were 40 techniques grouped under 11 different behaviour change mechanisms. Many of the included techniques are related to theory of planned behaviour constructs so such guidance may be a good place to start when designing persuasive messages which aim to change PA behaviour.

Another frequently applied model is the transtheoretical model of behaviour change (Prochaska & DiClemente, 1984). This is a model which posits that individuals go through stages when attempting to change health behaviour. There are five main stages. The first, precontemplation, is indicative of when an individual has no intention of changing their behaviour, they may not even recognise that not performing a certain behaviour is an issue (e.g. they may not recognise that inactivity brings about health risks). The second, contemplation, represents when people are aware that a problem with their behaviour exists, but they have not made a commitment to changing it (e.g. they recognise that inactivity brings about health risks, but have not committed to becoming more active). The third is preparation, whereby individuals have made a commitment to change their behaviour but have not actually begun to change it yet (e.g. they intend to become more active). The fourth is action where individuals are practicing the change in behaviour (e.g. they have taken up regular activity). The last stage is maintenance where individuals work to prevent relapsing to their former state; generally if people maintain a change in their behaviour for 6 months, they can be considered to have successfully maintained the change in behaviour (e.g. if they have been regularly undertaking PA for 6 months, then they have successfully changed their behaviour). The model is often presented in a spiral shape to signify that at any stage, relapse to a former stage is likely.

Spencer, Adams, Malone, Roy & Yost (2006) systematically reviewed literature examining the application of the transtheoretical model to exercise. Apart from tobacco use, exercise is the most common application of the model in published studies. Thirty-two stage-matched interventions were extracted. Stage-matched means that the promotion of exercise was conducted through techniques relevant to shifting the participant from the stage of change they were in to the next one. Most interventions used self-reported exercise measures. Seventeen of the stage-matched interventions had positive effects on exercise behaviour which lasted for the duration of the study period, but three of these were only 8 weeks in duration. A further 8 showed short-term positive effects which did not last over the study period. Only three did not support stage-matching; the rest had either inconclusive results or insufficient information to make a conclusion.

The studies in this review are almost exclusively limited to white, middle-class populations. This is problematic because other reviews have shown that adults of lower socio-economic status and of black or minority ethnicities are less likely than these counterparts to achieve higher levels of PA (Trost, Owen, Bauman, Sallis & Brown, 2002). Thus it is difficult to say whether stage transitions would reflect increases in exercise for these groups. Nonetheless, for the populations studied, there is relatively good evidence that stage transitions do predict changes in exercise behaviour. Whilst this evidence does not inform upon what sorts of message might be most effective at persuading someone to undertake exercise, it does demonstrate that whatever messages are used are likely to be more or less effective dependent on whether they are concordant with that person's stage of change. For example, someone in the precontemplation stage who does not see their inactivity as a health issue may benefit from reading information about the risks of inactivity or benefits of PA. For someone in the preparation stage, messages instructing on how to undertake PA, or that decrease barriers to PA may be the most effective.

2.8.2 Designing health promotion texts based on behaviour theories

Behaviour change theory has been applied to the study of health messages in a variety of media. These studies tend to involve a content analysis and generally appear to reach the same conclusion: that behaviour change theories and scientific research rarely inform the content of health messages in mass media. For example, a content analysis of exercise ‘apps’ (mobile applications) found that on a 100-point ‘theory score’ scale, apps’ scores ranged from 1 to 28 indicating that apps lacked theoretical content (Cowan et al., 2012). Another content analysis of nutritional information in *Men’s Health* magazines found that translation of scientific evidence into recommendations was often poorly executed and selective (Cook, Russell & Barker, 2014). A further analysis found that Canadian newspapers often overlook important methodological aspects of PA research when reporting findings (Faulkner, Finlay & Roy, 2007).

The only study which I am aware of that conducts a content analysis of brochures promoting PA was conducted by Gainforth et al., (2011). The authors constructed a coding taxonomy of 20 techniques grouped under four superordinate categories pertaining to knowledge-based information, outcome expectancies, self-regulation, and self-efficacy (as well as ‘other’ messages which encompassed text which could not otherwise be coded). They also coded pictorial content such as modelling of PA. Eighteen percent of brochure content targeted knowledge-based information, 20% of content promoted self-efficacy, 10% was classified as highlighting outcome expectancies, and a further 6% targeted self-regulation. The majority of content was classified as ‘other’ messages. The most popular information provision category concerned presenting PA recommendations. With self-efficacy, the most popular was pictures of PA modelling. With outcome expectancies, most content related to positive health benefits of PA. Lastly, the most popular self-regulation category concerned overcoming barriers to PA.

The fact that health promotion brochures often overlook potentially persuasive messages based on behavioural theories and empirical evidence leads to the question of whether including such content can improve intentions to change behaviour. Although to my knowledge experimental manipulation of brochures in such ways has not been done regarding PA, other health behaviours have been investigated in this way. Bishop, Marteau, Hall, Kitchener and Hajek (2005) recruited 330 female smokers from London and Manchester Primary Care Trusts who had received an abnormal cervical smear test result. In three conditions, participants were exposed to no leaflet, a leaflet with ‘threat’ and ‘efficacy’ messages, or the same leaflet with an additional detailed explanation on how smoking affects the cervix (i.e. designed to affect affective attitudes towards smoking abstinence). All leaflets were of an equivalent reading grade. Intentions to stop smoking were measured on two seven-point scales. Women who received the detailed brochure had higher intentions to stop smoking than the no-leaflet group but there was no significant difference between the two leaflet groups. There was also no difference between the leaflet groups in terms of perceived effectiveness of stopping smoking in reducing the risk of cervical cancer. However, the detailed leaflet was rated as significantly more coherent (better understanding) than the briefer leaflet. Neither leaflet increased women's self-efficacy for stopping smoking. This study provides limited evidence of the effectiveness of adding detailed explanations of the health-behaviour link. However, it is not clear whether women's attitudes towards smoking changed, and as only one singular technique was manipulated, this may not be sufficient in raising intentions to stop smoking over and above the brief leaflet.

In another study manipulating the content of health brochures, France, Montalva, France and Trost (2008) recruited 183 undergraduate American university students to read one of three brochures concerning blood donation. Forty-seven percent of participants had no prior experience with blood donation. A control brochure provided basic information about healthy eating and exercise. A standard brochure was administered which had been published by the American Red Cross and was being used at the time as the main method of recruiting new blood donors. It provided general information on donor availability, what happens to blood once it is donated and safety procedures put in place to protect donors and recipients. An enhanced brochure was created for the study based on existing evidence surrounding the importance of: (a) highlighting knowledge-based information about blood donation; (b) promoting positive attitudes towards blood donation, and; (c) self-efficacy in determining motivation to donate blood. One of the ways it enhanced self-efficacy for example was by listing various coping strategies prospective donors could employ for managing their fears about the pain involved in blood donation. Intentions were scored on the average of three seven-point scales. Analysis for this study was conducted on differences in intentions before reading a brochure until after reading a brochure.

After reading the enhanced brochure, participants reported significantly greater intentions to donate blood as well as significantly more positive attitudes, significantly less anxiety about the process and significantly higher self-efficacy. The standard brochure had comparable effects, but no significant effect on changes in attitudes. Having said this, effect sizes were two to five times larger for all changes after reading the enhanced brochure. This study provides better evidence that manipulating the content of health promotion brochures to include evidence-based correlates of behaviour change can influence intentions towards changing behaviour. Although, actual future blood donation behaviour was not assessed, it is already well-known that intentions to change behaviour are significant predictors of actually doing so (see section 2.8.1). Therefore, we might expect that changing attitudes and efficacy for undertaking PA in natural environments so have comparable effects on intentions to do so.

2.8.3 Gaps in knowledge

Research into health behaviour change has produced a wealth of theories that attempt to identify antecedents which could encourage people to change their behaviour. In the context of promoting PA, the theory of planned behaviour has been particularly well applied. Although section 2.2.3 stated that ecological approaches are needed in order to change people's PA behaviour at a population level, these do not have to exist in isolation from behavioural science interventions[h]. Brochures that are manipulated with content informed by behavioural theories or evidence-based correlates of PA behaviour change which are then distributed at a population level represent one way of

[h] A notion recognised in other ecological approaches to promoting PA (e.g. Sallis, Cervero, Ascher, Henderson, Kraft & Kerr, 2006).

harmonising these distinct approaches. Current experimental studies provide some evidence that manipulating theory-informed constructs in brochures can be effective at changing intentions to change behaviour.

Making sure that brochures which promote PA in natural environments include theory-informed content is important for a number of reasons. Firstly, as mentioned previously, NICE (2012) recommend that local authorities develop programmes for walking and cycling which ensure that such content is included. Secondly, at present, health promotion materials are rarely informed by behavioural theory meaning that people who stand to gain the most from a change in behaviour are accessing materials which do not adequately facilitate this. In the case of brochures advertising PA in natural environments, including such content means that people who are less active and visit natural environments less may be more encouraged to change their behaviour and thus experience the resultant health benefits. If sustained, these changes in behaviour could go some way to reducing inequalities in health.

At present, though, there are no studies which have manipulated the content of brochures promoting PA in natural environments to include more or less theory-informed content to investigate the effect on intentions to walk in natural environments. Considering that brochures advertising, for example, recreational walking in natural environments are likely to be accessed more frequently and by a greater diversity of the population than general PA promotion brochures (such as those featured in Gainforth et al.'s (2011) content analysis), the potential implications for population health of improving the content of these brochures could be substantial. Building on this, my final empirical study (Chapter 6) will manipulate an existing walking brochure to include more messages related to theoretical explanations of behaviour change to examine whether this could increase intentions to walk in natural environments, particularly with people that do not walk a lot at present.

2.9 Summary of literature review

Undertaking PA can lead to physical and mental health enhancement. However, rates of PA among the British population suggest an epidemic of physical inactivity which can create profound detriments to human health. Population-level approaches are needed to tackle this epidemic. Exposure to natural environments can also have physical and mental health benefits for humans. There is evidence that practicing PA in natural environments could lead to additional physical and mental health benefits. If so, this could help people maintain physically active behaviour.

Section 2.5 demonstrates that aesthetic qualities, visual attractiveness and physical attributes of natural environments are associated with PA participation. What is less clear is how these could affect PA outcomes. This is important as a poor quality natural environment could deter someone from repeating PA there. Evidence from laboratory studies suggests that degradation in natural littoral environments can adversely affect preferences for natural environments, as well as affect and perceived restorativeness associated with natural environments. Furthermore, exercise research demonstrates that degradation could adversely influence the psychophysiological outcomes of exercising in natural environments. Such research however is subject to methodological limitations which obscure both the true validity of these effects and why they might occur.

Knowledge of the extent to which degradation affects the outcomes of exercise could underline the importance of environmental conservation.

Section 2.6 details how access and contact with natural environments affects PA participation. Cross-sectional evidence supposes that access to natural environments is associated with PA attainment, but from this alone it is not clear whether people use natural environments for PA. GPS research suggests moderate contributions of the natural environment to health-enhancing PA while cross-sectional analyses of surveys concerning leisure visits suggest that the PA practiced within natural environments could be health-enhancing. Thus, natural environments may play an important role in overcoming the physical inactivity epidemic by providing spaces for health-enhancing PA attainment. However as yet, the intensity and duration of PA conducted in different types of natural environment is unknown. Better knowledge of this could help public health authorities decide where to direct scarce financial resources.

Section 2.7 highlights the paucity of research examining how best to promote PA in natural environments. The one systematic review on the topic suggests that promotional materials may be effective. One such promotional material that has been used in controlled trials to promote outdoor PA is brochures which advertise walking. In clinical populations, these have proved to have inconsistent effects, but subsequent research suggests this could be due to the content of such brochures not adequately facilitating PA uptake through the use of evidence-based behaviour change techniques. The nationwide distribution of brochures produced by local authorities that advertise walking in natural environments could profoundly impact people’s participation in outdoor walking in natural environments, and thus population levels of PA. However, as yet, there has been no systematic attempt to classify their content, despite national recommendations that they should include techniques to encourage the least active to participate in PA.

Section 2.8 discusses how these materials could be modified to encourage more people to be physically active in natural environments. Theories of health behaviour change have identified many constructs related to the formation of intentions to be physically active. Of all, the theory of planned behaviour seems to be the most commonly applied theory to the uptake of PA. Despite this, evidence suggests that health promotion materials rarely feature theory-informed content or content based on evidence-based correlates of behaviour change. With different health behaviours, experimental studies have demonstrated that manipulating the written content of brochures to include a wider range of behaviour change techniques could result in changes in intentions to perform health behaviours. Such an experimental approach has not been taken with brochures that promote PA in natural environments. If message content in these brochures could be optimised, it may encourage less active people to be more active in natural environments and experience the multitude of health benefits associated with that experience.

2.10 Research questions

These four areas of inquiry lead to four distinct research questions which will be addressed in the thesis (with relevant Chapters in brackets):

1. Does degradation affect the outcomes of PA in natural environments and if so, how? (Chapter 3).

2. What intensity and duration of PA is conducted in different types of natural environment? (Chapter 4).
3. What types of message are conveyed in brochures advertising PA in natural environments? (Chapter 5).
4. Can the content of brochures about walking in natural environments be enhanced to heighten intentions to engage in such activities? (Chapter 6).

Answering these four questions can aid public health decisions as to the value to human health of environmental conservation, which environments may need protecting most, and what the content of brochures advertising walking should include in order to increase population levels of inactivity. Chapter 3 explores the first of these research questions.

3. Does anthropogenic degradation affect the psychophysiological outcomes of walking in natural environments?

3.1 Introduction

The aesthetic quality of outdoor environments plays a key role in eliciting or inhibiting PA (Ward Thompson, 2013). For example, less aesthetically pleasing environments have been associated with less self-reported walking; enjoyable scenery with more leisure-time moderate-to-vigorous activity; and a lack of scenery with being sedentary (Humpel et al., 2002; Owen et al., 2004). This is important as while such factors may not predict PA as strongly as individual or social determinants (Giles-Corti & Donovan, 2002), they do exert a significant influence and are potentially more easily modifiable (Sallis et al., 1998). Concerning natural environments, qualitative research has suggested that graffiti and vandalism negatively influenced park-based PA, and the presence of trees, bushes, gardens, grass, flowers, water features, air quality and pleasant smells positively influenced park-based PA (McCormack et al., 2010). Biophysical qualities have also been shown to motivate infrequent users of natural environments (Dallimer et al., 2014). The additive psychological effects of PA in natural environments are well established (Bowler et al., 2010; Thompson-Coon et al., 2011), but the visual attractiveness of a natural environment may also augment or diminish these additive effects.

The visual attractiveness of a natural environment may affect its ‘restorativeness’. ‘Restoration’ refers to two distinct theories which posit different outcomes of exposure to natural environments. Firstly, it can refer to the psycho-evolutionary idea that natural environments elicit positive affect and consequently reduce physiological arousal (Ulrich, Simons, Losito, Fiorito, Miles

& Zelson, 1991). Finding that self-reported affective improvements and physiological recovery from stress (measured by electroencephalography, heart rate, muscle tension, skin conductance, and pulse transit time – which correlates highly with systolic blood pressure), both occur relatively rapidly when exposed to scenes of natural environments, particularly those with water, Ulrich (1981) and Ulrich et al., (1991) posited that exposure to natural environments involved an evolved, parasympathetic response.

Alternatively, ‘restoration’ refers to the cognitive idea that natural environments hold effortless attention through containing interesting sensory properties which in turn enables the restoration of directed attention (attention restoration theory; Kaplan, 1995). In contrast to Ulrich (1981) and Ulrich et al., (1991), evidence for this theory of ‘restoration’ depends on studies which demonstrate improvements in cognitive abilities following nature exposure (e.g. sustained attention tests, Berto, 2005; or search tasks involving high cognitive load, Hartig, Evans, Jamner, Davis & Gärling, 2003). Directed attention is analogous to the concept of voluntary attention described by William James (James, 1892). Kaplan (1995) posits that natural environments contain four components that can restore depleted directed attention resources: (a) a sense of ‘being away;’ (b) soft fascination (things that hold attention effortlessly such as clouds or snow patterns); (c) a sense of ‘extent’ – that natural environments have a large sense of scale and; (d) a sense of ‘compatibility’ where human actions in natural environments are less effortful than in other types of environment. A previously defined component, ‘coherence’, an aspect of ‘extent’, refers to the idea that activities and items in the natural environment are ordered and organised, however it has been difficult to successfully operationalise this construct and in most recent studies it has not been included. It is this latter theory of attention restoration that is the focus of the remainder of this chapter and henceforth ‘restorativeness’ refers to the ability to restore directed attention.

Studies have shown that preferences, perceived attention restoration and affective reactions are negatively affected when viewing scenes of degraded natural environments. Using a mixture of natural and anthropogenic types of degradation edited into photographs of freshwater and wetland environments, Wilson (1995) demonstrated that degradation negatively affected liking for the scene and preferences concerning recreation. Wyles et al., (2015) used a similar method to demonstrate that clean beaches were preferred and perceived to be more restorative than littered beaches. Specifically, fishing litter and public litter elicited the lowest rating of preference and perceived restorativeness as well as more unpleasant feelings and higher activation. This study is particularly important as the rates of public-related marine littering increase on UK shorelines (Marine Conservation Society, 2014). However, both of these studies used sedentary scenarios. When exposed to such scenes during an active task, the affective benefits of PA itself may antiquate any negative effects of the scene. Alternatively, the affective benefits of PA may be diminished because the scene exerts a stronger impact than the PA on the affective experience.

Pretty et al., (2005) investigated this using a short-duration treadmill walking exercise and found that exposure to natural environments containing anthropogenic degradation negatively impacted both physiological and affective outcomes of the activity. However, the types of degradation featured were more vivid than the more everyday types such as litter and their measures of affect have not been validated in the context of exercise (see section 2.5.2 for a discussion). Furthermore, there was no investigation of the mechanisms by which anthropogenic degradation led to decreased psychophysiological outcomes. One possible mechanism is that the clean and degraded environments were differently restorative. Indeed, previous controlled studies have shown that a more restorative experience of walking in natural environments often accompanies positive changes in affect (Gidlow et al., 2016; Hartig et al., 2003).

Traditionally, attention restoration has been measured through self-report items. For example, Hartig, Korpela, Evans & Gärling (1996) devised a 16-item questionnaire measuring the four components and Berto (2005) uses a reliable, shortened version of this with 5 items to measure the four main components and ‘coherence’. With advances in technology, it is becoming possible to study directed attention, and thus attention restoration, more objectively. Berto, Massaccesi & Pasini (2008) present the first application of eye-tracking as a method of measuring the attention restoration potential of different scenes. Eye movements are considered to reflect attentional processes and depend on a scene’s ‘informativeness’ (Buswell, 1935; Mackworth & Morandi, 1967); that is, the presence of coherent and incoherent objects in a scene, or the presence of objects and non-objects.

Specifically, Berto et al., (2008) recruited participants to rate scenes using self-report restoration scales to ascertain photographs that were low and high in the ‘fascination’ component. They then used these photographs in a free-viewing experiment with nine undergraduate students to determine the eye movement patterns associated with scenes that were high and low in ‘fascination’. Each photo was presented for 15 seconds. The low fascination photographs subtended a visual angle of 1.03° whereas the high fascination photographs subtended an angle of 0.97° ($p=0.02$) indicating a less effortful viewing strategy. The high fascination photographs also elicited fewer saccades (although not significantly fewer) and fewer fixations ($p<.001$).

Therefore, scenes low in fascination may not let directed attention resources restore as much as scenes which are high in fascination. These results are perhaps not surprising as photographs low on fascination (i.e. urban scenes) also frequently contain more stimuli compared to natural scenes. However, this does also mean that it could be the number of stimuli in a scene rather than its naturalness which is driving its restorativeness. The lack of a task or goal when viewing the photographs also raises the question of what the participants wanted to look for in the photographs. Previous research has established that cognitive goals influence numbers and patterns of fixations to a scene (Hayhoe & Ballard, 2005; Land, Mennie & Rusted, 1999). A task where participants are mentally fatigued beforehand might therefore influence what participants look at and what components are contributing to seeking restoration.

Another study used 19 ‘restorative’ and 19 ‘non-restorative’ photographs of park environments determined using a similar restorative rating tasks (Nordh, Hagerhall & Holmqvist, 2013). Thirty-three students from Sweden saw all photographs in random order while their eye movements were measured. Additionally, participants had to rate the restorativeness of every photograph by responding to the item, “I would be able to rest and recover my ability to focus in this environment” on an 11-point scale (0=not at all, 10=completely). To analyse the eye movement data, the researchers outlined up to ten possible areas of interest in each photo: hardscape, grass, lower ground vegetation, flowering plants, bushes, trees, water, visually dominant elements, other people, and benches. Before the task, participants were asked to imagine that they were mentally tired. This was so the authors could infer that attention to certain areas of interest was related to a need for restoration.

Trees, benches and bushes captured the most attention (measured by dwell time – the duration of all fixations within the area of interest). The more time participants spent looking at grass, the more likely it was that they would give the photograph a high restorative rating. All other correlations of this nature were insignificant. Therefore the authors inferred that longer viewings of trees, benches and bushes were associated with seeking restoration. Longer viewings of grass are likely to influence the restorative value one gives to an environment. However, the longer viewings of these components could be due to the fact that they are central elements in most photographs and central elements of a scene are often automatically focussed on (Tatler, 2007). In contrast with Berto et al., (2008), numbers of fixations were not significantly different between less and more restorative photos. Though more restorative photos did contain more natural elements, all photographs were nevertheless of ‘pocket parks’ and so are perhaps more closely comparable than the two types of scenes used in Berto et al’s (2008) study.

Eye-tracking represents an important methodological development in the restorative environments literature. This is because restorative ratings of scenes can only tell you the potential that an overall scene has in influencing attention restoration. Eye movement patterns can elucidate what components of scenes can influence attention restoration. Berto et al’s (2008) study reveals that urban scenes elicit more effortful attention generally. Nordh et al’s (2013) study reveals that attention to particular natural and manmade components of parks may be important for achieving restoration. Such results could inform choices of components for new or existing natural environments. The infancy of this type of research means limitations are still rife. Firstly, the artificial nature of these experiments limits understanding of how people perceive these environments in real life. In reality, a perceiver is in constant motion when perceiving a scene; either through locomotion, head turning (Lee & Kalmus, 1980) or even just eye movements (Lappe, Bremmer & van den Berg, 1999), meaning the optic array expands outwards from an ever-changing single point in visual space (Gibson, 1950). Thus, the components of environments which are visually attended to during any form of locomotion (and thus, in an ever-changing optic array) could be different to those in a static image, potentially affecting an environment’s restorative potential. Secondly, neither of the studies examined here use a task which actually induces a state in the participants where they need restoration. Nordh et al., (2013) ask participants to imagine such a state but this may not be sufficient. Doing so would more accurately outline how participants view scenes when in need of restoration. One way of doing so would be to administer a psychosocial laboratory task such as the Stroop task which induces stress-related psychophysiological changes (Renaud & Blondin, 1997).

Secondly, while the independent rating of photographs as more and less restorative is important for avoiding bias, it could also mean that non-restorative photographs always feature substantially more stimuli. Especially if the variety of stimuli is central to the image, this could mean that supposedly non-restorative photographs are merely eliciting more visual attention because they contain more stimuli. Experiments which vary perhaps just one component of a restorative/non-restorative scene could elucidate whether a particular type of component contributes differently to restoration than another.

3.1.1 Present study

In summary, anthropogenic degradation of natural environments plays an important role both in influencing PA participation and affecting psychological outcomes of viewing scenes. The evidence surrounding whether it plays an important role in the psychophysiological outcomes of PA in natural environments is unclear, and the mechanisms by which this may work have not been investigated. Therefore the present study addresses this by testing whether psychophysiological responses are different when exercising in exposure to littered and clean natural environments, and if so whether this is due to the environments' capacity to elicit different patterns of directed attention (measured in this instance by monitoring eye movements).

The first hypothesis was that psychophysiological improvements would occur in both conditions, but that they would be more pronounced when exposed to clean scenes of natural environments (see Figure 3.1). This general hypothesis is in line with Pretty et al., (2005). Physiological improvements were proposed to be characterised by decreases in heart rate and blood pressure. Psychological improvements were proposed to be characterised by increases in valence and decreases in activation[i] and lower perceived amounts of time elapsing

[i] While exercise of even low-intensity usually increases activation (e.g. Ekkekakis et al., 2000), even in outdoor environments (Focht, 2009), the only study I am aware of using single-item assessment of activation in response to simulated natural environments while exercising found decreases (White et al., 2015). Due to the methodological similarity of this study and the present study, decreases in activation are hypothesised here.

(consistent with White et al., 2015) and with smaller increases in RPE (proposed but not found by the same study).

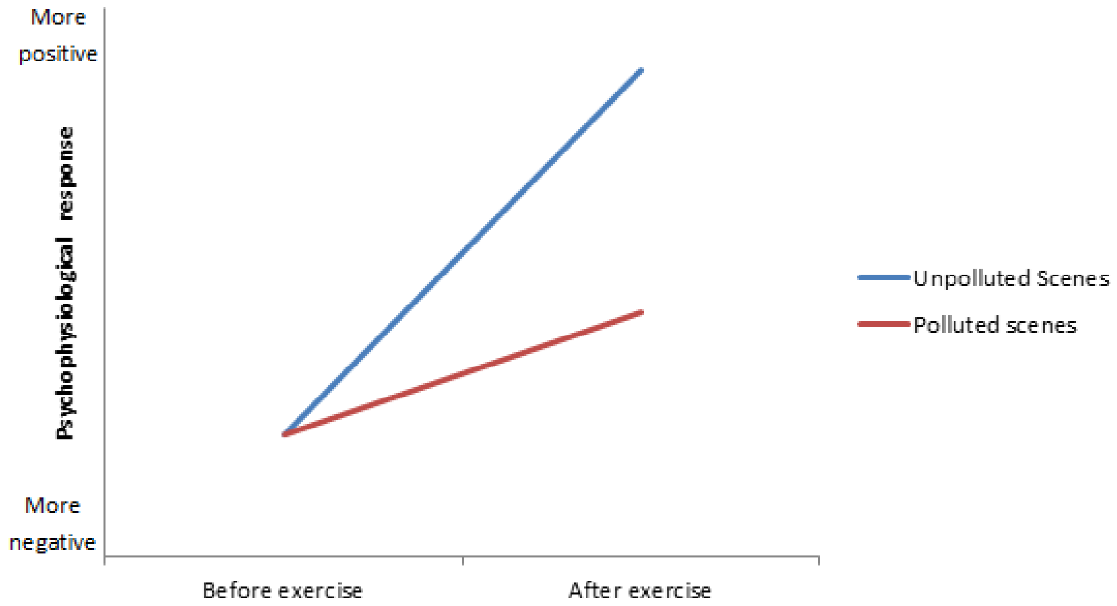


Figure 3.1 A graphical illustration of the first hypothesis – that psychophysiological responses and recovery from psychosocial stress would be more pronounced when exercising in exposure to clean beach environments.

The second hypothesis was that differences in eye movement patterns across the two scenes would mediate immediate post-exercise differences in psychological outcomes. That is, when viewing littered scenes there would be more effortful visual attention patterns which are responsible for worse psychological outcomes. Conversely, when viewing clean scenes, visual attention to equivalent areas would be less effortful and therefore result in better psychological outcomes. This indirect effects hypothesis is illustrated in Figure 3.2

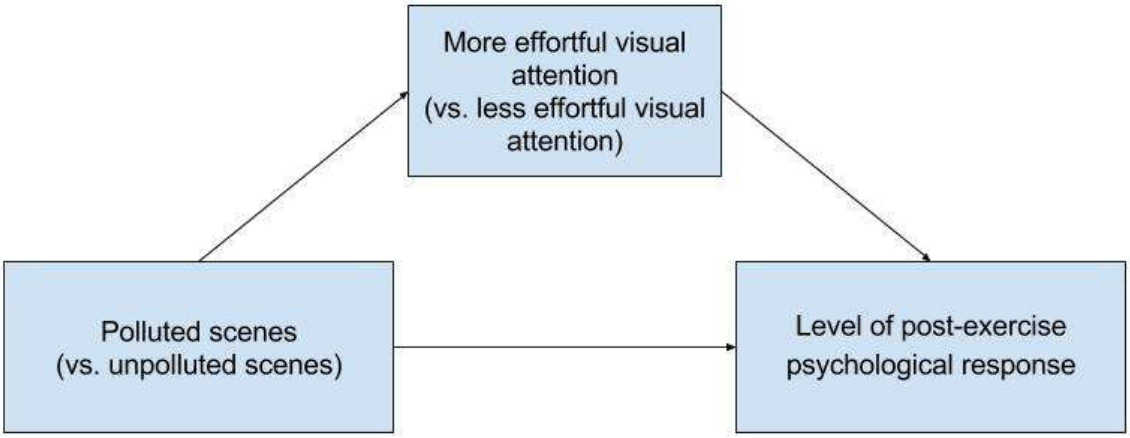


Figure 3.2 Proposed indirect effects hypothesis. Exercise in exposure to the two types of scene lead to differing post-exercise psychological outcomes through visual attention to the scenes.

3.2 Method

All methods used in the present study were approved by the University of Exeter's Sport and Health Sciences Ethical Committee. The study was additionally approved by the Exeter Clinical Research Facility for the purposes of recruitment.

3.2.1 Participants

Participants were recruited through opportunity sampling using both the Exeter Clinical Research Facility's 'Exeter 10,000' cohort and through adverts on a University of Exeter webpage and social media account. The former are a cohort of Exeter residents of various ages, health conditions etc. who were sent a detailed letter asking if they would like to take part in a study. The participants then chose to volunteer or not by sending a reply slip to the University. The cohort contained 950 eligible participants of which 40 were contacted per month. The latter strategies were targeted at students and provided an email address which potential participants could email for further information. It is impossible to know how many saw the advert on the social media account, but the account has over 40,000 followers. All participants were paid £10 after completion of each of two experimental sessions. Participants were required to have normal vision and hearing and not be dyslexic in order to complete the tasks appropriately, and be between the ages of 18 and 55 and able to walk unaided on a treadmill for at least 20 minutes to comply with ethical regulations.

3.2.2 Natural environment stimuli

Recorded video footage of natural environments was used in this study. Whilst viewing videos of natural environments is only modestly associated with more positive affect than viewing still images (Valtchanov, Barton & Ellard, 2010), using videos allowed us to concurrently project sound; the combination of the two has been shown to be crucial to the experience of tranquillity over and above either one alone (Pheasant, Fisher, Watts, Whitaker, & Horoshenkov, 2010) . Two videos were filmed at Holywell Bay, Cornwall, UK using a high definition camcorder with built-in stereo microphone. A coastal environment was chosen as research has shown littoral environments to be associated with higher preferences, greater positive affect and higher restorativeness ratings (White et al., 2010), whilst litter affects these ratings considerably (Wyles et al., 2015).

Each video consisted of a 10-minute, stationary, eye-level film of the bay under overcast weather conditions with equivalent illumination. The littered video contained seaweed, sticks and feathers (all sourced at the location) scattered along a tideline on the beach with the sea, headland, and sky in the background. The littered video was identical apart from visitor-related litter had been added to the naturally sourced items (see Figure 3.3). The visitor-related litter was both a) sourced at the location and b) brought to the location, and consisted of the most common visitor-related litter items found at British beaches (Marine Conservation Society, 2014, e.g. plastic bottles, crisp packets, cigarette stubs). In both videos, the tideline subtended approximately the same amount of space in the scene; so although there were objectively more stimuli in the littered video, we could tentatively state that any observed difference in eye movements would not be the result of this. These two conditions were chosen as Wyles et al., (2015) found significant differences in preference, affective ratings, and perceived restorativeness between beaches with seaweed and beaches with visitor-related litter.

Figure 3.3 Still images from the videos. A scene from the clean video is on the left and a scene from the littered video on the right.

3.2.3 Equipment

All sessions took place in the same laboratory. A Woodway treadmill was used for the walking task with digitised feedback (heart rate, speed) etc concealed so the participant could focus on the video. An ASUS laptop, Dell 2:1 speakers, and a Hitachi projector were used for all tasks and the video presentation. Heart rate was measured using a Polar Heart Rate Sensor H1 belt and Polar RS400 wrist-worn monitor. Blood pressure was measured using a Bosch and

Sohn ambulatory blood pressure monitor. An Applied Sciences Laboratories (ASL, Bedford, MA, USA) mobile eye-tracker with a modified portable Sony digital video cassette recorder logged all eye movement data onto tape which were subsequently converted into digital files. Eye-tracking analysis was conducted using GazeTracker software.

3.2.4 Measures

3.2.4.1 Physiological outcome measures

The first physiological outcome measure was MABP. This was calculated using the equation $MABP \approx diastolic + 0.33(systolic - diastolic)$. We used this composite blood pressure measure as opposed to systolic and diastolic separately to be comparable with previous research (Pretty et al., 2005). Heart rate was the second physiological outcome measure and was monitored consistently throughout exercise using the Polar Heart Rate Sensor belt. As well as comparability with previous research, administering such measurements is a basic requirement for acute sub-maximal exercise testing (American College of Sports Medicine, 2013).

3.2.4.2 Psychological outcome measures

Affective valence was measured through verbal administration of the FS which questions how participants feel “right now” on an 11-point scale (-5=very bad, 0=neutral, +5=very good). Affective activation was measured using verbal administration of the FAS which also asks how the participant feels “right now” but is measured on a 6-point scale (1=low arousal, 6=high arousal). Together, these two scales encapsulate the affect circumplex; a domain-general measure of basic affect which is valid for repeated measurements throughout an acute exercise session (Ekkekakis & Petruzzello, 2002). Perceived exertion was captured using the RPE scale (Borg, 1982); a 15-point scale ranging from 6 (extremely light) to 20 (maximal exertion). This is a valid measure of exercise intensity in this study as it correlates well with heart rate and maximal oxygen uptake in sub-maximal exercise sessions (Faulkner, Parfitt & Eston, 2007). Time perception was measured by asking participants how long they thought the video had been playing for in minutes and seconds. This measure has been used previously in studies of exposure to nature (Berry, Repke, Nickerson, Conway, Odum & Jordan, 2015), and in exercise studies using simulated nature stimuli (White et al., 2015).

3.2.4.3 Process measures of attention

Commensurate with research on restorative properties of natural scenes (Berto et al., 2008; Nordh et al., 2013), we used eye-tracking to measure attention towards litter on the tideline. Specifically, two measures were used. The first was the percentage of overall time focusing on the tideline (duration of all fixations) as opposed to other areas in the scene or externally (hereafter, dwell time). This measure has been used previously to identify restorative properties of environments (Nordh et al., 2013). The second concerned the number of fixations on the tideline (hereafter, numbers of fixations) which has also been used previously (Berto et al., 2008). Consistent with Berto et al., (2008), fixations were defined as when gaze is focussed on a particular point in visual space for a minimum duration of 150 milliseconds.

3.2.4.4 Biographical data

A number of items were administered to describe the sample, but these were not included as covariates in analysis in order to avoid overparameterization of the models. The 7-day recall of PA questionnaire (Blair et al., 1985) was administered. The questionnaire is validated for the general population (Montoye, Kemper, Saris & Washburn, 1996). It records data on the amount of moderate and vigorous activity the individual has undertaken in the last week as well as the amount of sleep they have had, their weight and height, and self-assessments of their readiness to exercise. Frequency of beach visits in the last 12 months was recorded using an item adapted from the Monitor of Engagement with the Natural Environment survey (Natural England, 2015) and read:

> “Thinking about the last 12 months, how often, on average, have you spent your leisure time by the beach?
>
> By ‘the beach’ we mean any time spent on beaches, including river estuary beaches, walking along promenades etc.
>
> This could be anything from a few minutes, to all day. It may include time spent close to your home, further afield or while on holiday.”

Participants responded by choosing one of eight options (never, once or twice, once every two to three months, once or twice a month, once a week, several times a week, every day, more than once per day). Participant’s age and gender were also recorded.

3.2.4.5 Perceived restorativeness and willingness to visit

Perceived restorativeness and willingness to visit the two scenes were also examined as a subsidiary analysis. Perceived restorativeness was assessed using the short-form PRS (Berto, 2005). This consists of five statements pertaining to five qualities of restorative environments (being away, fascination, coherence, scope, compatibility). Participants rate how much the statement applies to them on an 11-point scale (0=not at all, 6=rather much, 10=very much). Willingness to visit was measured on a 10 point scale (1=not at all, 10=extremely) using the item, “How willing would you be to visit this scene?” This item was taken from White et al’s (2010) study of aquatic environment preferences.

3.2.5 Design and procedure

A within-subjects design was employed where participants completed the experimental protocol viewing both the littered and clean video on different days. Allocation to the conditions was counterbalanced and randomised using a random number generator. Each session lasted 1 hour and took place at the same time of day to control for fluctuations in physiological measures.

Participants entered the lab and received a short explanation about the study after which they signed a consent form. During this time, participants were familiarised with the FS, FAS, and RPE scales. Participants were then fitted with the heart rate monitor and their eye movements were calibrated using a 9-point calibration procedure projected onto a white wall in front of the treadmill. The experimenter administered the 7-day recall of physical activity questionnaire (using episodic memory prompts where appropriate) and the participant rested for 10 minutes before baseline measures of heart rate, blood pressure, valence and activation were recorded. The participant then completed a three-minute Stroop task. This was used to manipulate a ‘need for restoration’ state characterised by high activation, negative valence, raised MABP, and increased heart rate (Hamer, Taylor, & Steptoe, 2006; Renaud & Blondin, 1997). One word was presented per second on the screen of the laptop; the participant had to name the colour of the word as quickly as possible. After the task, measures of blood pressure, heart rate, valence and activation were recorded again.

The participant then stood on the treadmill and put on the pre-calibrated eye-tracking equipment. The experimenter instructed the participant to warm up to a pace that corresponded to somewhere between 11 (fairly light) and 13 (somewhat hard) on the RPE scale mimicking moderate-intensity recreational walking (Murtagh et al., 2002). Once the participants had selected their pace, the experimenter explained that the participant would proceed to watch a video and that at intervals throughout, they would have to report their valence, activation, perceived exertion, and how long they thought the video had played for (time perception). The video presentation then began. At 2m30s, 6m, and 8m30s, the experimenter asked the participant to respond to each measure and the participants replied by declaring a corresponding number. These irregular intervals were chosen to avoid the possibility that participants would guess that regular time intervals were being chosen. Eye movements were recorded continuously throughout exercise. The most pleasurable exercise tends to be short-duration (10 minutes; Ekkekakis et al., 2000), moderate-intensity (Ekkekakis et al., 2011), exercise conducted in natural settings (Bowler et al., 2010; Thompson-Coon et al., 2011), hence why this task was chosen.

Additionally, the most common encounters with natural environments involve walking (Natural England, 2015).

Immediately after termination of the exercise, participants once again reported their valence and activation. After the exercise, participants were seated and completed the perceived restorativeness measure and remaining biographical data. They then rested for 10 minutes before having final measurements of blood pressure, heart rate, valence and activation recorded. They were paid before leaving the lab. In the second session, the procedure was identical apart from they did not complete the 7-day PA recall questionnaire again and the alternate video was shown. A diagram of the overall method is displayed in Figure 3.4.

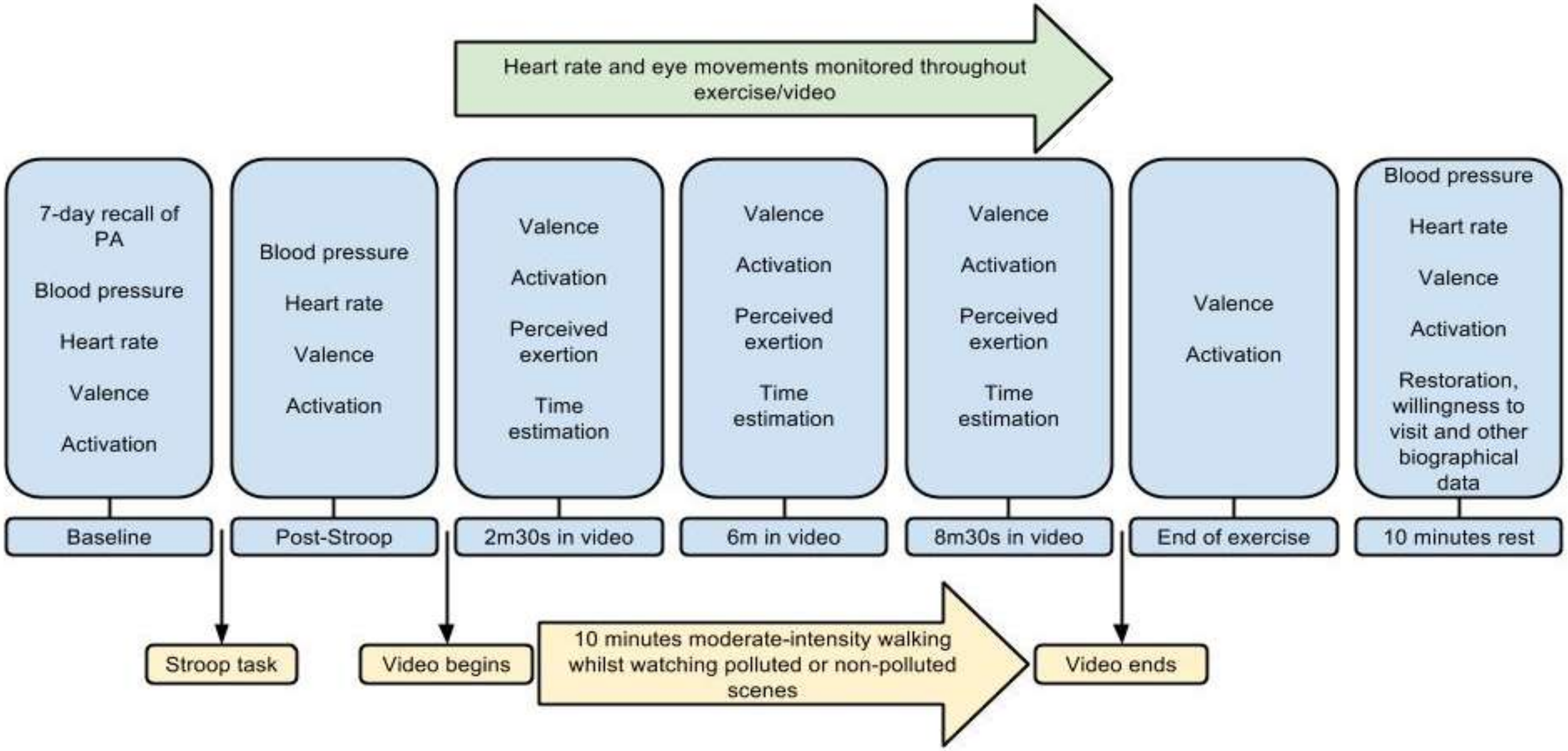


Figure 3.4 A diagram of the experimental procedure and measures taken at each timepoint.

3.2.6 Analysis strategy

3.2.6.1 Stroop manipulation

To test the effect of the Stroop task in manipulating a 'need for restoration' state, 2 (condition: littered, clean) by 2 (timepoint: baseline, post-Stroop) within-subjects ANOVAs were conducted for valence, activation, MABP and heart rate. Paired t-tests were used to confirm that post-Stroop scores on these variables did not differ between conditions.

3.2.6.2 Physiological outcomes

For analysis of MABP and heart rate, 2 (condition: littered, clean) by 2 (timepoint: post-Stroop, 10 minutes rest) repeated measures ANOVAs were conducted to test the hypotheses that exercise-induced reductions in MABP and heart rate would be more pronounced when exposed to clean scenes (i.e. there would be greater physiological recovery in the clean condition).

3.2.6.3 Psychological outcomes

For analysis of valence and activation, 2 (condition: littered, clean) by 6 (timepoint: post-Stroop, 2m30s in video, 6m in video, 8m30s in video, end of exercise, 10 minutes rest) repeated measures ANOVAs were conducted. Four planned interaction contrasts (post-Stroop to 2m30s in video; 2m30s to 6m in video; 6m to 8m30s in video; 8m30s in video to end of exercise) tested the hypothesis that exercise-induced, timepoint to timepoint increases in valence and decreases in activation would be more pronounced when exposed to clean scenes (i.e. participants would experience gradually more pleasant and less activated affective states in this condition). This proposed movement through the affect circumplex is consistent with findings in other simulation studies (White et al., 2015). One further planned interaction contrast (post-Stroop to 10 minutes rest) tested the hypothesis that the whole exercise session would elicit a greater decrease in activation and a greater increase in valence (i.e. greater recovery) when exposed to clean scenes. A main effect of timepoint was followed up with five simple contrasts (post-Stroop to 2m30s, 2m30s to 6m, 6m to 8m30s, 8m30s to end of exercise, post-Stroop to 10 minutes rest). Where sphericity could not be confirmed, the Greenhouse-Geisser adjustment was employed.

For analysis of RPE and time perception, 2 (condition: littered, clean) by 3 (timepoint: 2m30s in video, 6m in video, 8m30s in video) repeated measures ANOVAs were conducted. Two planned interaction contrasts tested the hypotheses that exercise-induced, timepoint to timepoint increases in RPE and estimates of elapsed time would be less pronounced when exposed to clean scenes (i.e. when exposed to clean scenes, perceived increases in exertion would be lower and time estimations would increase less steeply too). Where sphericity could not be confirmed, the Greenhouse-Geisser adjustment was employed.

3.2.6.4 Eye-tracking analysis

For all eye-tracking measures, participants were excluded from analysis if their studentised residual score for either eye-tracking measure exceeded the ±2 range; studentised residuals are recommended as more appropriate for detecting outliers than standardised residuals (Behnken & Draper, 1972; Davies & Mutton, 1975). If a participant's score was deemed an outlier in one condition, but not in the other, both were excluded so a balanced within-subjects comparison was maintained. Descriptive statistics and t-tests were employed to observe whether more attention was paid to the littered tideline. Pearson correlations investigated the relationship between the eye-tracking measures and the psychological outcome variables. Percentile bootstrapped indirect effects models were conducted to test the hypothesis that differences in visual attention mediated differences in post-exercise psychological outcomes. We adhered to the protocol for within-participant mediation analysis described by Montoya and Hayes (under review) and 5,000 bootstrap samples were used.

3.2.6.5 Perceived restorativeness and willingness to visit

As five items were used to assess perceived restorativeness (see section see section 3.2.4.6), Cronbach's alpha testing was employed to see if the items were related sufficiently ($\alpha \geq .7$). If not, Pearson correlations were interrogated to determine which items were and were not related. Those that were related were collapsed into a composite restorativeness measure and any others analysed separately correcting the alpha level accordingly. T-tests then tested the hypotheses that participants would perceive clean scenes as more restorative and that they would be more willing to visit them.

3.3 Results

In total, 34 participants were recruited. Two of these only participated in one session so a final sample of 32 participants (20 females, M age = 27) were included in analysis. Seventeen participants saw the clean video in their first session (this discrepancy in perfect counterbalancing was a result of the two participants who failed to return for second visits; both of whom were allocated to the littered video first). The study attracted a physically active sample with participants reporting doing on average 151 (SD=140) minutes of vigorous-intensity physical activity, and 317 (SD=263) minutes of moderate-intensity physical activity in the previous week. The large standard deviations suggest that some participants in the sample may have reported more PA than they actually undertake[j]. The sample additionally had a healthy average BMI of 23.07. With regards to beach visits in the last 12 months, the modal option was "once every two to three months" and the majority of participants (n=21) reported not having visited a beach in the last week. In both conditions, heart rate during exercise indicated that participants were exercising, on average, at just below moderate-intensity (littered M=103.75; clean M=105.28)[k]; this difference was not significant (p=.37).

3.3.1 Manipulation check and subsequent baseline differences

Administering the Stroop task successfully raised levels of activation from baseline (F(1, 31)=76.01, p<.001, η^2_p=.71), but caused no changes in valence (F(1, 31)=0.07, p=.80, η^2_p=.00) or MABP (F(1, 31)=0.29, p=.60, η^2_p=.01), and heart rate marginally decreased (F(1, 31)=2.97, p<.1, η^2_p=.09). Thus, the Stroop task had only successfully manipulated a 'need for restoration' in so far as it raised levels of activation. Nonetheless, we persisted with post-Stroop psychophysiological responses as new 'baseline' scores. T-tests confirmed there were no differences between littered and clean conditions for activation (*p*=1.00), valence (*p*=1.00), MABP (*p*=.24) or heart rate (*p*=.71), after the Stroop

[j] Indeed, the median number of minutes of vigorous PA in the last week was 123; the median number of minutes of moderate PA in the last week was 210, supporting this idea.
[k] Based on the principles for healthy adults that $HR_{max} = 208 - 0.7 \times age$ (Tanaka, Monahan & Seals, 2001) and that moderate-intensity PA corresponds with 55 to 69% of maximum heart rate (Murtagh et al., 2002). In our sample, the average age was 27, so moderate-intensity PA corresponded to 55 to 69% of 193 (220 – 27). This equates to 106.15bpm to 133.17bpm.

task. Means and standard deviations for all measures across all timepoints can be viewed in Table 3.1.

3.3.2 Mean arterial blood pressure

As expected, MABP decreased marginally from post-Stroop levels to 10 minutes rest post-exercise (F(1, 31)=4.08, p=.05, η^2_p=.12). There was no main effect of condition (F(1, 31)=0.58, p=.45, η^2_p=.02) suggesting that neither environment experienced higher MABP overall. The interaction between condition and timepoint demonstrated that MABP recovery was not significantly different when exposed to either littered or clean scenes (F(1, 31)=1.82, p=.19, η^2_p=.06). See Table 3.2 for results of all main effects, interactions and planned contrasts.

3.3.3 Heart rate

Overall, there was no reduction in heart rate from post-Stroop levels to 10 minutes rest post-exercise (F(1, 31)=1.42, p=.24, η^2_p=.04). There was also no main effect of condition (F(1, 31)=0.04, p=.85, η^2_p=.00) suggesting that neither environmental condition elicited higher heart rate responses overall. The interaction between timepoint and condition was also not significant (F(1, 30)=0.40, p=.53, η^2_p=.01) meaning that heart rate reductions were of a similar magnitude in both environmental conditions.

Table 3.1

Means and standard deviations (in italics) concerning physiological and psychological outcome variables for both conditions across all timepoints

	Littered							Clean						
	Base-line	Post-Stroop	2m30s in video	6m in video	8m30s in video	End of exercise	10 minutes rest	Base-line	Post-Stroop	2m30s in video	6m in video	8m30s in video	End of exercise	10 minutes rest
MABP	86.11 *9.70*	86.32 *11.29*	-	-	-	-	85.41 *8.64*	87.18 *7.68*	87.80 *11.17*	-	-	-	-	85.29 *7.89*
HR	71.09 *9.85*	70.72 *9.37*	103.03 *14.63*	105.00 *14.32*	106.94 *14.56*	104.44 *14.71*	69.13 *8.94*	72.53 *10.11*	69.94 *10.68*	104.03 *13.81*	106.69 *14.97*	105.28 *14.55*	107.50 *14.06*	69.28 *9.36*
Valence	2.41 *1.48*	2.38 *1.56*	2.53 *1.14*	2.41 *1.10*	2.34 *1.31*	2.47 *1.19*	2.63 *1.24*	2.44 *1.83*	2.37 *1.66*	2.63 *1.43*	2.56 *1.56*	2.59 *1.72*	2.72 *1.61*	2.88 *1.39*
Activation	2.50 *0.72*	3.38 *0.94*	3.00 *0.98*	2.72 *1.02*	2.66 *1.04*	2.78 *0.87*	2.50 *0.80*	2.44 *0.88*	3.38 *0.87*	2.91 *1.12*	2.81 *1.03*	2.84 *1.08*	2.91 *1.00*	2.37 *0.83*
RPE	-	-	11.25 *0.98*	11.47 *1.19*	11.72 *1.25*	-	-	-	-	11.16 *0.77*	11.28 *1.02*	11.28 *1.28*	-	-
Time perception	-	-	2m22s *49s*	5m31s *1m40s*	7m49s *2m12s*	-	-	-	-	2m14s *40s*	5m12s *1m7s*	7m7s *1m41s*	-	-

Table 3.2

Results of ANOVAs for psychophysiological outcome variables with planned contrasts.

	(df)	F	P	η^2_p
MABP				
Environment (E)	(1, 31)	0.58	0.45	0.02
Timepoint (T)	(1, 31)	4.08	0.05	0.12
E x T	(1, 31)	1.82	0.19	0.06
HR				
E	(1, 31)	0.04	0.85	0.00
T	(1, 31)	1.42	0.24	0.04
E x T	(1, 31)	0.40	0.53	0.01
Valence				
E	(1, 30)	0.84	0.37	0.03
T[a]	(5, 155)	1.64	0.20	0.05
E x T[a]	(5, 155)	0.52	0.67	0.02
Post-Stroop-2m30s x E	(1, 31)	0.18	0.68	0.01
2m30s-6m x E	(1, 31)	0.24	0.63	0.01
6m-8m30s x E	(1, 31)	0.52	0.48	0.02
8m30s-End of exercise x E	(1, 31)	0.00	1.00	0.00
Post-Stroop-10mins rest x E	(1, 31)	0.86	0.36	0.03
Activation				
E	(1, 31)	0.08	0.78	0.00
T[a]	(5, 155)	12.27	<0.001	0.29
E x T	(5, 155)	0.81	0.55	0.03
Post-Stroop-2m30s x E	(1, 31)	0.13	0.72	0.00
2m30s-6m x E	(1, 31)	1.21	0.28	0.04
6m-8m30s x E	(1, 31)	0.42	0.52	0.01
8m30s-End of exercise x E	(1, 31)	0.14	0.71	0.00
Post-Stroop-10mins rest x E	(1, 31)	0.27	0.61	0.01
RPE				
E	(1, 31)	2.72	0.11	0.08
T[a]	(2, 62)	2.83	0.09	0.08
E x T	(2, 62)	2.19	0.12	0.07
2m30s-6m x E	(1, 31)	0.25	0.62	0.01
6m-8m30s x E	(1, 31)	2.58	0.12	0.08
Time perception				
E	(1, 31)	4.59	0.04	0.13
T[a]	(2, 62)	367.43	<0.001	0.92
E x T[a]	(2, 62)	2.94	0.08	0.09
2m30s-6m x E	(1, 31)	0.73	0.40	0.02
6m-8m30s x E	(1, 31)	4.64	0.04	0.13

[a] Greenhouse-Geisser adjustment employed.

3.3.4 Affective valence

Overall, there were no significant differences for affective valence scores across timepoints (F(5, 155)=1.64, p=.20, η^2_p=.05 – Greenhouse-Geisser adjusted). However there was a marginally significant cubic trend across timepoints (F(1, 31)=3.88, p=.06, η^2_p=.11; see Figure 3.6) with valence increasing initially, decreasing after 2m30s in exercise and increasing again after 6m. Neither environmental condition elicited higher overall affective valence scores (F(1, 31)=0.84, p=.37, η^2_p=.03). There was also no interaction between condition and timepoint (F(5, 155)=0.52, p=.67, η^2_p=.02 – Greenhouse-Geisser adjusted) suggesting that the trajectory of affective valence changes were similar for both environmental conditions. Accordingly none of the planned interactions were significant (see Table 3.2). See Figure 3.6 for an illustration of affect circumplex trajectories in both environmental conditions.

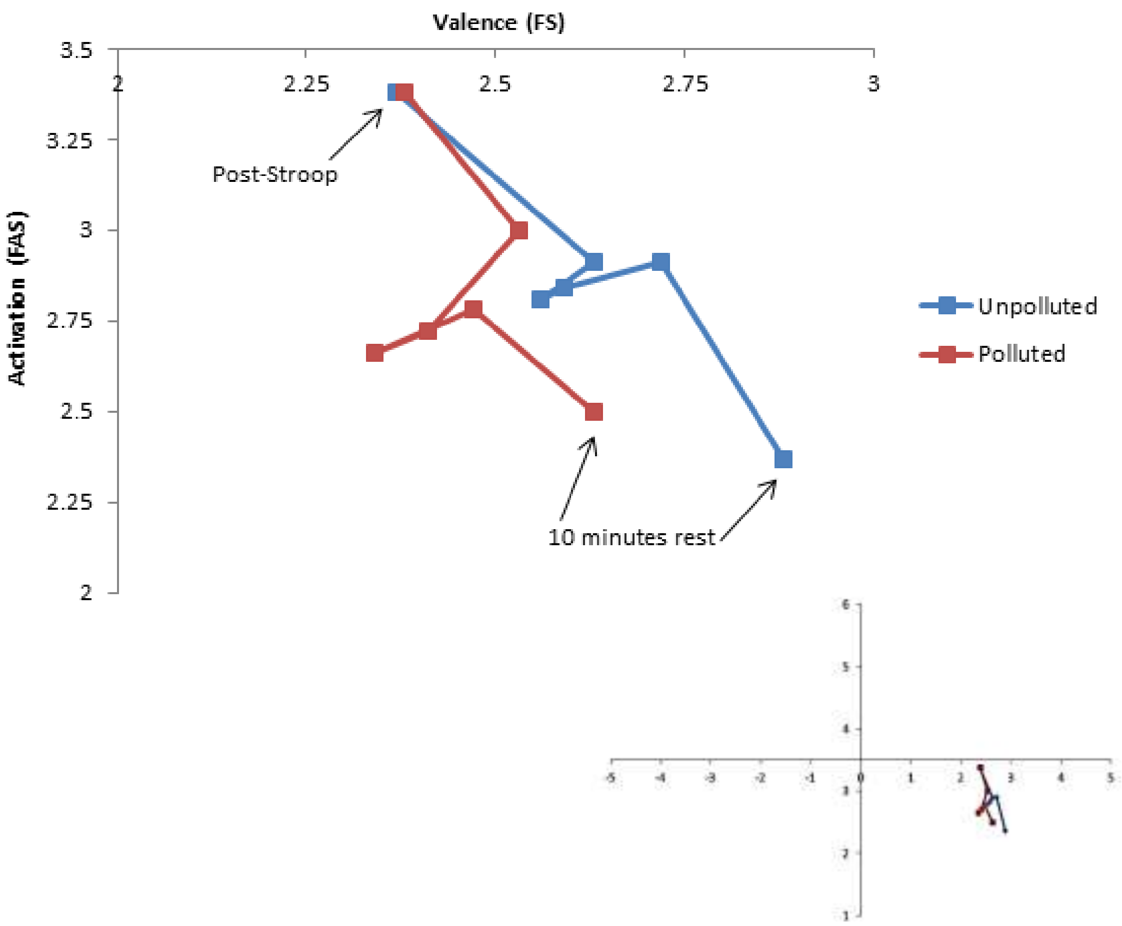


Figure 3.6 Changes in affective activation and valence from post-Stroop to 10 minutes rest post-exercise when exposed to littered and clean beach scenes (illustration in bottom right corner shows the patterns relative to the entire affect circumplex).

3.3.5 Affective activation

Overall, there was a significant main effect of timepoint ($F(5, 155)=12.27$, $p<.001$, $\eta^2_p=.29$ – Greenhouse-Geisser adjusted). Follow-up repeated contrasts revealed significant decreases in activation from post-Stroop levels to 2m30s ($F(1, 31)=9.27$, $p<.01$, $\eta^2_p=.23$), 2m30s to 6m ($F(1, 31)=4.73$, $p<.05$, $\eta^2_p=.13$), and from post-Stroop to 10 minutes rest ($F(1, 31)=50.18$, $p<.001$, $\eta^2_p=.62$; see Figure 3.6 for an illustration of these comparisons). There was also a significant cubic trend ($F(1, 31)=10.43$, $p<.01$, $\eta^2_p=.25$) with activation decreasing initially, increasing from 6m until the end of exercise and then decreasing afterwards.

Neither environmental condition elicited higher overall affective activation (F(1, 31)=0.08, p=.78, η^2_p=.00). There was also no interaction between condition and timepoint (F(5, 155)=0.81, p=.55 η^2_p=.03) suggesting that the trajectory of changes in affective activation were similar across environmental conditions. Accordingly, none of the planned interaction contrasts were significant.

3.3.6 Rates of perceived exertion

Overall, there was a marginal increase in perceived exertion across timepoints (F(2, 62)=2.83, p=.09, η^2_p=.08 – Greenhouse-Geisser adjusted). Neither environmental condition elicited significantly higher perceived exertion overall (F(1, 31)=2.72, p=.11, η^2_p=.08), and there was no interaction between condition and timepoint (F(2, 60)=2.19, p=.12, η^2_p=.07) indicating that the trajectory of changes in perceived exertion was similar across conditions. Accordingly, neither of the planned interaction contrasts proved significant.

3.3.7 Time perception

Obviously, there was a highly significant main effect of timepoint such that participants time estimations increased as the session progressed (F(2, 62)=367.43, p<.001, η^2_p=.92 – Greenhouse-Geisser adjusted). There was also a significant main effect of condition such that time estimations were consistently higher when viewing littered scenes (F(1, 30)=4.59, p<.05, η^2_p=.13). Furthermore, there was a marginally significant interaction between condition and timepoint (F(2, 62)=2.94, p<.1, η^2_p=.09 – Greenhouse-Geisser adjusted). Observing the planned interaction contrasts revealed that this was because from 6m to 8m30s in exercise, estimates of elapsed time grew more steeply when viewing the littered scenes compared to the clean scenes ($F(1, 31)=4.64$, $p<.05$, $\eta^2_p=.13$).

3.3.8 Eye-tracking

Eight participants had faulty eye-tracking data and were excluded from this analysis. Two participants’ eye movements failed to record for the entire ten minute duration, but we maintained their dwell time data on the assumption that proportions would not have changed considerably with the additional time. Outlier detection eliminated one further participant from analysis of dwell time, and a different participant for numbers of fixations. See Table 3.3 for descriptive statistics for the eye-tracking measures as well as correlations between the two measures and the four psychological outcome variables. Descriptive statistics reflected the hypothesis that more attention was paid to the littered tideline. Observing the standard deviations reveals that there was more variation in attention to the littered tideline than the clean tideline. The eye-tracking measures appeared to be uncorrelated with psychological outcomes.

Table 3.3

Means and standard deviations concerning the eye-tracking measures along with correlations with psychological outcome variables.

		Littered	Clean
Dwell time (%)	N	23	23
	Mean	9.56	6.79
	SD	5.82	5.55
	Valence at end of exercise	.01	.22
	Activation at end of exercise	.19	.34
	RPE at 8m30s	.25	-.05
	Time perception at 8m30s	.03	.22
Fixations (count)	N	21	21
	Mean	239.10	167.67
	SD	161.55	139.41
	Valence at end of exercise	-.01	.21
	Activation at end of exercise	-.13	.17
	RPE at 8m30s	.10	-.06
	Time perception at 8m30s	.04	.34

N.B All statistics exclude outliers. * Correlation is significant at the p<.05 level.

A paired t-test revealed that participants spent a significantly greater percentage of time dwelling on the littered tideline than the clean tideline (M_{diff}=2.78; $t(22)=2.13$, $p<.05$). Another t-test revealed that the littered tideline attracted marginally more fixations than the clean tideline (M_{diff}=71.43; $t(20)=1.76$, $p<.1$).

Results for indirect effects models can be seen in Table 3.4. Differences in neither dwell time nor numbers of fixations mediated any differences in post-exercise psychological outcomes. Some of the stronger effects reflected the hypothesis that when viewing the littered tideline, more attention is paid which in turn leads to worse psychological outcomes. For example, there were indications that differences in both dwell time (bootstrapped 95% CI -0.09, 0.39) and numbers of fixations (bootstrapped 95% CI -0.08, 0.38) were responsible for differences in time perception at 8m30s (i.e. more attention to littered tideline led to more perceived time elapsing). However, due to low sample sizes, it is difficult to definitively state these conclusions.

Table 3.4

Results of indirect effects models predicting differences in immediate post-exercise psychological outcomes from differences in eye movements. Effects are presented with percentile bootstrapped 95% confidence intervals in parentheses.

	Dwell time	Fixations
Valence at end of exercise	0.03 (-0.14, 0.26)	0.06 (-0.06, 0.34)
Activation at end of exercise	-0.08 (-0.38, 0.12)	-0.08 (-0.35, 0.08)
RPE at 8m30s	-0.04 (-0.25, 0.11)	-0.03 (-0.24, 0.12)
Time perception at 8m30s	0.12 (-0.09, 0.39)	0.11 (-0.08, 0.38)

N.B Clean scenes act as the comparator in all cases. Bootstrap confidence intervals were calculated using the percentile method and employed 5,000 bootstrap resamples.

3.3.9 Perceived restorativeness and willingness to visit

Collapsing PRS items across conditions, Cronbach's alpha testing revealed that the 5 PRS items were not strongly related (α=.65). Specifically, 'fascination' was uncorrelated with 'scope' (r=.18, *p*=.33), and 'coherence' was uncorrelated with all four other PRS items; such issues with the 'coherence' item have been noted elsewhere (Hartig et al., 1997). Accordingly, the other four items were collapsed into an average PRS score and compared across scenes with an alpha adjusted to .04. 'Coherence' was tested separately with an alpha of .01. Clean scenes were perceived as more restorative than littered scenes (M_{diff}=0.82, $t(31)$=4.19, p<.001). However, both scenes were perceived as equally 'coherent' (M_{diff}=0.34, $t(31)$=1.22, p=.23). Participants were also more willing to visit clean scenes in the future (M_{diff}=1.37, $t(31)$=4.53, p<.001).

3.3.10 Unplanned analysis

The order of conditions was counterbalanced to minimise the possibility of order effects. As a robustness check, we added the order in which participants underwent conditions as a between-subjects variable to the ANOVAs previously examined. A number of three-way interactions occurred indicating that the order in which participants underwent conditions significantly influenced the findings. For MABP, there was a significant three-way interaction (η^2_p=.21, 95% CI .03, .39[I]). Follow-up, Bonferroni-adjusted pairwise comparisons revealed that participants experienced significant decreases in MABP in the clean condition, but only when this was the first condition undertaken (M_{diff}=-4.38, p<.01). There was also a three-way interaction concerning heart rate (η^2_p=.13, 95% CI .00, .31). Follow-up, Bonferroni-adjusted pairwise comparisons revealed that, similarly to MABP, participants experienced marginal decreases in heart rate in the clean condition, but only when this was the first condition undertaken (M_{diff}=-3.12, p<.1).

For affective activation, a significant three-way interaction also existed (η^2_p=.12, 95% CI .03, .18). For this variable, the ANOVAs were ran for each order separately and the same planned interaction contrasts were observed (see section 3.2.6.3). From post-Stroop levels to 2m30s in exercise, there was a significant drop in affective activation, but only for the condition that was undertaken first (clean then littered: η^2_p=.26, 95% CI .02, .49; littered then clean: η^2_p=.35, 95% CI .04, .56). The overall reduction in affective activation (post-Stroop levels to 10 minutes rest post-exercise) was significant for participants viewing the clean condition, but only if they saw this condition first (η^2_p=.34, 95% CI .05, .55). However, the reverse order did produce a marginal effect (η^2_p=.19, 95% CI .00, .43) indicating that whatever condition the participant saw first elicited the greatest overall decreases in affective activation. There was also a three-way interaction regarding rates of perceived exertion (η^2_p=.10, 95%

[I] The 95% confidence intervals in section 3.3.10 refer to the confidence interval surrounding the effect size estimate; the script devised by Wuensch (2009) was used to create these confidence intervals. This reportage was preferred to reporting F tests due to the low sample sizes employed in this analysis.

CI .00, .21). Again, ANOVAs were re-run for both possible orders. From 6m to 8m30s in exercise, perceived exertion decreased while watching clean scenes and increased while watching littered scenes, but only if the clean scenes were viewed first (η^2_p=.31, 95% CI .04, .52). Taken together these results generally indicate that favourable psychophysiological responses were observed in the clean condition, but only if it was experienced first.

Following this, differences in attention measures between the two scenes were investigated to see whether they were moderated by the order of conditions. When littered scenes were seen second they attracted more dwell time (M_{diff}=3.62; p<.1) and more fixations (M_{diff}=105.82; p=.12) compared to when they were viewed first[m]. The data were further interrogated using conditional indirect effects models to test whether the mediations were moderated by the order of conditions[n]. However, this produced no significant results. The only result to approach significance indicated that dwell time on the littered tideline led to *higher* activation at the end of exercise, but only if this was viewed second (clean then littered: indirect effect=.16, bootstrapped 95% CI -0.05, 0.56; littered then clean: indirect effect=.08, bootstrapped 95% CI -0.11, 0.39).

3.4 Discussion

The aim of the present study was to investigate whether exposure to littered and clean natural environments during short-duration, moderate-intensity walking exercise resulted in different psychophysiological responses, and if so, whether this worked through differing visual attention to scenes. In general,

---

[m] When the order was reversed: Dwell time (M_{diff}=1.68; $t(9)$=0.70, p=.48); fixations (M_{diff}=33.60; $t(9)$=0.52, p=.61).

[n] Again, using percentile bootstrapping methods with 5000 resamples.

overall psychophysiological responses to the two environments did not differ significantly. The only significant effect suggested that perceptions of elapsed time grew more steeply towards the end of exercise when exposed to littered scenes. While more attention was paid to littered scenes than clean scenes, these differences did not mediate immediate post-exercise differences in psychological outcomes. Unplanned analysis revealed that the order of conditions significantly affected results. With the majority of outcome variables, favourable psychophysiological responses were experienced when viewing the clean scenes, but only if they were viewed first. Furthermore, there were greater differences in visual attention between the two scenes when littered scenes were viewed second. That is, the addition of litter to scenes provoked greater increases in visual attention than the deletion of litter provoked decreases.

3.4.1 Psychophysiological outcomes of exercise in littered and clean environments

There are a number of interpretations as to why this study failed to find differences in the affective outcomes of exercise in littered and clean environments. The first is that the null hypothesis is true. Pretty et al., (2005) found differences in the affective outcomes of simulated outdoor walking when participants walked in exposure to environments of differing pleasantness, but these differences were based on scores on a state-based measure of affect (the profile of mood states questionnaire). As deliberated in section 2.2.2, consensus within exercise psychology is that such measures do not capture the full range of affective states and domain-general measures are thus seen as more justifiable (Ekkekakis & Petruzzello, 2002). Domain-general measures of affect may simply be unaltered by the environmental conditions in which one exercises or the exercise may exert a much stronger influence on affect than the environment, thus 'washing-out' any differences. In this sense, our results are consistent with some previous research such as Martens, Gutscher & Bauer (2011) who found that walking in 'tended' versus 'wild' forests resulted in no differences in activation and arousal.

A second interpretation is the study was underpowered to find such effects. In the present study, an a priori power analysis was not deemed suitable as at the time of conducting the experiment there was a dearth of research examining minor environmental manipulations on similar measures of affect, and thus little evidence to power a sample size calculation upon. The findings presented herein consequently represent a piloting approach to the topic. To test whether the study was underpowered to find affective differences, an a posteriori power analysis was performed on the differences between valence and activation 10 minutes post-exercise. For valence, the power achieved was 0.21[o] and for activation the power achieved was 0.14[p]. These values demonstrate that the study was not sufficiently powered to find differences between valence and arousal at 10 minutes rest post-exercise. Using the effect sizes calculated, a replication of this study with power of 0.8 would require 180 participants to detect significant differences in valence and 309 to detect significant differences in activation at 10 minutes rest post-exercise (based on a two-tailed test). Such numbers would not have been achievable within the financial and temporal constraints of this study.

Activation tended to decrease throughout exercise in both conditions. It could be that the exercise was not of a sufficient intensity to bring about increases in

---

[o] Criteria: Two-tailed test, α=0.05, n=32. Clean M=2.88, SD=1.39. Littered M=2.63, SD=1.24. Correlation between groups was r=0.593. Resultant effect size dz=0.21.
[p] Criteria: Two-tailed test, α=0.05, n=32. Clean M=2.37, SD=0.83. Littered M=2.50, SD=0.80. Correlation between groups was r=0.530. Resultant effect size dz=0.16.

activation; indeed, on average, participants exercised at just under moderate-intensity (see section 3.3). Despite this, Ekkekakis et al., (2000) found that participants who self-selected a low-intensity walking pace still demonstrated increases in activation across a 10 minute walk. A different explanation then is that the natural stimuli brought about restorative effects which were characterised by decreases in activation. White et al., (2015) found similar decreases in scores on the FAS during cycling exercise whilst exposed to green and blue (coastal) environments.

Supporting research on flow in exercise (e.g. Jackson & Marsh, 1996), in both conditions, the perceived time which had elapsed was less than that which actually had. The present study extended these findings by showing that exercising while exposed to littered scenes led to higher estimations of elapsed time than exercise while exposed to clean scenes. This is important as it means that people undertaking informal PA in outdoor settings may be less likely to spend as much time doing so if the quality of the environment is poor. This could consequently lead to less energy expenditure and therefore fewer health benefits. Furthermore, White et al., (2015) found that exercising in a coastal environment led to lower perceived exercise time than a control group (whereas comparisons with green and urban environments did not). That significant differences in perceived exercise time were found when the quality of an environment is only subtly manipulated has potential implications for environmental conservation as well as public health. Future research may wish to explore the relationship between perceived exercise time and environmental quality.

3.4.2 The role of visual attention

Our principal hypotheses regarding visual attention to the two scenes were confirmed: despite controlling for area subtended in a scene, the littered tideline attracted marginally more fixations and significantly more dwell time. Thus, littered beaches can be said to afford more effortful viewing strategies. This extends the findings of Berto et al., (2008) by showing that even when controlling for the amount of stimuli in a scene, supposed restorative and less restorative scenes elicit different patterns of eye movements. Thus the restorative effects of exposure to littered coastal environments demonstrated in previous research (Wyles et al., 2015) could be said to have been confirmed using this objective measure of attention restoration.

There was no strong evidence that differences in eye movements across the two scenes mediated differences in immediate post-exercise psychological outcomes. Whilst a lack of statistical power may explain this result, it may also be the case that PA affects psychological outcomes and eye movements independently. High levels of PA drive visual attention towards exercise cues (Calitri, Lowe, Eves & Bennett, 2009) and previous research has shown that short sessions of PA affect dwell time towards appetitive visual stimuli (Van Rensburg, Taylor & Hodgson, 2009). Thus, it may be the exercise task (or the characteristics of the physically active sample) affecting eye movements rather than aspects of the image and this could explain the lack of a relationship between the scenes, eye movements, and psychological outcomes.

The proportion of time spent dwelling on either tideline was relatively low. This suggests that other areas of the scene captured attention. Moving stimuli often capture visual attention (Franconeri & Simons, 2003). As waves were the only aspect of the video in constant motion, attention to these may explain the lack of dwell time on the tideline. Future research could investigate whether attention to moving areas of natural scenes attracts more attention than stationary objects, and whether this contributes to the restoration of attention.

3.4.3 Order effects

The order in which participants underwent the two conditions influenced results considerably. There was a consistent pattern of results whereby if the clean video was seen first (and the littered video second), significant positive psychophysiological responses were observed in response to clean scenes. Better recovery from the psychosocial stressor in terms of MABP, heart rate and affective activation are testament to this. Perceived exertion during the exercise was also favourably affected such that perceived exertion decreased towards the end of exercise for participants viewing clean scenes in this order. This again could have implications for conservation. If a familiar environment becomes littered, people may not experience the same psychophysiological benefits from walking in it that they did when it was not littered. Conversely, when the order of conditions was reversed, the same psychophysiological benefit of exercise in clean environments was not observed, suggesting that if an environment’s quality is improved, it may not necessarily lead to better psychophysiological outcomes of a short walk there. Counterbalanced randomisation of conditions remains important for studies of this nature, but future studies should test for order effects in analysis.

The order of conditions also affected visual attention. Adding litter to the beach resulted in increases of 3.6% more dwell time and 106 more fixations. However removing litter from the beach only resulted in 1.7% less dwell time and 34 fewer fixations. This order effect could be explained by previous research on visual perception. When scenes depicted in photographs are similar, appearances of novel or new objects (Yantis, 1993; Yantis & Jonides, 1990; 1996), deletions of existing objects (Theeuwes, 1991), and objects of distinct colour or shape (Theeuwes, 1994) may all influence visual attention. However, the addition of new objects is the most influential in affecting visual attention (Karacan, Cagiltay, & Tekman, 2010). This could therefore be why such big differences in visual attention are seen when litter is added to the beach scene. This finding suggests that walking on littered beaches may therefore not allow directed attention to restore as much as walking on cleaner beaches. Moreover, when a beach or other natural environment becomes littered, it could have more substantial impacts on its ability to restore attention compared to when it is improved.

However, the order of conditions did not moderate the mediational processes hypothesised in section 3.1.1. As noted in section 3.4.2, this could well be due to a lack of statistical power or due to the idea that it is exercise rather than the scenes which are driving eye movements. However, this leaves open the question of why significant order effects were found regarding psychophysiological outcomes independent of eye movement analysis. People tend to underestimate the positive hedonic experience of exercise (Ruby, Dunn, Perrino, Gillis & Viel, 2011), so one explanation could be that when invited to participate, participants made affective judgements about how they would feel when exercising that were exceeded when undertaking the clean condition first (but not when undertaking the littered condition first). Familiarity with the beach environment could have meant that in the second session, when seeing clean scenes, a positive response was inhibited (i.e. the participants may have been more uninterested in the task).

3.4.4 Strengths and limitations

One strength of this study is that it advances the procedures needed for laboratory studies investigating the effects of environment on psychological outcomes of exercise. Consistent with contemporary research in exercise psychology (Ekkekakis & Petruzello, 2002), the present study utilised dimensional measures to assess affective outcomes as opposed to state-based measures whose usage have less sound rationales, but which are nonetheless more commonplace in analogous studies (Thompson-Coon et al., 2011). As well as bringing this field of study in line with exercise psychology, utilising dimensional measures in the future will allow researchers to assess the relative strength, and thus the importance, of the environment and the exercise task on affective outcomes independently.

We also sought to advance the field of study by investigating potential mediators of the relationship between exercise settings and affective outcomes. Variations in visual attention or attention restoration are two of many explanations as to why exercise in different environments could lead to difference affective outcomes, and future research should seek to explore the strength of others. The stimuli used in the present study were designed to have higher ecological validity than stimuli in previous studies examining exercise in different quality environments (Pretty et al., 2005). We recommend that future studies do the same, thus enhancing applicability to real-life settings and providing evidence which is more likely to be of interest to environmental conservation and public health.

This sample of participants self-reported high physical fitness and as a result did not exercise at moderate-intensity even when instructed to walk at a fast walking pace (see 3.3). This is another potential reason why the proposed differences in valence and activation were not found (see 3.4.1); participants may not have exercised at an intensity which is near enough to the ventilatory or lactate thresholds that are traditionally associated with increases in pleasure (Ekkekakis et al., 2011). Future research should therefore seek to replicate the study using less active populations. Indeed White et al., (2015) did demonstrate differences in valence and arousal between simulated outdoor exercise and a control group in a sample of postmenopausal women, who are more likely to be less active. More generally, exercise in exposure to natural environments could be more beneficial for clinical subgroups (Barton & Pretty, 2010) so how such populations respond to the stimuli used in the present study could be informative in terms of tailoring exercise referrals for these populations.

One of the primary aims of this study was to emulate previous research (e.g. Pretty et al., 2005) using different measures and more ecologically valid stimuli. Nevertheless, we recognise that the laboratory setting of the study limits external validity. Future research should investigate how the findings differ in controlled field studies. It could be that due to a broader sensory experience (e.g. unpleasant olfactory sensations from degradation) the findings are rendered significant in the predicted directions.

Future research employing eye-tracking methodology in this way should over-recruit to avoid loss of power when it comes to data analysis. A limitation of the present study was that many participants were lost when analysing eye movements due to equipment faults or a failure to accurately calibrate eye movements. Based on this data, future researchers could expect a 25% attrition rate when analysing eye movements. Due to the nature of the task, it is also conceivable that the eye-tracker was jogged during exercise rendering some participants observed eye movements invalid. Whilst every measure was taken to ensure against this (e.g. only the experimenter handled the equipment), it remains a possibility. Future research may also want to validate the use of this measure as a way of measuring directed attention restoration. For example, differences in eye movements across natural scenes could be associated with changes in performance on cognitive tasks such as the backward digit span test, the symbol modalities test or the Necker cube pattern control test; all of which have been used to explore directed attention restoration in exposure to nature previously (Berto, 2005).

3.4.5 Conclusions

In this physically active sample, psychophysiological outcomes of moderate-intensity, short-duration walking exercise were mostly unaffected by whether littered or clean beach scenes were displayed concurrently. However, clean scenes did facilitate psychophysiological improvements if they were presented first and there was some evidence that time moved slower in exposure to clean beach scenes. Therefore, when a familiar natural environment becomes littered with anthropogenic degradation, people may not have as rewarding an experience when walking there. Littered scenes afford more effortful viewing strategies, especially if viewed second, but these appear to be unrelated to psychological outcomes. Nonetheless, this suggests that littered natural environments may hinder their restorative potential. The results call for better integration of exercise psychology practice into so-called ‘green exercise’ studies and more exploration of mechanisms on why exercise in different environments may result in different psychological outcomes. The study suggests the need for more highly powered research into the topic. Replication with less active samples and outdoor settings are also needed and the eye-tracking method requires validation in future research.

4. Energy expenditure on recreational visits to different natural environments

4.1 Introduction

Cross-sectional research has generally demonstrated that there are consistent positive associations between neighbourhood green space and levels of PA (Calogiuri & Chroni, 2014; Lee & Maheswaran, 2011). One way this has been investigated is through examining access to natural environments and corresponding PA levels. Lachowycz and Jones (2014) found that people living in greener areas of England report more days per week of walking for at least 30 minutes. Conversely, residents from an English city demonstrated no relationship between living distance from a park and whether or not they did five or more sessions of walking or aerobic PA in the last week (Panter & Jones, 2008). As Hillsdon et al., (2006) note, inconsistency in such studies is rife and this may be because studies can often only account for the presence and proximity of greenspace, and not whether it is actually visited. However, some cross-sectional studies do address this omission. For example, Coombes et al., (2010) found a positive association between visiting greenspace at least once in the last week and the likelihood of achieving recommended PA guidelines. Nonetheless, from this type of evidence, it is still not possible to discern whether health-enhancing PA is performed in greenspace. This needs to be established if natural environments are to be considered public health resources as opposed to a preferred visit destination of more active people.

Studies now examine PA in situ using global positioning systems and are often conducted with children (e.g. Wheeler et al., 2010). However, one study observing parents-child pairs found that both the parent and child spent around 20% of their time jointly engaged in moderate-to-vigorous PA (MVPA; ≥3 METs for adults, ≥4 METs for children) in open spaces such as parks, gardens and beaches (Dunton et al., 2013). Additionally, in a sample of American adults, only 8.2% of all moderate and 9.4% of all vigorous activity took place in parks (Evenson, Wen, Hillier, & Cohen, 2013). Whilst the former study shows that diverse natural environments can promote MVPA, it cannot determine what environments are associated with what activities. The latter study shows modest associations, but only examines one type of environment (parks). Public health policymakers interested in environmental supports for PA may need to know which types of environment are most beneficial for supporting physical activity (Lee & Maheswaran, 2011) but the above literature is not able to inform on this. Furthermore, GPS studies have been criticised as being devoid of context e.g. by not accounting for the distance travelled to a destination or the mode of transport used (Chaix et al., 2013; see section 2.6.2).

Another way of investigating the relationship between contact with natural environments and PA attainment is by looking at national visitor surveys. White et al., (2014) used a near-representative sample of the English population to find that people living closest to the English coastline were the most likely to self-report achieving PA guidelines. There was a gradient such that the further away from the coast an individual lived, the less likely they were to self-report achieving PA guidelines. Further, this relationship was mediated by whether the respondent had made a visit to the coast in the past week. This suggests that coastal residents living nearer the coast may be directly using it for health-enhancing PA. Mitchell (2013) used a Scottish health survey to find that woodlands and forests were the most often used environment for health-enhancing PA; about 20% of respondents used such environments once a week for health-enhancing PA. Both of these studies suggest that more expansive environments are used more often for health-enhancing PA. However both of them are unable to account for the amount of PA conducted in different natural environments. That is, how intense the PA is, and how long it is conducted for.

4.1.1 Present study

The present study addresses limitations with the above literature using the Monitor of Engagement with the Natural Environment Survey (MENE; Natural England, 2015). This is a dataset concerning recreational visits to natural environments. Using this, it is possible to determine the type and quantity of PA conducted in different environments using estimates of energy cost (METs) and duration, the absence of which has formed an important limitation previously (Mitchell, 2013; White et al., 2014). The central research question for this study was what types of natural environment are associated with recreational visits involving higher intensity activities, longer visit durations, and higher energy expenditure? Considering relationships between greenspace and health are moderated by urbanity (Mitchell & Popham, 2007), a subsidiary question was how do the relationships between environments and energy expenditure differ between individuals from rural and urban areas? Lastly, other studies do not account for the distance travelled to natural environments (Chaix et al., 2013), and recent research has suggested that people situated nearest to the coastline directly use the coastline in order to achieve higher levels of PA (White et al, 2014). Therefore, the final research question was how does the relationship between environments and energy expenditure vary with the distance travelled to the destination?

4.2 Methodology

4.2.1 Sample

MENE is an ongoing survey using a cross-sectional, representative sample of English adults (aged 16 and over) that concerns recreational visits to natural environments (Natural England, 2015). Data is collected throughout the year via in-home interviews with a weekly quota sampling method and respondents report details concerning their visits to natural environments in the last week. All responses were recorded using a Computer Assisted Personal Interviewing (CAPI) device. Once respondents had provided brief details of all visits made in the last week, the CAPI device randomly selected one visit for the interviewer to ask more detailed questions about. The aim of random selection at the point of interview was to reduce potential biases such as recency effects for recall. The data used in the current paper concern this randomly selected visit. Individual-level variables such as self-reported PA, age and gender are also surveyed. Several inclusion criteria existed for this study (consult appendix A for details). Data from 2009-2014 were used and the overall sample size was 71,603.

4.2.2 Outcomes

4.2.2.1 Activity intensity

The first outcome variable was the intensity of the activity reported. Every respondent chooses an activity that they did on their visit from a predefined list.

MET rates were ascribed to each activity. One MET is equivalent to a standard resting metabolic rate (RMR) of 3.5ml O2 kg-1·min-1 (3.5 millilitres of oxygen consumption per kilogram of body weight of the individual per minute engaged in the activity). METs are then a ratio of the work metabolic rate to this standard RMR. MET scores were derived from the compendium of physical activities (Ainsworth et al., 2011) and have been used frequently in cross-sectional analyses of recreational PA (e.g. Yu et al., 2011). Where multiple activities in the compendium could relate to the activity in the survey, an average MET score was used. For example the activity ‘walking with a dog’ is 3.0 METs and derived from one activity in the compendium (walking the dog), whereas the activity ‘beach, sunbathing or paddling’ is 1.9 METs and averaged across two activities in the compendium (lying quietly, doing nothing; water walking, light effort, slow pace). Consult appendix B for details on how all MET rates were derived.

4.2.2.2 Duration of visit

The survey records the duration of all visits using the following question:

> *“How long did this visit last altogether –that is from the time you left to when you returned?”*

It is clear that respondents could interpret this question in different ways. Firstly, they could report, as asked, the duration of their entire visit including travel to and from their start point. It could be that the respondents only travelled one-way before moving elsewhere. However, we argue that most respondents interpreted this question as the amount of time spent in the natural environment, excluding all travel time. This is because in many cases, respondents’ reported travel distance and visit duration are incompatible (e.g. travelling 80-100 miles, but only reporting duration of an hour). Nevertheless, as different interpretations are possible, we separate the findings into different models: Model 1 assumes the respondents reported duration as intended, potentially including travel time. Model 2 subtracts an estimate of the duration spent travelling to and from the destination and omits respondents who report incompatible travel times and durations. Model 3 subtracts a one-way estimate of travel time, again omitting respondents with incompatible travel times and durations. Additionally, a model is presented whereby only respondents who walked to their destination within 5 miles of their start point, and who undertook walking (or walking with a dog) as their chosen activity, were included. As well as representing the most common visit, it would not be of concern that duration included travel time, as this also represents time being physically active. In this sense, it acts as a robustness check and is henceforth referred to as the “walkers only” model. For further details as to how these models were constructed, consult appendix C.

4.2.2.3 Energy expenditure

The final outcome variable concerned total energy expenditure. Following earlier work (e.g. Rind & Jones, 2011), MET minutes were calculated by multiplying the MET rate by the duration of the visit (using all models detailed above).

4.2.3 Predictors

4.2.3.1 Environment visited

Every respondent reports the environment that they visited. Respondents can select one of: In a town or city (hereafter referred to as urban greenspace; 47% of visits); in the countryside (countryside; 43% of visits); a seaside resort or town (seaside resort; 7% of visits); or other seaside coastline (other coast; 3% of visits). These were used as the environments in this study and urban greenspaces, where most visits were taken, represented the reference category.

4.2.3.2 Individual-level

For descriptions and reference categories pertaining to all other predictors, consult appendix D. Firstly, the possibility that more and less active people use environments differently for recreation was controlled for by examining self-reported PA. Previous research has shown that regular exercisers use indoor exercise settings more frequently than outdoor for PA (Hug, Hartig, Hansmann, Seeland & Hornung, 2009). Gender and age were adjusted for as women have been found to engage in less vigorous PA in parks than men (Cohen et al., 2007) and the relationship between recreational walking and greenspace quantity may be moderated by age (Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008). Socio-economic status (SES) was controlled for as low SES groups may be less likely to use beaches for recreational walking (Giles-Corti & Donovan, 2002). We additionally adjusted for work and marital status, ethnicity, and disability which have all been associated with the active use of parks (Bedimo-Rung, Mowen & Cohen, 2005).

4.2.3.3 Visit characteristics

The relationship between environments and the outcome variables could be explained by different types of visit so visit characteristics were also controlled for. Firstly, the presence of other adults, children and dogs on the visit were adjusted for. Greenspaces afford social activity (Coley, Sullivan, & Kuo, 1997; Kweon, Sullivan, & Wiley, 1998) and coastlines promote PA for families (Ashbullby, Pahl, Webley, & White 2013). Beaches in England can forbid dog-walking so urban greenspaces and countryside may better support this activity and thus cause differences in METs.

Whether the visit was taken on a weekend or weekday was also controlled for as certain leisure opportunities may be more feasible at weekends (e.g. coastal watersports); and thus be responsible for different levels of energy expenditure in separate environments. Respondents who made just one visit in the past week were compared with those who reported multiple visits. Frequent greenspace users have been found to be more active (Coombes et al., 2010), therefore frequent visitors may have used certain environments for activities of higher METs.

The start point of the visit was also adjusted for as visits starting from, for example, holiday accommodation, may have distinct characteristics (e.g. long durations) which could moderate the relationship between different environments and the outcome variables. The distance travelled to the destination was also controlled for. A higher proportion of people may have to travel longer distances to reach environments such as the coastline, so the distance travelled may moderate any relationships between environments and duration or energy expenditure. The travel mode used for the visit was also accounted for as ownership and use of a car may foster better access to some activities (e.g. watersports). Seasonality was adjusted for as individuals may favour certain environments in some seasons as opposed to others (Badland, Christian, Giles-Corti, & Knuiman, 2011). Lastly, the year of the survey was controlled for to examine annual differences in the outcome variables.

4.2.4 Analysis strategy

A series of regression models were constructed. In each model the first step included only the visited environment. In the second step, the self-reported PA variable was entered. The third step added the remaining individual-level variables and the final step included visit characteristics. The results are presented using each model listed in section 4.2.2.2. Any resultant systematic differences between the environments and the outcome variables can then be examined. As a sensitivity analysis, we excluded dog-walking visits as research has found that features such as the presence of dog fouling receptacles and perceived safety, affect the likelihood of dog-walking (Cutt, Giles-Corti, Knuiman, & Burke, 2007). These features may be more abundant in certain environments. The energy expenditure model was stratified both by urbanity/rurality of residence and then by travel distance (see section 4.1.1). This dichotomy is defined in line with the 2001 Office for National Statistics classification where urban areas comprise urbanised settlements only, and rural areas comprise villages, town and fringe settlements, and hamlets or isolated dwellings.

4.3 Results

4.3.1 Descriptive statistics

Frequencies of respondents undertaking different activities are displayed in Table 4.1.

Table 4.1

Frequency and proportion of respondents undertaking different visit activities.

Activity (MET rate of activity)	N	%
Eating or Drinking Out (1.75)	2761	3.9
Fieldsports (6.39)	390	0.5
Fishing (3.50)	512	0.7
Horse Riding (5.50)	473	0.7
Off Road Cycling or Mountain Biking (8.50)	699	1.0
Off Road Driving or Motorcycling (4.00)	118	0.2
Picnicking (1.75)	602	0.8
Playing with Children (3.58)	6542	9.1
Road Cycling (7.50)	1520	2.1
Running (7.00)	2092	2.9
Appreciating Scenery from a Car (1.30)	492	0.7
Swimming Outdoors (6.00)	213	0.3
Beach, Sunbathing Or Paddling (1.90)	696	1.0
Visiting An Attraction (3.50)	2093	2.9
Walking Without a Dog (3.50)	25791	36.0
Walking With a Dog (3.00)	23094	32.3
Watersports (5.78)	310	0.4
Wildlife Watching (2.50)	510	0.7
Informal Games and Sport (e.g. frisbee or golf) (4.43)	2695	3.8

This shows that nearly 70% of respondents undertook some form of walking on their visit. The most popular vigorous-intensity activity (>6 METs) was running, accounting for nearly 3% of visits and the most popular light intensity activity (<3 METs) was eating or drinking out, accounting for nearly 4% of all visits.

Table 4.2 displays descriptive statistics on how the three outcome variables differ by visit location. For all of the first three models, activities undertaken in coastal environments are lower in METs. However, coastal visits are longer in duration and consequently incur more expended MET minutes than visits to countryside or urban greenspaces.

Table 4.2

Means and standard deviations (in parentheses) of the three outcome variables by visit location and model.

Model	Visit location	Activity intensity (METs)	Duration (minutes)	Energy expenditure (MET minutes)
Model 1 (n=71,603)	Urban green spaces	3.54 (1.16)	109.87 (91.35)	382.54 (349.64)
	Seaside resort	3.33 (1.10)	162.17 (123.50)	527.02 (446.34)
	Other coast	3.43 (1.18)	147.63 (115.01)	506.19 (461.66)
	Countryside	3.59 (1.20)	121.91 (103.17)	450.22 (444.62)
Model 2 (n=56,568)	Urban green spaces	3.52 (1.14)	96.62 (87.65)	333.53 (330.49)
	Seaside resort	3.31 (1.08)	130.91 (103.79)	423.56 (375.00)
	Other coast	3.40 (1.17)	122.39 (101.01)	417.84 (404.34)
	Countryside	3.59 (1.18)	106.27 (96.64)	391.68 (405.27)
Model 3 (n=66,153)	Urban green spaces	3.52 (1.14)	98.88 (88.98)	342.24 (336.21)
	Seaside resort	3.32 (1.07)	140.37 (112.24)	454.41 (403.22)
	Other coast	3.41 (1.16)	127.17 (107.19)	434.56 (426.06)
	Countryside	3.58 (1.18)	106.99 (99.14)	394.11 (416.64)
Walkers only (n=33,408)[a]	Urban green spaces	3.27 (0.25)	73.32 (56.76)	242.91 (195.19)
	Seaside resort	3.28 (0.25)	88.22 (66.80)	293.88 (231.63)
	Other coast	3.26 (0.25)	91.58 (65.41)	302.82 (228.53)
	Countryside	3.19 (0.24)	72.50 (51.52)	234.41 (175.14)

[a] small standard deviations and mean differences are a result of restricting this model to two activities (walking and walking with a dog) with a MET range of 3 to 3.5.

[n.b] Model 1 includes the whole sample and assumes respondents report visit durations as intended. Model 2 subtracts a one-way, and model 3 a two-way, estimate of travel time. The "walkers only" model includes only respondents who walked to their destination, within 5 miles and undertook walking (with or without a dog) on their visit.

4.3.2 Transformations

Distributions of all outcome variables were positively skewed. Whilst transformations did not improve model fit for METs and duration, log-transforming MET minutes did result in better model fit, so this transformation was used in the analysis.

4.3.3 Model fit

Table 4.3 displays results for all model permutations; consult appendices E to H for complete models. Dependent on model, 0.3-2.4% of the variance in METs was explained by visited environment alone compared to 31.3-35.4% when controlling for all predictors. For visit duration, 0.6-2% of the variance was explained by visited environment alone compared to 10.4-36.1% in fully-adjusted models. Lastly, 0.7-1.2% of the variance in log-transformed MET minutes was explained by visited environment alone, compared to 12.5-32.7% in fully-adjusted models. In all models and for all outcomes, visit characteristics explained substantially more variance than other predictors.

4.3.4 Intensity, duration and energy expenditure in different environments

4.3.4.1 METs

For model 1, unadjusted coefficients revealed that visits to the countryside were associated with higher METs than visits to urban greenspaces whereas visits to the two coastal categories were associated with lower METs. These differences remained after adjustments: countryside visits (*b*=.04, 95% CI .03, .06); seaside resorts (*b*=-.17, 95% CI -.20, -.14); other coastline (*b*=-.09, 95% CI -.13, -.05). Being male, younger, of higher SES, in education, unmarried, of black or minority ethnicity, and without a disability were associated with higher METs. Also, being with children or other adults on the visit; not being with a dog on the visit; visiting on weekdays; travelling 6-20 miles to the destination; travelling by bicycle; and visiting in summer were associated with higher METs.

Table 4.3

Regression coefficients and 95% confidence intervals for each of the outcome variables by the type of environment visited.

		METs			Duration			Log-transformed MET minutes		
Model		*b*	LB	UB	*b*	LB	UB	*b*	LB	UB
Model 1	*Unadjusted*									
	Constant	3.54	3.53	3.55	109.87	108.80	110.94	2.44	2.44	2.44
	Visit location (urban green spaces=ref)									
	Countryside	0.05***	0.03	0.07	12.04***	10.49	13.58	0.05***	0.04	0.06
	Seaside resort	-0.21***	-0.24	-0.17	52.30***	49.34	55.26	0.14***	0.13	0.15
	Other coast	-0.11***	-0.16	-0.06	37.76***	33.50	42.03	0.12***	0.11	0.14
	R^2	0.003			0.020			0.012		
	Fully-adjusted [a]									
	Constant	2.61	2.54	2.68	92.14	86.29	97.98	2.29	2.27	2.31
	Visit location (urban green spaces=ref)									
	Countryside	0.04***	0.03	0.06	3.39***	2.05	4.74	0.02***	0.02	0.03
	Seaside resort	-0.17***	-0.20	-0.14	14.87***	12.41	17.34	0.03***	0.02	0.04
	Other coast	-0.09***	-0.13	-0.05	9.80***	6.31	13.30	0.03***	0.02	0.05
	R^2	0.320			0.361			0.327		
	N=71,603									
Model 2	*Fully-adjusted* [a]									
	Constant	2.78	2.70	2.86	84.29	77.71	90.87	2.23	2.20	2.26
	Visit location (urban green spaces=ref)									
	Countryside	0.07***	0.06	0.09	1.68*	0.16	3.20	0.02***	0.01	0.02
	Seaside resort	-0.17***	-0.20	-0.14	7.57***	4.88	10.26	0.02**	0.01	0.03
	Other coast	-0.09***	-0.14	-0.04	4.20*	0.36	8.03	0.03**	0.01	0.05
	R^2	0.313			0.273			0.276		
	N=56,568									
Model 3	*Fully-adjusted* [a]									
	Constant	2.75	2.68	2.82	99.42	32.36	93.40	2.35	2.32	2.37

	Visit location (urban green spaces=ref)									
	Countryside	0.05***	0.04	0.07	1.30$^{n.s}$	-0.09	2.69	0.01**	0.00	0.02
	Seaside resort	-0.17***	-0.20	-0.14	10.94***	8.43	13.45	0.03***	0.02	0.04
	Other coast	-0.08***	-0.13	-0.04	5.56**	2.01	9.10	0.02**	0.01	0.04
	R^2	0.332			0.321			0.301		
	N=66,153									
Walkers Only	*Fully-adjusted* [a]									
	Constant	2.98	2.96	3.00	60.11	54.52	65.71	2.18	2.15	2.21
	Visit location (urban green spaces=ref)									
	Countryside	-0.04***	-0.04	-0.03	0.95$^{n.s}$	-0.29	2.19	0.01***	0.01	0.02
	Seaside resort	0.01*	0.00	0.02	10.66***	8.02	13.30	0.07***	0.05	0.08
	Other coast	-0.00$^{n.s}$	-0.02	0.01	15.06***	11.30	18.81	0.10***	0.07	0.12
	R^2	0.354			0.104			0.125		
	N=33,408									

[a] Adjusted for a) data on physical activity in the last week, b) individual-level data on gender, age, socio-economic status, work status, marital status, ethnicity and disability and; c) visit-level data on the presence of children, adults, and dogs on visits; day of the week; visit frequency in the last week; visit start point, season of visit and survey year. ^{LB} Lower-bound; ^{UB} Upper-bound; *** p<.001; ** p<.01; * p<.05; $^{n.s}$ not significant.

None of the associations between environments and METs changed using models 2 or 3. In the “walkers only” model, adjusted results revealed that visits to the countryside were associated with lower METs than visits to urban greenspaces (*b*=-.03, 95% CI -.04, -.03) and visits to seaside resorts with higher METs (*b*=.01, 95% CI .00, .02). However, as this model was restricted to respondents undertaking walking or walking with a dog, this reflects the fact that countryside environments were more often used for dog-walking than seaside resorts and urban greenspaces (dog-walking is lower in METs than walking without a dog).

4.3.4.2 Duration

Using model 1, visits to seaside resorts, other coast, and the countryside were associated with longer durations than visits to urban greenspaces. These differences remained after adjustments: countryside visits (*b*=3.39, 95% CI 2.05, 4.74); seaside resort visits (*b*=14.87, 95% CI 12.41, 17.34); other coastline visits (*b*=9.80, 95% CI 6.31, 13.30). Being male, younger, of lower SES, in education, unmarried, of black or minority ethnicity, without a disability, and reporting meeting PA guidelines were associated with longer visit durations. Additionally, being with children or other adults on the visit; not having a dog on the visit; visiting at weekends; only making one leisure visit to a natural environment in the past week; beginning the visit from holiday accommodation; travelling over 20 miles to the destination; travelling by public transport; and visiting in summer were associated with longer visit durations.

No associations between environments and visit duration changed systematically using model 2. Using model 3 and the “walkers only” model, after adjustments, visits to the countryside were not significantly longer than visits to urban greenspaces (model 3; *b*=1.30, 95% CI -0.09, 2.69; walkers only; *b*=0.95, 95% CI -0.29, 2.19), although visits to the two coastal categories remained significantly longer.

4.3.4.3 MET minutes

In model 1, unadjusted coefficients revealed that visits to seaside resorts, other coast, and the countryside were associated with more MET minutes than visits to urban greenspaces. These associations remained after adjustments: countryside visits (*b*=.02, 95% CI .02, .03); seaside resorts (*b*=.03, 95% CI .02, .04); other coastline (*b*=.03, 95% CI .02, .05). These associations along with subsequent stratifications are displayed in Figure 4.1. Reporting meeting PA guidelines; being male; younger; in education; unmarried; of black or minority ethnicity; and without a disability were associated with more MET minutes. Having children or other adults on the visit; not having a dog on the visit; visiting at the weekend; only visiting a natural environment once in the past week; beginning the visit from holiday accommodation; travelling more than 20 miles; travelling by bicycle; and visiting in summer were also associated with more MET minutes.

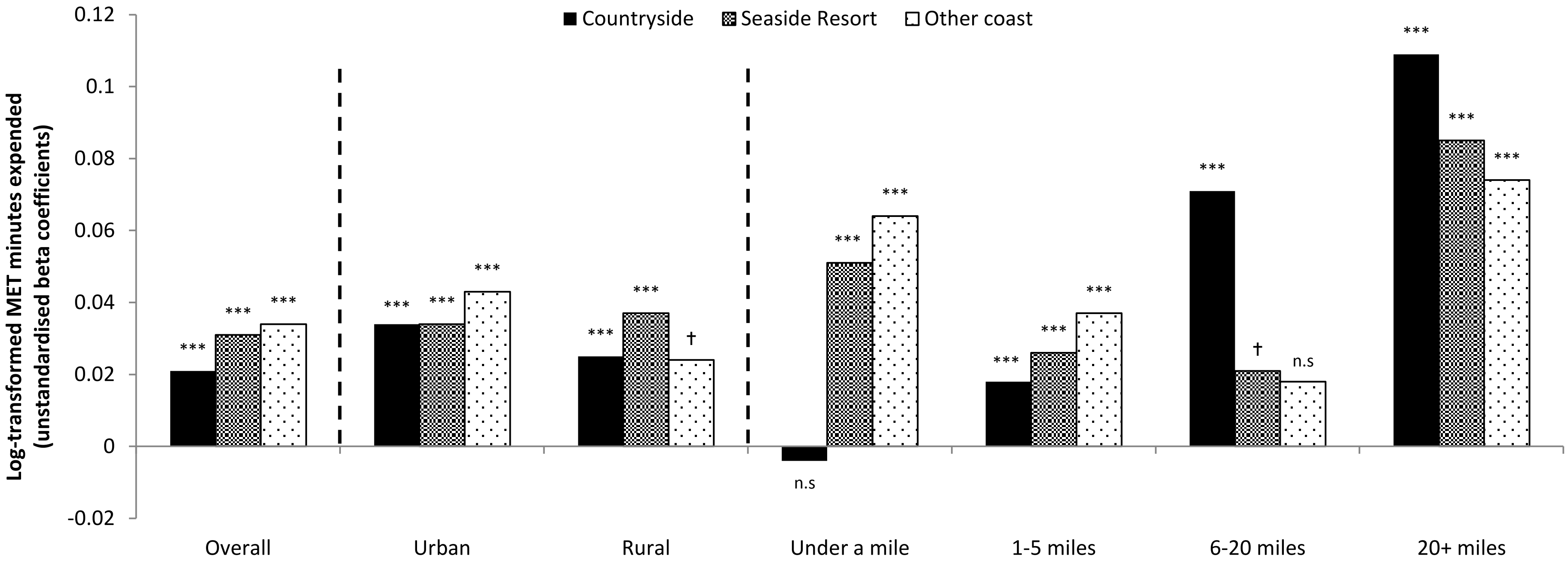


Figure 4.1 Overall and stratified effects of visited environment on total MET minutes expended (model 1).

Overall n=71,603; urban n=54,613; rural n=15,392; under a mile n=27,458; 1-5 miles n=29,516; 6-20 miles n=9,733; 20+ miles n=4,896. Adjusted for a) data on physical activity in the last week, b) individual-level data on gender, age, socio-economic status, work status, marital status, ethnicity and disability and; c) visit-level data on the presence of children, adults, and dogs on visits; day of the week; visit frequency in the last week; visit start point, season of visit and survey year.

*** comparison to the reference category (urban greenspaces) is significant at the $p<.001$ level.
† comparison to the reference category (urban greenspaces) significant at the $p<.1$ level.
n.s comparison to the reference category (urban greenspaces) is non-significant.

The relationships between environments and MET minutes did not change using model 2. In model 3, although all environments were still associated with more MET minutes than urban greenspaces, the order was different with seaside resorts averaging the most, followed by other coast, and then the countryside. The “walkers only” model displayed the same pattern as model 1, though differences between environments were greater. As associations did not change substantially as a function of the model used, and as we deem respondents to have actually reported the duration of time in the natural environment (rather than including travel time) the remainder of the analysis is conducted using model 1.

4.3.4.4 Sensitivity analysis

Model 1 regressions were repeated excluding dog-walking visits (32.3% of visits; see 2.4). Excluding these resulted in higher METs and longer durations in all environments but associations did not change systematically. The order in which environments were associated with MET minutes, however, did change. Countryside visits were now associated with the most (b=.05, 95% CI .04, .06), followed by other coastline (*b*=.04, 95% CI .02, .05) and seaside resorts (*b*=.03, 95% CI .02, .04), suggesting that more dog-walking visits took place in the countryside. However, as significance did not substantially change after exclusion, dog-walking visits were retained in all further analysis.

4.3.5 Are the relationships between environments and MET minutes moderated by urbanity?

For stratified regression results, consult appendices I and J. Urban inhabitants expended most MET minutes in other coastline environments (*b*=.04, 95% CI

.03, .06), followed by seaside resorts (*b*=.03, 95% CI .02, .05), and the countryside (*b*=.03, 95% CI .03, .04). Rural inhabitants expended the most MET minutes in seaside resorts (*b*=.04, 95% CI .02, .06), followed by the countryside (*b*=.02, 95% CI .01, .04), and other coastline (*b*=.02, 95% CI -.00, .05) which in turn were only associated with marginally more than urban greenspaces. Concisely, whilst urban greenspaces were still associated with less energy expenditure than visits to other environments, urban inhabitants expended the most energy at other coastline environments and rural inhabitants at seaside resorts.

4.3.6 Are the relationships between environments and MET minutes moderated by travel distance?

Respondents who travelled under a mile to their destination expended more MET minutes in seaside resorts (*b*=.05, 95% CI .03, .07) and other coastline (*b*=.06, 95% CI .04, .09) but not in the countryside (*b*=-.00, 95% CI -.01, .01) compared to urban greenspaces. Respondents travelling 1-5 miles displayed the same pattern as the original regression whilst those who travelled 6-20 miles only expended significantly more MET minutes in the countryside (*b*=.07, 95% CI .06, .09) compared to urban greenspaces. Lastly, respondents travelling over 20 miles expended more MET minutes in all environments compared to urban greenspaces, but the order is the reverse of the original regression. In sum, respondents situated within a mile of the coastline expended more energy in these environments, and respondents travelling farther distances expended more energy in the countryside.

4.4 Discussion

This is the first study to illustrate how the English population expend energy in diverse natural environments through recreation, as well as how long and short-distance travellers, and urban and rural dwellers do so differently. Countryside and urban greenspace visits were associated with more intense activities than coastal visits. However, longer durations of coastal visits meant that these were associated with the most energy expenditure. Moreover, these relationships persisted using multiple model permutations which accounted for potentially different reportage of visit durations. Urban and rural inhabitants demonstrated higher energy expenditure in all environments compared to urban greenspaces, though the order and significance of these comparisons differed. Coasts were used for more MET minutes by locals than urban greenspaces and countryside were. However people travelling over 6 miles expended more energy in the countryside than in the other three environments.

4.4.1 Affordances of outdoor activity

Different natural environments promote different types of recreational visit, and can thus impact on the health benefit of such visits. Environments offer ‘affordances’ that elicit behaviour (J. J. Gibson, 1979) i.e. environments (and the features of them) offer the possibility of an action. Whilst these exist in reality they better reflect the range of actions that the perceiver is aware of, rather than all possible actions (Heft, 2010). The findings suggest coasts are associated with visits incurring the most energy expenditure, and this appears to be driven by longer durations. Coasts could therefore be said to ‘afford’ longer bouts of lower-intensity PA resulting in higher overall energy expenditure. In Heft’s (2010) view this could mean that there are fewer barriers to (or more opportunities for) longer visits when individuals visit the coast. This could be due to the variety of recreational opportunities in coastal environments (Wyles, Pahl, & Thompson, 2014).

Nevertheless, individuals who visited countryside or urban greenspace environments were more inclined to do more intense activities. This may be because opportunities for more intense activity are better afforded by these areas. Running may be more suited to countryside and urban greenspaces where circular routes are more easily defined than they would be at the coast for example. The more intense activities possible in coastal locations (swimming and watersports) only attracted 0.7% of the sample (Table 4.1) perhaps because there are more barriers to these activities e.g. higher fitness or greater expertise. Again this supports the notion that whilst affordances are tangible (e.g. the sea affords swimming), they also reflect individual perceptions (e.g. more people perceive barriers towards watersports; fewer people perceive barriers to running in greenspaces).

Knowledge of which environments afford health-enhancing PA can aid tailored exercise promotion with consequent implications for public health. For example people who enjoy running could be advised to visit green environments where this may be better facilitated. If an individual prefers lower intensity activity, a coastal visit could be encouraged, where, because longer visit durations are probable, they may be more likely to expend additional energy. Clearly, cognitive antecedents of environment and activity choice need to be better understood in order to facilitate such interventions. Nevertheless, distinguishing environmental affordances makes these recommendations at least feasible, where previous research dichotomising urban and natural spaces could not (Lee & Maheswaran, 2011).

4.4.2 Urban and rural distinctions

Rural inhabitants expended more energy on visits than urban residents, but the differences between environments were more modest. Previous research has demonstrated that proximity to accessible greenspaces may be most important for urban populations in terms of self-reported health (Maas, Verheij, Groenewegen, De Vries, & Spreeuwenberg, 2006, Mitchell & Popham, 2007). As such, rural inhabitants may display similar energy expenditure in different environments because proximity to them is less important. Indeed, in a previous study, rural inhabitants were more willing to travel further to recreational facilities (Solomon, Rees, Ukoumunne, Metcalf & Hillsdon, 2013).

4.4.3 Travel distance

Coastal visits were associated with more energy expenditure than urban greenspace and countryside visits, but this relationship was most prominent in local visitors (people travelling less than a mile). This could explain why previous research has found English coastal residents to be more active (White et al., 2014) and report higher self-reported health (Wheeler, White, Stahl-Timmins & Depledge, 2012). People travelling farthest tended to expend more energy in countryside environments. Again this may be because coasts better afford long bouts of low-intensity activity (e.g. sunbathing) for long-distance travellers, whereas the countryside affords long bouts of at least moderate-intensity activity (e.g. hill-walking) for long-distance travellers. This finding may further reflect a distance decay effect, well recognised in tourism geography (McKercher, 2008), whereby the proportion of people who perceive a particular activity affordance associated with an environment declines with increasing travel distance to that environment.

4.4.4 The relative importance of the environment to energy expenditure

An estimation of the relative importance of the visited environment in predicting energy expenditure can be derived from comparing coefficients with those for other factors such as season, SES and gender. Taking Model 1 (appendix E) we can see that, compared to urban greenspaces, the coefficients for log-transformed MET minutes of countryside (0.02), seaside resorts (0.03) and other coast (0.03) appear relatively small (though these are all based on log-transformations). Nevertheless they are comparable to the effects of season (e.g. autumn vs. winter = 0.03), larger than SES (e.g. DE vs. AB = 0.01) and only a little smaller than gender (female vs. male = -0.05). In other words, the environment seems to play just as important a role in influencing energy expenditure as socio-demographic and seasonal variables.

4.4.5 Limitations and future research

The main strength of this research is that it utilised a large sample to highlight how visits to different natural environments can be more or less health-enhancing. Future GPS research could investigate how different natural environments afford different PA intensities. Furthermore, the health benefits of urban greenspace visits, which were visited most often by this sample (see 4.2.3.1), could be clarified by establishing estimates of how much energy is expended on urban or indoor leisure visits. On a smaller scale, previous research has already demonstrated that people complete more steps per minute, and more 10 minutes bouts of moderate-to-vigorous intensity PA, in urban green spaces compared to urban centres (Sellers, Grant, Ryan, O'Kane, Raw & Conn, 2012).

Also, the shorter length of urban greenspace visits may not be a negative in terms of overall energy expenditure, as visitors may substitute other time with health-enhancing activity elsewhere such as in gyms. Additionally, our analysis is unable to account for any effects of 'moral self-licensing' (Merritt, Effron & Monin, 2010) where for instance, because an individual has engaged in a longer walk (something 'good'), they feel able to 'treat themselves' to a bigger piece of cake (something 'bad') resulting in overall energy intake which may be greater than that expended (e.g. Dolan & Galizzi, 2015). Further work is thus needed to focus on more extensive observations of specific visits to see whether certain types of visit are more likely to result in such 'moral self-licensing' than others, with implications for public health interventions.

This research is cross-sectional and thus subject to a number of limitations. For example, it implies that coastal locals use coasts in more health-enhancing ways than other environments. However, this research is unable to establish whether moving residence to coasts results in more active use of them, or whether more active people move there to seek PA opportunities. Although longitudinal designs for similar studies have been developed using panel data (e.g. White, Alcock et al., 2013a, 2013b), there is currently no comparable data on contact with natural environments so at present these limitations are difficult to address.

Furthermore, METs are a standardised unit of energy expenditure and subject to criticisms of generalizability. Energy expenditure involved in PA is dependent on factors such as body mass and terrain (Ainsworth et al., 2000). For example, walking on softer substratum like sand substantially affects energetic costs (Lejeune, Willems, & Heglund, 1998). Also, two activities in the study involve energy intake (eating or drinking out; picnicking) which cannot be accounted for. Despite this, measuring energy expenditure objectively with accelerometry may not be feasible on a similar scale (Trost et al., 2005). Additionally, despite establishing the robustness of our results using different model permutations, it is not possible to determine precisely how long an individual was in an environment doing a particular activity; this is a priority for future research.

Lastly, despite the potential for health-enhancing PA opportunities in more expansive environments, access to these areas is impractical for some of the population and therefore research is needed to isolate features of environments that promote behaviour such as longer visit durations. Knowledge of these could in turn inform urban park and trail design, for instance, to encourage urban areas to be used for longer bouts of activity. These need not be physical features as previous research has shown auditory water stimuli in urban areas is appreciated (Völker & Kistemann, 2013) and can positively influence visitation (Yang & Kang, 2005).

4.4.6 Conclusion

When undertaking recreational visits to natural environments, people visiting more expansive types such as coasts and countryside often expend more energy. Although statistically the effects reported in this study are small, at a population level the differences could be substantial. Furthermore, isolating how different environments afford different activities could allow future PA promotion to be tailored more closely to the interests and dispositions of target groups, especially those who undertake relatively little PA at present. Designers should consider what volumes and intensities of physical activity they wish to elicit when designing new recreational spaces or routes so the correct environmental qualities for eliciting such behaviour are selected. Knowing the behavioural affordances of a more diverse range of natural environments provides a useful starting point.

5. How do brochures promote walking in natural environments? A content analysis.

5.1 Introduction

There is general acceptance that exposure to natural environments adds to the affective benefits of PA alone (Bowler et al., 2010; Thompson-Coon et al., 2011). Heightening the affective benefits of PA might lead to a greater likelihood that the activity will be repeated (Rhodes & Kates, 2015) and previous research has shown that PA in outdoor and natural environments increases future intentions to be active (Focht, 2009; Hug et al., 2009). Therefore, practicing PA in natural environments could be a useful way to increase PA adherence. Despite this, there has been little research to date which examines how best to promote PA in natural environments. The only systematic review to look at strategies promoting PA in natural environments found inconsistent results regarding the impact of environment changes on PA behaviour (Hunter et al., 2015). However, the review found consistently positive results with the three studies that used promotional programmes (Cohen et al., 2013; Merom et al., 2003; Tester & Baker, 2009). These promotional programmes often took the form of written communications (e.g. brochures, signage, press advertisements and maps).

This is important as, in the UK, the National Institute for Health and Care Excellence (2012) has specific guidelines for programmes which aim to promote walking and cycling locally. Specifically, the guidelines state that local authority directors for countryside management, environment, leisure services, parks, and public health etc. “ensure programmes are based on an understanding of…factors influencing people's behaviour such as their attitudes, existing habits, what motivates them and their barriers to change" (NICE, 2012, p.14). Additionally they assert that those directors, "ensure programmes include communications strategies to publicise the available facilities (such as walking or cycle routes) and to motivate people to use them" (NICE, 2012, p.14). Moreover, they advise that directors, "develop walking programmes for adults who are not active enough, based on an accepted theoretical framework for behaviour change" (NICE, 2012, p.18). Printed materials such as brochures are a ubiquitous medium for communicating persuasive messages (Brito & Pratas, 2015) and helping individuals change their behaviour (Bull, Holt, Kreuter, Clark & Scharff, 2001). Brochures produced within local authorities in the UK are common, written by local councils, charities, and tourism organisations, and often advertise walking in natural environments as a leisure activity for tourists and locals alike (e.g. heritage trail brochures; Hayes & MacLeod, 2007). Their content should be subject to NICE's (2012) recommendations.

Randomised controlled trials have investigated the effectiveness of similar brochures previously. Pleguezuelos et al., (2013) administered urban walking circuit brochures to a sample of patients recovering from chronic obstructive pulmonary disorder. The brochures contained specified routes, details of attractions, maps, details of the duration and distance, and information about public transport connections. Nine months after rehabilitation, patients who had received the brochures walked more minutes per day, and on more days per week than patients who did not receive the brochures (see section 2.7.2). Conversely, Peels et al., (2014) administered brochures about walks and cycling in the local environment to a sample of older adults and found no additional effect on weekly minutes of PA or days of PA per week (see section

2.7.2). This could be because the content of the brochures in Pleguezuelos et al.'s (2013) study contained more persuasive behavioural techniques than the brochures in Peels et al.'s (2014) study (see section 2.7.1). This further outlines the importance of knowing how brochures promote walking in outdoor, and particularly natural, environments.

5.1.1 Analysing health brochures

It is well-known that health promotion materials more generally are rarely informed by behaviour change theories. For instance, Abraham, Krahé, Dominic & Fritsche (2002) undertook a quantitative content analysis of 71 brochures from two European countries promoting safer sex. They designed a manual to facilitate coding of the brochures by multiple persons which contained 45 semantically distinct coding categories. Principally, these categories reflected five main superordinate behavioural content areas: (a) the provision of information (in this case around HIV or sexually transmitted infections); (b) outcome expectancies (e.g. affective outcomes of using a condom or delaying sexual intercourse); (c) normative information (e.g. how others use condoms, or how peers would approve of condom use); (d) the promotion of intentions and preparatory actions (e.g. suggesting the reader purchase condoms) and; (e) self-efficacy (e.g. conveying the sense that purchasing condoms is easy, or instructing the reader on where to purchase them). These five main content areas comprise a range of social-cognitive models of behaviour change such as the health beliefs model (Becker, Heafner, Kasl, Kirscht, Maiman & Rosenstock, 1977), social-cognitive theory (Bandura, 1986, 1997), and the theory of planned behaviour (Ajzen, 1991). Briefly, in their set of brochures, categories pertaining to social norms and the promotion of behavioural intentions featured less often than the provision of information and the efficacy of condom use. The authors concluded that the brochures rarely targeted the strongest correlates of condom use.

In a further content analysis, the authors formalised this methodology into the Content Analysis Approach to Theory-Specified Persuasive Educational Communication (CAATSPEC; Abraham, Southby, Quandte, Krahé & van der Sluijs, 2007). The authors used this scheme to analyse the content of 82 leaflets encouraging the safe and responsible use of alcohol. Again, categories fell under superordinate categories of information provision, highlighting consequences, establishing normative beliefs, prompting actions, and encouraging or instructing actions (i.e. broadly analogous to Abraham et al., 2002). A reliable coding manual was produced and the authors found that the leaflets made use of a small array of potentially persuasive messages targeting modifiable cognitive antecedents of drinking beyond recommended limits.

A further study used the CAATSPEC approach to analyse the content of 22 PA brochures sourced from Canadian and American national health organisations (Gainforth et al., 2011). The authors constructed a coding taxonomy of 20 techniques grouped under four superordinate categories pertaining to knowledge-based information, outcome expectancies, self-regulation, and self-efficacy (as well as ‘other’ messages which encompassed text which could not otherwise be coded). In a departure from CAATSPEC, they also coded pictorial content such as modelling of PA. Eighteen percent of brochure content targeted knowledge-based information, 20% of content promoted self-efficacy, 10% was classified as highlighting outcome expectancies, and a further 6% targeted self-regulation. The majority of content was classified as ‘other’ messages. The most popular information provision category concerned presenting PA recommendations. With self-efficacy, the most popular was pictures of PA modelling. With outcome expectancies, most content related to positive health benefits of PA. Lastly, the most popular self-regulation category concerned overcoming barriers to PA. The authors noted a dearth of text detailing goal-setting, planning, and affective benefits of PA. This may have been because the PA brochures are targeted at people who are already motivated to be active rather than inactive people.

However, these studies do contain limitations. Regarding Gainforth et al's (2011) content analysis, the fact that almost half of all content was unable to be categorised suggests that there may have been persuasive techniques missing from their taxonomy. For example, under their self-efficacy and self-regulation superordinate categories, there was no category pertaining to maintenance of PA behaviour; a key challenge of long-term behaviour change (Rothman, 2000). A broader taxonomy of techniques which encompass all phases of behaviour change may therefore be necessary. Such taxonomies have been developed recently. For example, Michie et al., (2013) hierarchically cluster 93 different behaviour change techniques in an attempt to create a common language for reporting specific components of behaviour change interventions. The problem with these overarching taxonomies, as the authors note, is that in any given context (e.g. health setting, target behaviour, country, type of media), the specific persuasive techniques which are appropriate will be much more tightly defined than those in the overarching taxonomy.

More problematic for the present thesis, many of the qualities of natural environments that one might deem persuasive in getting people to engage with walking in natural environments do not seem to be encompassed by such taxonomies. While taxonomy categories pertaining to health, environmental, and emotional consequences of behaviour may appear to encompass these things, scrutiny of the definitions of these categories reveals that they do not (see Michie et al., 2013 Supplementary Material p.7-8). Qualitative research has highlighted that physical attributes of environments may persuade irregular users of natural environments to use them more frequently (e.g. Dallimer et al., 2014; Irvine et al., 2013). While these attributes may well have health or emotional benefits for the individual, they may just as importantly give rise to other benefits (religious, spiritual, educational, recreational opportunities) which may serve as motivators for walking in natural environments. This presents with a new array of consequences and motivators of behaviour which are not included in overarching taxonomies.

5.1.2 Present study

Despite many studies of other health brochures, a content analysis of persuasive messages in recreational walking materials has not yet been undertaken. Recreational walking brochures, a popular form of tourism marketing (Brito & Pratas, 2015), guide readers through walking routes in natural environments, normally with the aid of a map, drawing their attention to potentially interesting features (e.g. historical sites; see an example of a two-page extract in Figure 5.1). These brochures are often produced within local authorities by city councils, charities, and countryside/park planning leads and are thus subject to NICE's (2012) recommendations (see section 5.1) which instruct that such materials publicise available facilities and motivate inactive people to use them based on accepted theoretical explanations of behaviour change. Therefore, their reach and potential to affect behaviour is vast.

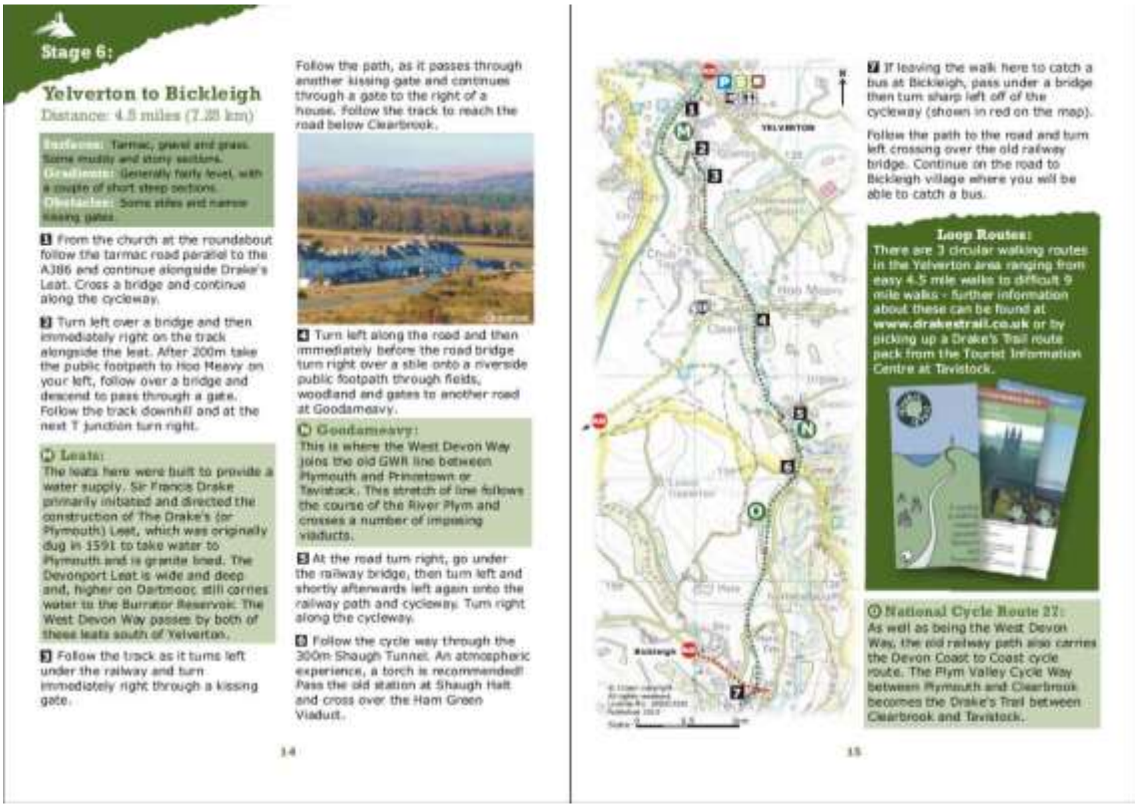


Figure 5.1 A two-page extract from West Devon Way (© Devon County Council).

However, there is little research into which messages are included in brochures and which may be most persuasive for particular audiences. Given the range of reasons for accessing the natural environment for walking, which may vary across population groups and settings, there is a need to establish a rigorous way to classify content and help identify which messages are persuasive and for whom. Adapting the CAATSPEC approach to persuasive materials, the present study categorised the content of recreational walking brochures using a novel coding taxonomy drawing on five theoretically-based superordinate categories. Two research questions were addressed: Firstly, can the content of recreational walking brochures be reliably categorised? Second, if so, what persuasive messages are included in recreational walking brochures?

5.2 Method

CAATSPEC is an application of quantitative content analysis to persuasive texts and can be used to outline messages used in health promotion materials. It uses mutually exclusive coding categories to classify text so no piece of text can be coded as more than one persuasive message. It was suited to this study as recreational walking brochures are persuasive texts that may promote a change in a health behaviour pattern (uptake of walking). This is the first application of CAATSPEC to materials in which health promotion was not necessarily the aim.

5.2.1 Sampling

Brochures were collected from July to December 2013 in the county of Devon, UK. Convenience sampling was employed; sourcing brochures from councils, holiday parks, visitor information centres and supermarkets. This involved visiting as many of these places as was feasible in two principal holiday destinations (Torbay and the North Devon coast) and one major city (Exeter). The following inclusion criteria were applied: (a) the brochures (printed or digital) advertised recreational walking in natural environments including mixtures of urban and natural environments and; (b) brochures had to be available free of charge to ensure they could have the widest readership. Twenty-six brochures were collected; details of which can be found in Appendix K. Brochures had a range of 54 to 712 paragraphs and 524 to 17,126 words (M=3,539). Two pages from a brochure are displayed in Figure 5.1 above.

5.2.2 Taxonomy

Following a reading of selected brochures, the CAATSPEC was modified to correspond to specific messages included in the brochures. All categories were arranged under superordinate headings that encompass the key components of behaviour change in a variety of evidence-based theories, namely, providing information, highlighting potential consequences and opportunities, establishing normative beliefs, promoting intentions and planning, and enhancing self-efficacy (Albarracín, Gillette, Earl, Glasman, Durantini & Ho, 2005; Fisher & Fisher, 1992). The final taxonomy had three further levels of specificity arranged hierarchically and can be viewed in Figure 5.2.

We attempted to map brochure text onto previous definitions of behaviour change techniques using established taxonomies (Abraham & Michie, 2008; Michie et al., 2013). A taxonomy emerged where each category represented a distinct persuasive message. However, categories warranted greater specificity than techniques defined in general taxonomies. To take an example, Abraham and Michie identified the general change technique “provide information on consequences” as derived from explanatory theories (Abraham and Michie, 2008). The authors defined the technique as, “information about the benefits and costs of action or inaction, focusing on what will happen if the person does/ does not perform the behaviour.” (Abraham & Michie, 2008; p.382). This technique was rendered domain-specific by Michie and colleagues (Michie et al., 2013) who identified the technique as comprising health, social, environmental, and emotional consequences (p.92). In the present study, we further adapted the technique to better represent persuasive messages found in recreational walking brochures. Specifically, consequences of recreational walking in the present taxonomy comprised health, social, environmental, financial, heritage, visually aesthetic, and recreational consequences (see definitions below).

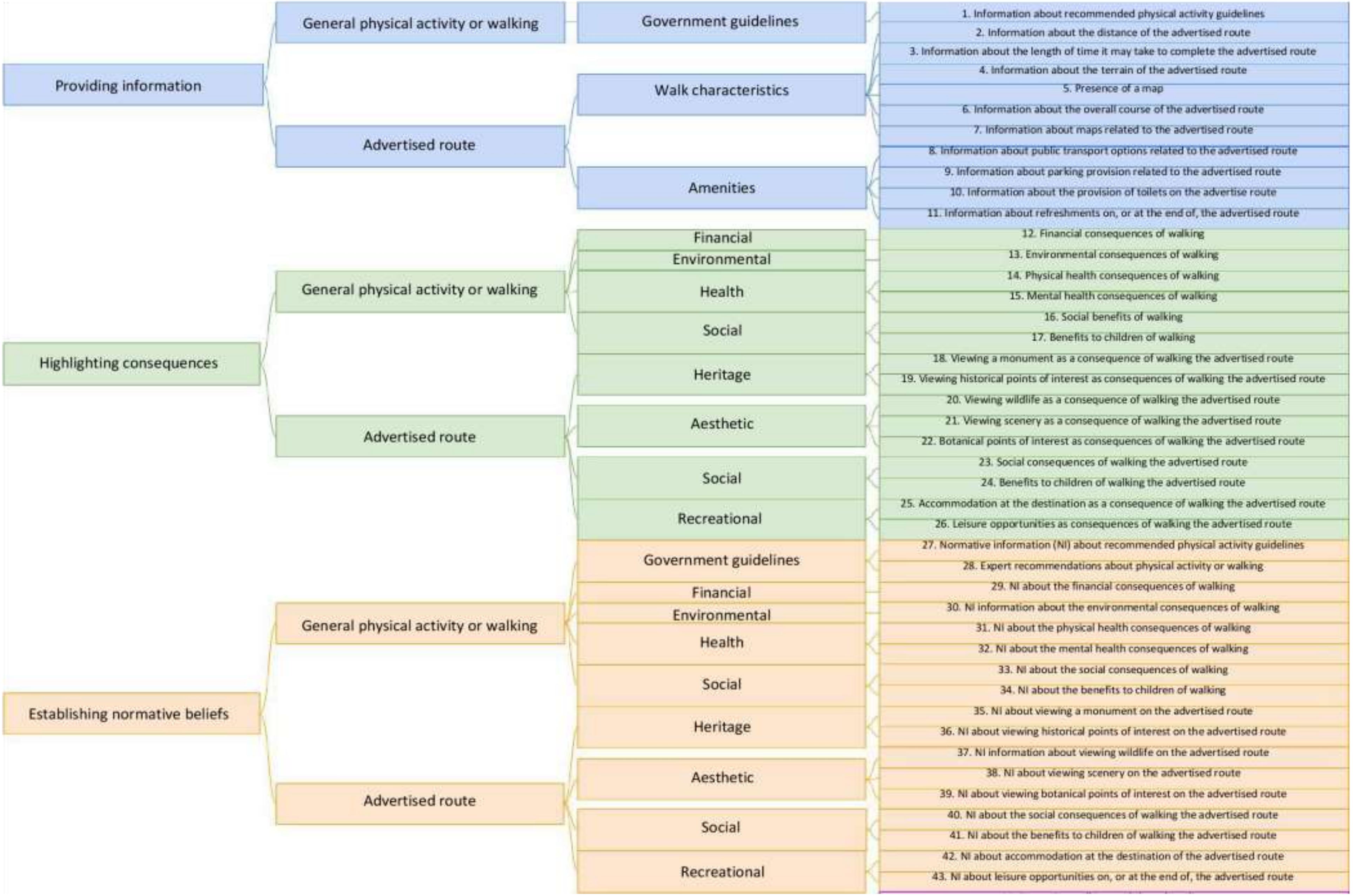


Figure 5.2 Complete coding taxonomy.

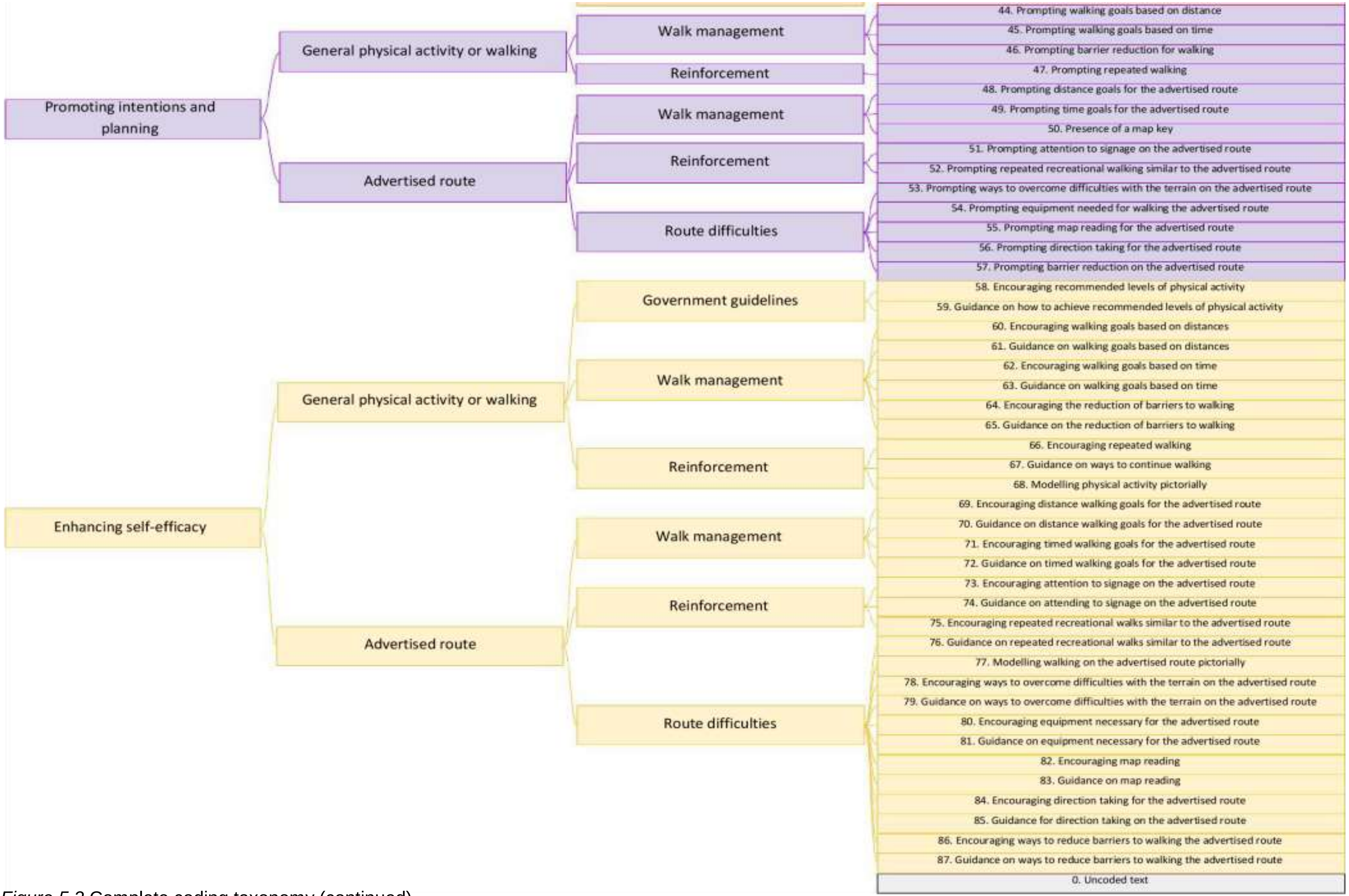


Figure 5.2 Complete coding taxonomy (continued)..

In a modification to CAATSPEC, categories were created to classify pictures of people walking (modelling behaviour) and graphics of maps (aids to planning). This was the only pictorial which was coded. Other pictorial content, such as pictures of scenery or wildlife, were instructed not to be coded as these could be considered multiple categories (e.g. a picture of wildlife could be conveying a potential opportunity for one reader i.e. there are opportunities to view wildlife on this route, but another could perceive it as a way of raising normative beliefs i.e. *most* people watch wildlife on this walking route, so I should too; this ambiguity is not present with written messages). Listed below are details of categories under each superordinate from the finalised taxonomy. The full coding manual can be viewed in Appendix L.

5.2.2.1 Providing information

Category 1 reflected information on PA recommendations or the prevalence of PA or walking in a population. Categories 2-7 detailed characteristics of the route such as the terrain or distance. Categories 8-11 concerned amenities such as public transport links or the availability of refreshments on the route.

5.2.2.2 Highlighting potential consequences and opportunities

Categories 12-17 concerned general consequences of PA or walking including: financial (e.g. saving money over car trips); environmental (e.g. more sustainable travel mode than car use); physical and mental health (e.g. improving cardiovascular health; feeling happier); and social (e.g. family enjoyment). Categories 18-26 described more extrinsic consequences and opportunities such as heritage features (e.g. historical sites); visual aesthetics (e.g. wildlife, scenery); sociability (e.g. family enjoyment); and recreation (e.g. leisure opportunities).

5.2.2.3 Establishing normative beliefs

Categories 27-34 outlined general normative information about PA or walking, or the consequences of these including: expert recommendations on PA, and financial, environmental, health, and social consequences. In a similar way to highlighting potential consequences and opportunities, categories 35-43 detailed normative information about more extrinsic consequences and opportunities.

5.2.2.4 Promoting intentions and planning

Categories 44-47 prompted general behaviours related to PA or walking including: setting goals based on distances (e.g. decide how far you will walk); or times (e.g. consider freeing up some time for walking); reducing barriers (e.g. think what would make being active easier for you); or prompting activity maintenance (e.g. make sure to keep up your walking once you have started). Categories 48-57 were designed to identify messages specific to the advertised route such as prompting goals based on distance (e.g. try breaking up the route into segments); attending to signage (e.g. use the waymarkers); or managing the terrain (e.g. be careful of the busy road).

5.2.2.5 Enhancing self-efficacy

Following CAATSPEC, most categories under this superordinate were dichotomised as encouraging or guiding behaviour. Encouragement categories conveyed the sense that behaviour was easy to execute, and guidance categories instructed on how to execute behaviour. Categories 58-68 related to building confidence for PA or walking in general and included: guidance on reducing barriers to activity, for example not knowing where to walk (e.g. go to a website and you can find guided walks in your area); encouraging setting walking goals based on time (e.g. it easy to find everyday opportunities to go walking); or modelling walking pictorially. Categories 69-87 related to building confidence for completing the advertised route and included: guidance on maintaining recreational walking behaviours (e.g. purchase more outdoor walking brochures from the visitor information kiosk in the city centre); encouraging the use of appropriate equipment (e.g. it is simple to get walking boots from your local outdoors shop); or guidance on direction taking (e.g. turn left at the end of the road). As can be imagined, this last category was likely to be central to recreational walking brochures.

5.2.3 Coding procedures

A pilot coding manual was tested by two coders but demonstrated insufficient reliability. To improve the manual, categories were added and deleted, definitions were revised, and coding procedures were modified. With the revised manual, and in accordance with a previous content analysis (Gainforth et al., 2011), a line-by-line coding procedure was utilised in order to facilitate inter-coder reliability testing. Sentences acted as ‘units of analysis’ and coders were instructed on how to detect changes in semantics within and across sentences, and how to code these accordingly. Importantly, categories were exclusive; text could only be coded under one category. The manual also provided specific guidance on distinguishing semantically similar categories. For example, some messages prompted behaviours whilst others provided guidance on the same behaviours e.g. category 53 refers to messages suggesting ways to deal with the terrain on the advertised route whereas category 79 refers to messages explicitly providing guidance on how to deal with these. Coders were instructed that any category prompting behaviour would refer to specific behaviour (e.g. be careful climbing the muddy hill) but any category guiding behaviour will inform them on how to execute that behaviour (e.g. taking shorter strides will ensure you do not slip up on the muddy hill). Coding instructions can be seen as part of the coding manual in Appendix L. Coding a brochure took approximately 90 minutes.

5.2.4 Reliability

Inter-coder reliability was assessed using the AC1 statistic (Gwet, 2002). The prevalence of some categories was very small and AC1 adjusts reliability accordingly where alternatives (e.g. Cohen's Kappa; Cohen, 1960) would not. The protocol for reliability testing was as follows: Two brochures were selected by myself on the basis that they varied in style, length and publisher; thus potentially encompassing the broadest range of categories. Two coders (including myself) would code the brochures, line-by-line, as described above. If reliability was established at all hierarchical levels ($AC1 \geq 0.7$, $p<.05$), testing would stop, providing that individual categories demonstrated reasonable reliability too ($AC1 \geq 0.6$; $p<0.2$). This generous alpha level was selected so that categories with only one agreed instance (identified by both coders) were judged reliable despite the lack of more instances to determine reliability at conventional alpha levels. This is because coders selecting one piece of text and identifying it as the same category of a possible 87 was unlikely to be due to chance. If any individual categories did not meet this criterion, consensus would be sought using an independent coder and the category dropped if agreements on disagreed instances were not reached. If any level of the hierarchy demonstrated unsatisfactory reliability, then the manual would be revised and testing repeated with two further brochures. If any individual category's AC1 exceeded the alpha level ($p>0.2$), or if there were no instances of a category found, the category was deemed a 'potential category of persuasive message', but with insufficient data to determine reliability.

5.2.5 Analysis strategy

To examine frequently employed persuasive messages, only categories which appeared in more than three brochures were included in the main content analysis. Categories which appeared in more than three brochures but had insufficient data to determine reliability in the testing phase were noted as requiring further reliability testing. We examined frequencies and proportions of content firstly across and then within superordinate categories.

5.3 Results

5.3.1 Reliability

Reliability statistics can be viewed in Appendix M and Appendix N. In total, 476 category instances (9.3% of all content) were double-coded. Coders agreed on the same categories for 363 (76.26%) of these. Satisfactory reliability was achieved at all levels of the hierarchy (superordinate level: AC1=0.77, 95% CI 0.73, 0.82; individual category level: AC1=0.76, 95% CI 0.72, 0.80). There were only 35 categories (including an 'uncoded text' category) that contained enough instances to confidently confirm reliability. We believe this reflects the lack of diverse persuasive messages used in brochures and not inadequate sampling. The number of additional categories for which reliability could have been established through double-coding more brochures did not justify the labour involved in further line-by-line double-coding.

Individually, there were six categories that did not meet our reliability criteria ($AC1 \leq 0.6$; $p<0.2$). All textual instances coded under these categories were discussed between myself and an independent coder, and categorisations agreed for all, so no categories were dropped. Afterwards, 448 of the 476 category instances were agreed upon and the reliability of all levels of the hierarchy had improved significantly (superordinate level: AC1=0.96, 95% CI 0.94, 0.98; individual category level: AC1=0.94, 95% CI 0.92, 0.96). As a consequence of this resolution phase, two further categories did not meet our reliability criteria (category 53: prompting ways to overcome difficulties with the terrain on the advertised route; category 73: encouraging attention to signage on the advertised route). In total however, these categories only comprised five disagreements, so in line with previous content analyses (Abraham et al., 2007), decisions of the primary coder were accepted as they had the benefit of coding all brochures in the sample.

5.3.2 Content analysis

All percentages reported reflect subordinate categories which were included in more than three brochures in the sample. Using this criterion, 33 of the original 87 categories formed a useful taxonomy of potentially persuasive messages frequently used in recreational walking brochures. Descriptive statistics for these 33 categories are displayed in Table 5.1 and descriptive statistics for all categories are provided in Appendix O. Of these 33, seven had insufficient data in the reliability phase to determine reliability (categories 3, 18, 49, 55, 70, 77, and 81). Category 53 (see section 5.3.1) was also contained in these 33. Interpretations on all of these categories need therefore to be considered cautiously. Of the 25 with sufficient data in the reliability phase, AC1's ranged from 0.69 to 1.00, so good reliability can be assumed for the rest of the categories included here. There were 4,800 instances of coded text within these 33 categories (94% of all content). Messages providing information accounted for 30.92% of all coded content (*M*=57 instances per brochure). Messages highlighting consequences accounted for 26.94% (*M*=50 instances). Messages promoting intentions and planning accounted for 5.58% (*M*=10 instances). Messages enhancing self-efficacy accounted for 36.56% (*M*=68 instances). No categories pertaining to messages establishing normative beliefs appeared in more than 3 brochures.

5.3.2.1 Messages providing information

The most prevalent types of messages under this superordinate were those categorised as information about the overall course of the advertised route (category 6), accounting for 26.48% of all content which provided information, and 8.19% of content overall. This included summaries of where the route would take the reader e.g. 'this walk explores an inland section of the Bude Canal on the Devon-Cornwall border' or information on the location e.g. 'Exmouth is a gateway town'. Other widely used categories included information about public transport options related to the advertised route (category 8) e.g. 'many of the trails have convenient parallel public transport routes - bus or train', information about the terrain of the advertised route (category 4) e.g. 'mostly level and easy although there is one steep climb on an inclined plane', and information about the distance of the advertised route (category 2) e.g. 'a 13km/8 mile circuit'.

Table 5.1

Frequency of category inclusion.

Message	No. of brochures	No. of instances	Max instances	% all content	% of superordinate
Providing information	26	1484	299	30.92	-
2. Information on the distance of the advertised route	24	221	44	4.60	14.89
3. Information on the length it may take to complete the advertised route	7	27	14	0.56	1.82
4. Information on the terrain of the advertised route	22	228	48	4.75	15.36
5. Presence of a map	22	106	12	2.21	7.14
6. Information on the overall course of the advertised route	23	393	91	8.19	26.48
7. Information on maps related to the advertised route	13	54	19	1.13	3.64
8. Information on public transport options related to the advertised route	16	254	54	5.29	17.12
9. Information on parking provision related to the advertised route	10	42	9	0.88	2.83
10. Information about provision of toilets on the advertised route	12	47	18	0.98	3.17
11. Information on refreshments on, or at the end of, the advertised route	15	112	29	2.33	7.55
Highlighting consequences	26	1293	361	26.94	-
18. Viewing a monument as a consequence of walking the advertised route	13	44	13	0.92	3.40
19. Viewing historical features as consequences of walking the advertised route	26	663	187	13.81	51.28
20. Viewing wildlife as a consequence of walking the advertised route	20	85	20	1.77	6.57
21. Viewing scenery as a consequence of walking the advertised route	24	300	98	6.25	23.20
22. Botanical points of interest as consequences of walking the advertised route	20	60	13	1.25	4.64
25. Accommodation at the destination as a consequence of walking the advertised route	6	17	6	0.35	1.31
26. Leisure opportunities as consequences of walking the advertised route	11	124	30	2.58	9.59
Promoting intentions and planning	26	268	55	5.58	-
48. Prompting distance goals for the advertised route	7	16	5	0.33	5.97
49. Prompting time goals for the advertised route	6	13	6	0.27	4.85

50. Map key	17	25	2	0.52	9.33
51. Prompting attention to signage on the advertised route	10	27	8	0.56	10.07
52. Prompting repeated recreational walking similar to the advertised route	19	105	17	2.19	39.18
53. Prompting ways to overcome difficulties with the terrain on the advertised route	9	37	12	0.77	13.81
55. Prompting map reading for the advertised route	5	7	3	0.15	2.61
56. Prompting direction taking for the advertised route	5	7	2	0.15	2.61
57. Prompting barrier reduction on the advertised route	9	31	13	0.65	11.57
Enhancing self-efficacy	26	1755	403	36.56	-
70. Guidance on distance walking goals for the advertised route	7	11	3	0.23	0.63
74. Guidance on attending to signage on the advertised route	5	5	1	0.10	0.28
76. Guidance on repeated recreational walks similar to the advertised route	12	65	20	1.35	3.70
77. Modelling walking on the advertised route pictorially	8	35	12	0.73	1.99
79. Guidance on ways to overcome difficulties with the terrain on the advertised route	14	50	8	1.04	2.85
81. Guidance on equipment necessary for the advertised route	4	6	3	0.13	0.34
85. Guidance for direction taking on the advertised walk	23	11	362	32.98	90.20

“No. of brochures” refers to the number of brochures in which the category (or superordinate content area) featured.
“No. of instances” refers to the number of instances of the category (or superordinate content area) that were present in all 26 brochures.
“Max instances” refers to the maximum number of instances of the category (or superordinate content area) in any one brochure.
“% all content” refers to the percentage of all content (encompassed by these 33 categories) which is accounted for by the category (or superordinate content area).
“% of superordinate” refers to the percentage of superordinate content which is accounted for by the category.

5.3.2.2 Messages highlighting potential consequences and opportunities

The most frequently occurring types of messages were those categorised as viewing historical points of interest as consequences of walking the advertised route (category 19) accounting for 51.28% of content which highlighted consequences and 13.81% of content overall. This was also the only individual category to appear in every brochure. This incorporated descriptions of geology e.g. ‘celebrating 95 miles of internationally important rocks displaying 185 million years of the Earth's history, the Jurassic Coast is a geological walk through time’. It also detailed historical facts about the advertised route e.g. ‘in 1861, the arrival of the railway, linking the town with Exeter, brought with it a dramatic population explosion’. Other common categories included viewing scenery as a consequence of walking the advertised route (category 21) e.g. ‘the South-West Coast Path is a superb way to experience a range of fine Devon scenery, from cliff tops to wide estuaries, sandy bays to wooded valleys’, and leisure opportunities as consequences of walking the advertised route (category 26) e.g. ‘the estuary is a hub of activity for recreational activities; such as sailing, canoeing, windsurfing, fishing and scuba diving’.

5.3.2.3 Messages promoting intentions and planning

Prompting repeated recreational walking similar to the advertised route (category 52) was the most widely used message category, responsible for 39.18% of promoting intentions and planning content and 2.19% of content overall. This included the promotion of related brochures without instruction on how to obtain these e.g. ‘an introductory leaflet and a detailed route book on the Tarka Trail are both available’. It also included ways to enjoy the advertised walk, again without instruction on how to do so e.g. ‘why not try your hand at Geocaching when on the trail’? It further included contact details on guided walks e.g. ‘why not join one of a number of free guided tours’? Another often used category was prompting ways to overcome difficulties with the terrain on the advertised route (category 53). This included directions to ‘be aware’ or ‘take care’ e.g. ‘care should be taken at all times when walking on roads’, or, ‘take care crossing the Exe over Bickleigh Bridge’. Another common category was prompting barrier reduction on the advertised route (category 57) e.g. ‘you can pick up short sections of the trail from a number of easily accessible points’.

5.3.2.4 Messages enhancing self-efficacy

The most often used category was guidance for direction taking on the advertised walk (category 85). This category was present in 23 of the brochures and accounted for 90.20% of all self-efficacy content, and 32.98% of content overall. It embodies the nature of walking brochures; instructing on how to progress through a route. This is different from provision of route information as it builds confidence for wayfinding. Examples include, ‘just before you reach a cattle grid turn left alongside a bank’, or, ‘go through the gate at the top left corner of the next field, to the road’. In a similar way to messages promoting intentions and planning, other common categories included guidance on repeated recreational walks similar to the advertised route (category 76). This is qualitatively different from the promotion of repeated recreational walks as it provides means by which the reader can access further walking information. For example, ‘free booklets about Devon coast and countryside including walking trails, cycling, horse riding and wildlife can be ordered through the Devon County Council website at www.devon.gov.uk’, or, ‘leaflets on all of these walks are available from Exeter City Council and the Visitor Information Centre'. Other frequently used message categories were guidance on ways to overcome difficulties with the terrain on the advertised route (category 79) e.g. 'this route is closed during the shooting season from 1st October to 1st February, and walkers should follow the alternative route along the quiet road instead at that time', or, 'aim to walk this part of the route within two hours of low tide (see local press or visit www.teign-estuary.org)', and modelling walking on the advertised route pictorially (category 77).

5.3.2.5 Uncategorised content

4.04% of all content was unable to be categorised under any of the 87 categories. This equated to 206 instances of uncategorised text compared to 4,893 instances of categorised text. The proportion of text which went uncategorised per brochure ranged from 0% to 10.71%. Examination of this text revealed no systematic exclusion of content related to recreational walking. The majority of this text related to authorship credits, website addresses unrelated to walking, and advertisements for holiday attractions. The only recurring behavioural message types that went uncategorised concerned the advertisement of cycle routes and the prompting or instructing of environmental behaviours e.g. 'support local shops and services' or, 'take your litter home and recycle it where possible'.

5.4 Discussion

This is the first study to develop a specific coding taxonomy for, and conduct a content analysis of, recreational walking brochures. Acceptable reliability of this taxonomy was established at each hierarchical level and for most frequently occurring categories. The content analysis suggested that brochures promoted walking in natural environments through messages which provide information on the route, highlight potential consequences and guide on wayfinding. However, they lacked variety in message types; frequently omitting information which could raise normative beliefs, promote intentions, or enhance self-efficacy, for walking.

5.4.1 How do brochures encourage recreational walking in natural environments?

Brochures often provided information that aims to facilitate easier access to a walking route, as opposed to information about PA more generally. They also provided information on the course, distance, duration, and terrain of a route, seemingly in order to detail the amount of time and level of expertise required to undertake the walk. In contrast to traditional PA promotion, messages highlighting consequences often framed environmental features as motives to walk rather than potential health gains. Importantly, previous research has demonstrated that for people who visit natural environments infrequently, subjective qualities like this are more important motivators for visiting than the achievement of physical fitness (Dallimer et al., 2014; Irvine et al., 2013; McCormack et al., 2010). Thus, highlighting environmental features may persuade less frequent visitors, who are also more likely to be less active (Coombes et al., 2010), to visit natural environments. Promoting intentions and enhancing self-efficacy in the brochures were mainly used to draw the reader's attention to other recreational walking materials and how to access them. Whilst this could support walking maintenance behaviours, the aim of those messaging strategies may have been simply to drive further interest in a destination or organisation (Brito & Pratas, 2015).

5.4.2 Do brochures conform to national guidance?

A key public health priority is to encourage those who are least motivated, to engage in recreational walking (Ogilvie et al., 2007), and natural environments could support this (Chapter 4). Considerable investment has been directed towards improving natural environments and opening up walking routes (Hunter et al, 2015) but little is known about how to sell these opportunities through printed media to those who are less motivated to walk. In the present study, walking brochures lacked general and normative information about PA for health, behavioural prompts and efficacy information (especially content encouraging walking behaviours). Most brochures and much of the content therein, whether intentionally or not, was therefore intended for people who already do recreational walking in the natural environment. This is at odds with national guidance on walking (NICE, 2012) which recommends that all programmes promoting walking should utilise evidence-based theoretical explanations of behaviour change to encourage the least active to use local walking infrastructure.

While further research is needed to explore which messages may be most effective, there appears to be more scope in the brochures to change cognitions about recreational walking (e.g. build confidence to complete walks, raise descriptive norms about outdoor walking), and encourage behavioural strategies (e.g. provide walking goals in terms of distance or time). Naturally, many more considerations are involved in creating a recreational walking brochure. The overall layout, typesetting, language style and numerous other features are important in attracting or deterring a potential reader from picking up a brochure or persuading them to change their behaviour (Abraham and Kools, 2012). Nonetheless, the selection of appropriate behavioural antecedents to write into messages remains important (Brawley and Latimer, 2007).

5.4.3 An illustrative brochure

Exeter Walking Map stood out as the brochure having both most even category-to-instance ratio (24 categories featured comprising 51 textual instances) and the most even distribution of categories across superordinate content areas. This brochure was also largely devoted to the promotion of walking more generally as opposed to its related recreational walking routes (around the city of Exeter, UK). For example it outlined physical health consequences (category 14) e.g. ‘walking can help you live longer, helps protect you from heart disease, diabetes, cancer, osteoporosis and much more’ and included four references to mental health consequences (category 15) e.g. ‘walking can activate the happy hormone which makes you feel good, improves your mood and reduces stress’. It contained normative information on walking’s’ benefits to children (category 34) e.g. ‘children like to walk to school so they can chat to their friends.’ Furthermore it included text reducing general barriers to walking (category 46) e.g. ‘walking need not require any special equipment’, and provided guidance on walking goals based on time management (category 63) e.g. ‘by walking to work, school, the shops or the station you can get your daily exercise as part of your normal routine’. It was also one of only two brochures in the sample to explicitly state PA guidelines; in this case providing guidance how someone could achieve them (category 59): ‘Doing 10,000 steps per day will contribute to the recommendation of moderate-intensity physical activity for at least 30 minutes on 5 or more days per week’. This brochure demonstrates how a variety of behavioural information can be incorporated into a recreational walking brochure.

5.4.4 Strengths, limitations, and future research

The main strength of this study is that it has produced a coding taxonomy that can be used or modified to analyse materials that advertise recreational PA in a variety of different media. Furthermore, it has identified for the first time the range of messages used in recreational walking brochures that attempt to persuade people to walk in natural environments. The coding taxonomy was meant to be flexible to suit the needs of different settings by maintaining stable superordinate content areas but individual categories which could be adapted to cater for specific needs. It was however, developed with a geographically specific set of brochures and therefore generalisation to other locations is uncertain. Nonetheless, the brochures did cover a variety of areas from small cities to rural towns and villages in both inland and coastal areas. For different environments and PA conventions present in other countries or larger urban areas, the taxonomy may have to be adapted.

Although the taxonomy was reliable at all levels of the hierarchy, eight of the 33 frequently occurring categories did not meet our reliability criteria. Although this suggests inadequate sampling, not one of these categories alone accounted for more than 1% of all content, suggesting that further reliability testing may still not have yielded enough instances for confident reliability assessments.

Perhaps in the future a combination of traditional presence-or-absence methods (Abraham et al., 2007) supplemented by line-by-line procedures (Gainforth et al., 2011) could improve reliability protocols in comparable content analysis studies. Nevertheless, categories may need to be omitted or revised in any future applications of the coding taxonomy should they fail to meet acceptable reliability criteria.

The coding taxonomy maintains some degree of convergent validity with previous content analysis schemes (Abraham et al., 2007) and behaviour change technique taxonomies (Abraham and Michie 2008; Michie et al., 2013) upon which it is based. The aim of the study was not to fully validate the taxonomy, but future research could undertake this. For example, the hierarchical structure could be validated using cluster analysis techniques in a Delphi-style exercise in a similar way to which Michie et al., (2013) developed their taxonomy. Furthermore, testing the predictive validity of categories could elucidate on their persuasiveness. For example, researchers could test whether categories highlighting consequences alter attitudes towards walking or whether categories enhancing self-efficacy make people feel more confident about walking. Developing the categories in the present taxonomy was achieved by expanding behaviour change techniques in more comprehensive taxonomies (Abraham and Michie 2008; Michie et al., 2013). This suggests that in any context-specific content analysis, especially those examining materials which are not ostensibly affiliated with health promotion, such taxonomies could possible only be used to derive more relevant message categories.

While pictures of people walking and of maps were coded as potentially persuasive messages, other pictorial content was excluded as it was difficult to identify other pictures (e.g. of wildlife) as mutually exclusive persuasive messages (see section 5.2.2). However, the persuasiveness of pictorial content for motivating health behaviour change cannot be underestimated. Not only can they enhance the effectiveness of written warning labels, as exemplified with their inclusion on cigarette packaging (Fong, Hammond & Hitchman, 2009), but they can also aid recall of behavioural instructions over and above written instructions alone (Kools et al., 2006). Future content analyses may wish to code the presence of other pictures if they can be deemed to enhance the written messages in the materials in such ways.

In future, controlled trials could use the taxonomy prospectively as a guide to creating intervention materials that target different antecedents of behaviour change, and test with more precision which 'ingredients' are most effective and appealing to different groups (eg, urban vs. rural dwellers, tourists vs. home based, disadvantaged vs. affluent communities). Future research might also wish to test different types of brochure in terms of their ability to alter attitudes towards walking or intentions to walk. For example, controlled studies could administer brochures which were identical in style but varied in terms of the type of message employed. This would allow researchers to test how original vs. tailored information could be differently persuasive and thus inform guidelines on how to produce recreational walking brochures.

5.4.5 Conclusion

Content in recreational walking brochures sampled from Devon, UK, can be coded for the presence of potentially persuasive messages using the coding taxonomy developed here. These brochures' principle persuasive strategies are to guide wayfinding, provide information on amenities and access, and enhance the appeal of various properties of natural environments. Whilst highlighting attractive properties could motivate inactive people, omitting messages related to the promotion of intentions or self-efficacy and failing to raise normative beliefs may equally fail to encourage inactive people to engage in recreational walking in natural environments. In future, brochures could utilise a wider variety of message strategies in their text in order to engage such populations. Simultaneously, public health campaigns to increase walking could learn from initiatives used in the promotion of health behaviours for other ends, such as highlighting environmental features that could support walking.

6. Can the content of recreational walking brochures be improved to heighten walking intentions?

6.1 Introduction

Engaging inactive populations in walking is a public health priority (Ogilvie et al., 2007; NICE, 2012). The natural walking pace of inactive adults is usually of a health-enhancing intensity (Rowe, Kang, Sutherland, Holbrook & Barreira, 2012). Natural environments appear to be conducive to supporting health-enhancing bouts of walking for inactive people for a number of reasons. Firstly, experimental research has demonstrated that people are more likely to conduct uninterrupted bouts of health-enhancing PA in natural environments than in urban centres (Sellens et al., 2012). Secondly, energy expended in natural environments appears to be sufficient for health-enhancement (Mitchell, 2013; see Chapter 4). Thirdly, people living in socioeconomically disadvantaged areas are more likely to be less active and bear the burden of ill health associated with this (Ball, 2015). However, such populations may have good access to natural environments (Macintyre, 2007; Macintyre, Macdonald & Ellaway, 2008) and thus the promotion of PA in natural environments for such inactive populations is both feasible, and potentially effective at increasing their levels of PA (Ball, Carver, Downing, Jackson & O'Rourke, 2015).

However, documented attempts to promote PA in natural environments for inactive and socioeconomically disadvantaged populations are uncommon. Hunter et al.'s (2015) systematic review of interventions to promote PA in urban green space (see also sections 2.7 and 5.1) identified a few interventions that attempted this with mixed success. For example, in one intervention which improved parks in low-income American neighbourhoods, overall park use and park-based PA declined (Cohen, Golinelli, Williamson, Sehgal, Marsh & McKenzie, 2009). In another, improvements to facilities of a park in the most disadvantaged decile in Victoria, Australia, elicited significant increases in park users, number of people walking in the park, and the number of people being vigorously active in the park (Veitch, Ball, Crawford, Abbott & Salmon, 2012). As discussed previously (section 5.1), the most effective method of promotion of PA in natural environments is through promotional programmes, often taking the form of written materials.

Despite this, Chapter 5 demonstrated that written materials advertising PA in natural environments (specifically recreational walking brochures) do not necessarily use collections of persuasive messages which are likely to persuade inactive people to undertake walking. This in direct contrast to national recommendations (NICE, 2012), and means that, if accessed, a recreational walking brochure could potentially deter an inactive individual from walking in natural environments and exacerbate socioeconomic inequalities in recreational PA participation (Beenackers et al., 2012). Considering the imminent completion of a national coastal footpath in England (Marine and Coastal Access Act, 2009) and the widespread distribution of brochures advertising walking routes in natural environments (Hayes & MacLeod, 2007), the need to design brochures which can effectively promote walking in natural environments for inactive people has never been greater.

The two most fundamental considerations when designing brochures which aim to change health behaviour are the format of the brochure and the content of the messages. As discussed in section 2.8, research on how best to design the format of brochures in terms of aiding recall, comprehension, and the search for information is well established (Abraham & Kools, 2012; Kools et al., 2006; 2007; 2008). Instead, this study focuses on the content of the messages contained within the text of brochures. The use of behaviour change theories in designing persuasive written messages is crucial (Abraham et al., 2002; 2007; Abraham, Kelly, West & Michie, 2009; Gainforth et al., 2011). This is because they allow designers to choose combinations of behavioural techniques which have shown empirical promise in influencing intentions to perform the target behaviour, or actual performance of the target behaviour (Michie, Abraham, Whittington, McAteer & Gupta, 2009).

As discussed in section 2.8.1, the theory of planned behaviour has been applied to the uptake of PA on numerous occasions with relative success. Hagger et al., (2002) meta-analysed data from 72 articles to find that the theory explained 44.5% of variance in PA intentions. After addition of internal aspects of perceived behavioural control (akin to self-efficacy or confidence for undertaking PA) and past PA behaviour to their analysis, 60.2% of variance in intentions to be active was explained as well as 46.7% of the variance in actual PA behaviour. Despite some attenuation of the posited pathways of the theory, all pathways remained significant. The theory has also been successfully applied in interventions to specifically promote walking among the general population (Darker, French, Eves & Sniehotta, 2010). Qualitative research has shown physical attributes of environments to influence PA behaviour for inactive people (Dallimer et al., 2014; Irvine et al., 2014; McCormack et al., 2010), but even these relationships have been shown to be mediated by the proposed pathways of the theory of planned behaviour (Rhodes, Brown & McIntyre, 2006). Taken together, these findings indicate that designing messages based on the constructs within the theory of planned behaviour (attitudes, subjective norms, and perceived behavioural control) might be the most effective way of enhancing intentions to walk.

6.1.1 Present study

The present study explored whether modifying the content of recreational walking brochures could heighten intentions to walk in natural environments, especially for people who are not regular recreational walkers at present. Specifically, in an experimental survey design, a no-brochure condition acted as a baseline for the strength of outdoor recreational walking intentions. Another condition used a standard brochure extract (from the sample included in Chapter 5). A third condition used an enhanced brochure in which text which may be ineffective at heightening intentions for recreational walking in natural environments was replaced with text designed to positively influence the antecedents of intention formation proposed by the theory of planned behaviour. Both stated intentions (self-report scales) and revealed intentions (choice to request further walking information or not) were used as dependent variables.

In line with similar research investigating brochures manipulated with theory of planned behaviour content (e.g. Bishop et al., 2005; see section 2.8.2), a linear trend was hypothesised whereby individuals who read the enhanced brochure would exhibit stronger recreational walking intentions than individuals who read the standard brochure, who would in turn have stronger intentions than those who read no brochure. Considering the difficulty of engaging “new” walkers in recreational walking in natural environments, further hypothesised differences between people who regularly undertake walking in natural environments (hereto "walkers") and those who do not (hereto "non-walkers") were made. It was hypothesised that walkers would respond with higher intentions after reading the standard brochure compared to no brochure, but that reading the enhanced brochure would have no additional impact because it contained no more persuasive information for them. It was also hypothesised that non-walkers would express equivalent intention strength in response to both the no brochure and standard brochure conditions because the standard brochure did not facilitate walking in natural environments for them. However, we predicted that they would respond with much higher intentions towards the enhanced brochure because it contained the relevant, persuasive information they required. Figure 6.1 displays these hypotheses graphically.

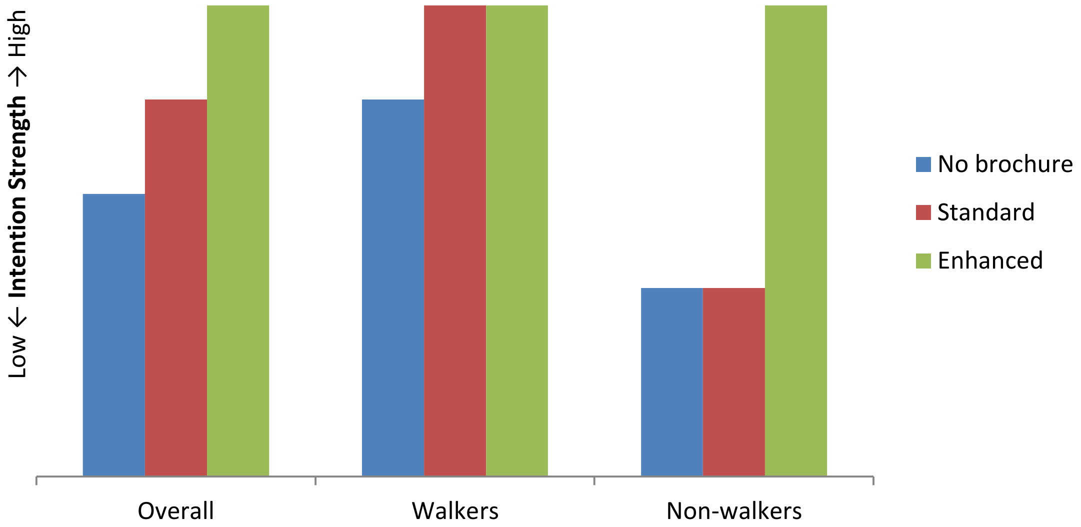


Figure 6.1 Graphical representations of hypotheses.

It was additionally hypothesised that non-walkers' favourable intentions towards the enhanced brochure (compared to the other conditions) would be mediated by differences in reported attitudes, norms and self-efficacy; the three antecedents of intentions posited by the theory of planned behaviour and manipulated in the enhanced brochure.

6.2 Method

All methods involved in this study were approved by the University of Exeter's Sport and Health Sciences ethics committee.

6.2.1 Sample

Respondents were recruited through an online consumer panel (Cint) who were accessed by a third-party market research company who delivered the survey and recorded data. Cint refers to a worldwide consumer panel of around 19 million people who earn small financial rewards for completing online surveys and questionnaires. The methodology in the UK is such that a researcher can potentially access a demographically representative sample of the British population. In the present study only respondents from the UK were recruited and, to comply with ethical regulations, only people aged between 18 and 65 were accessed. All respondents were invited to participate via email and recruitment ceased only when there were sufficient completed responses in every condition.

A sample size calculation was performed using G*Power (Faul, Erdfelder, Lang & Buchner, 2007) with results from Bishop et al.'s (2005) study of different brochures to enhance women's intentions to stop smoking following an abnormal cervical smear test result. In this study the authors administered three types of brochure in a between-subjects design: a) a standard brochure with brief detail; b) an enhanced brochure with more detail; or c) no brochure. These three groups were deemed broadly analogous to the three conditions administered in this study. Stated intentions in this study were measured using the average of two 7-point intentions items. As the present study also used the mean score of two 7-point intentions items as one of its main dependent variables, this was seen as an ideal measure upon which to calculate sample size. Mean intention-scores associated with stopping smoking were as follows: no-brochure group M=2.4 SD=1.6 (n=124); standard brochure M=2.6 SD=1.8 (n=98); enhanced brochure M=3.0 SD=2.0 (n=108). The pooled SD was 1.79 and resultant effect size (Cohen's f) was 0.142. To achieve power of 0.8 (α=0.05), 486 participants needed to be recruited.

6.2.2 Experimental conditions

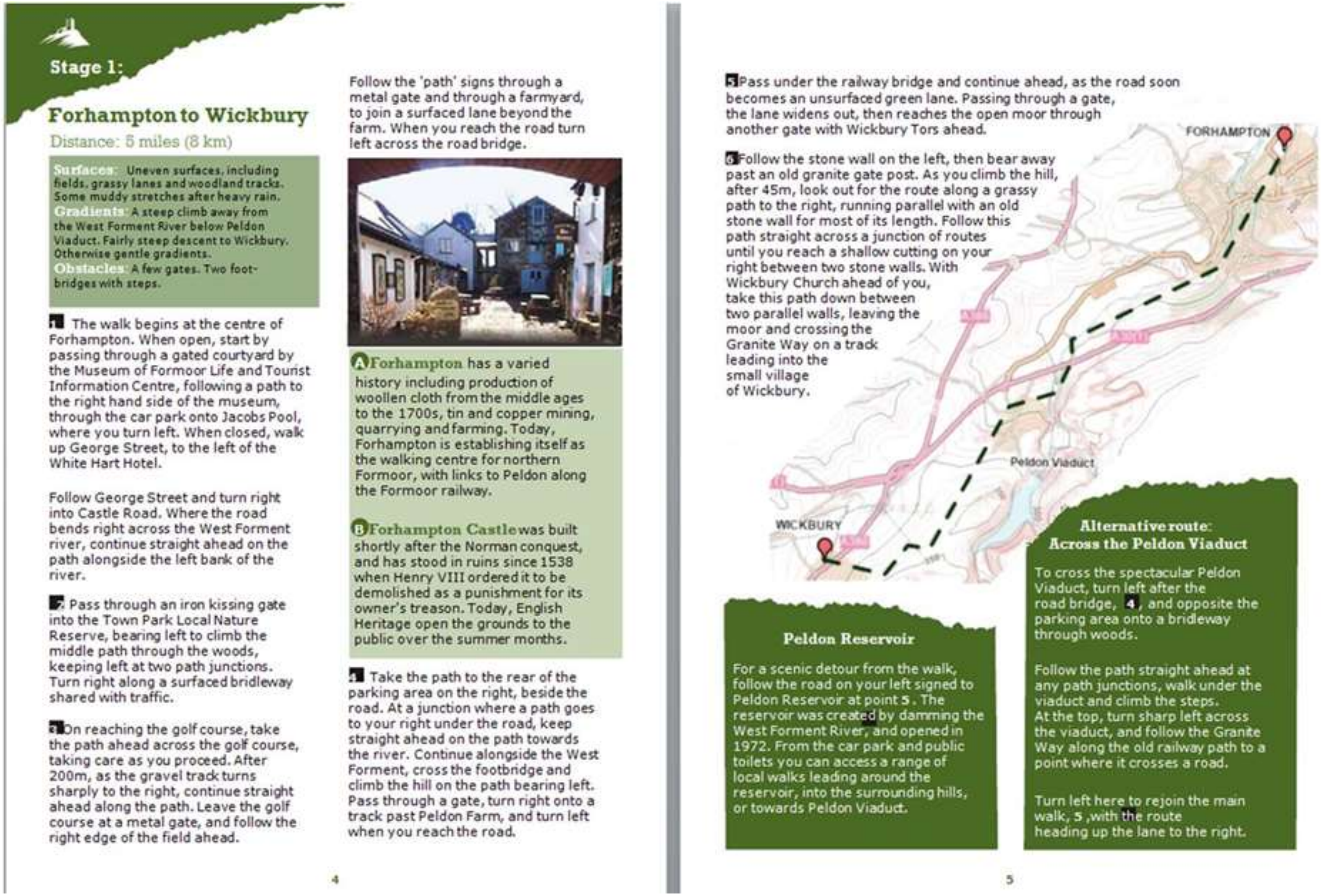
A no-brochure condition was used to ascertain baseline recreational walking intentions. In this condition, respondents were unencumbered by any type of informational intervention. Although this meant that the conditions would not be standardised in terms of the nature of the intervention task, it was impossible to guarantee that any other reading materials would be devoid of information that may influence theory of planned behaviour constructs. Respondents were therefore asked to spend a few minutes imagining an outdoor recreational walk; doing this meant that all conditions were at least standardised in terms of the time they took to complete.

Twenty-six brochures were studied in the previous chapter. Most of these were affiliated with Devon County Council and used a similar structure whereby the reader is instructed through a series of directions and alerted to potential opportunities along the way. The decision was therefore taken to select one of these brochures to act as the standard brochure condition. Specifically, a two-page extract of the West Devon Way brochure was used (Figure 6.2). The only modifications to the original brochure we carried out were changing place names to fictitious ones to avoid the possibility of respondents being too familiar with a route, and replacing the Ordnance Survey map with our own representation for copyright purposes.

The enhanced brochure is displayed in Figure 6.3. The appearance of the brochure was kept as similar to the standard brochure as possible; only the text in the main body of the brochure was altered. The text was modified with the aim of altering affective and instrumental attitudes, establishing descriptive normative beliefs, and enhancing behavioural control regarding recreational walking in natural environments, and by consequence, increasing intentions for the same behaviour[q]. We used Abraham's (2012) guidance on behaviour change techniques that can be incorporated into text (broadly similar to the CALO-RE taxonomy of behaviour change techniques used for changing diet and PA behaviour; Michie, et al., 2011) to inform the development of the enhanced brochure. After brochure enhancements were made, we analysed both the standard and enhanced brochures using the taxonomy developed in Chapter 5 to demonstrate that the enhanced brochure had a more balanced distribution of potentially persuasive message categories. The change mechanisms, associated behaviour change techniques, and the overall logic model we used to inform the development of the enhanced brochure (and evaluate both brochures) can be seen in Figure 6.4. See Appendix P for an

[q] We decided not to manipulate injunctive norms (e.g. whether peers would approve of the behaviour) as pre-testing suggested these messages sounded too artificial. Furthermore we did not manipulate some external control aspects (e.g. access to appropriate finances in order to get to the walk; the availability of open green space nearby etc) because the nature of this task was essentially fictional.

annotated version of the enhanced brochure which highlights the exact text which was added, the change mechanism which the text was targeting and the related behaviour change technique which was employed.


Stage 1:

Forhampton to Wickbury

Distance: 5 miles (8 km)

Surfaces: Uneven surfaces, including fields, grassy lanes and woodland tracks. Some muddy stretches after heavy rain.
Gradients: A steep climb away from the West Forment River below Peldon Viaduct. Fairly steep descent to Wickbury. Otherwise gentle gradients.
Obstacles: A few gates. Two foot-bridges with steps.

1 The walk begins at the centre of Forhampton. When open, start by passing through a gated courtyard by the Museum of Formoor Life and Tourist Information Centre, following a path to the right hand side of the museum, through the car park onto Jacobs Pool, where you turn left. When closed, walk up George Street, to the left of the White Hart Hotel.

Follow George Street and turn right into Castle Road. Where the road bends right across the West Forment river, continue straight ahead on the path alongside the left bank of the river.

2 Pass through an iron kissing gate into the Town Park Local Nature Reserve, bearing left to climb the middle path through the woods, keeping left at two path junctions. Turn right along a surfaced bridleway shared with traffic.

3 On reaching the golf course, take the path ahead across the golf course, taking care as you proceed. After 200m, as the gravel track turns sharply to the right, continue straight ahead along the path. Leave the golf course at a metal gate, and follow the right edge of the field ahead.

Follow the 'path' signs through a metal gate and through a farmyard, to join a surfaced lane beyond the farm. When you reach the road turn left across the road bridge.

A **Forhampton** has a varied history including production of woollen cloth from the middle ages to the 1700s, tin and copper mining, quarrying and farming. Today, Forhampton is establishing itself as the walking centre for northern Formoor, with links to Peldon along the Formoor railway.

B **Forhampton Castle** was built shortly after the Norman conquest, and has stood in ruins since 1538 when Henry VIII ordered it to be demolished as a punishment for its owner's treason. Today, English Heritage open the grounds to the public over the summer months.

4 Take the path to the rear of the parking area on the right, beside the road. At a junction where a path goes to your right under the road, keep straight ahead on the path towards the river. Continue alongside the West Forment, cross the footbridge and climb the hill on the path bearing left. Pass through a gate, turn right onto a track past Peldon Farm, and turn left when you reach the road.

4

5 Pass under the railway bridge and continue ahead, as the road soon becomes an unsurfaced green lane. Passing through a gate, the lane widens out, then reaches the open moor through another gate with Wickbury Tors ahead.

6 Follow the stone wall on the left, then bear away past an old granite gate post. As you climb the hill, after 45m, look out for the route along a grassy path to the right, running parallel with an old stone wall for most of its length. Follow this path straight across a junction of routes until you reach a shallow cutting on your right between two stone walls. With Wickbury Church ahead of you, take this path down between two parallel walls, leaving the moor and crossing the Granite Way on a track leading into the small village of Wickbury.

Peldon Reservoir

For a scenic detour from the walk, follow the road on your left signed to Peldon Reservoir at point 5. The reservoir was created by damming the West Forment River, and opened in 1972. From the car park and public toilets you can access a range of local walks leading around the reservoir, into the surrounding hills, or towards Peldon Viaduct.

Alternative route: Across the Peldon Viaduct

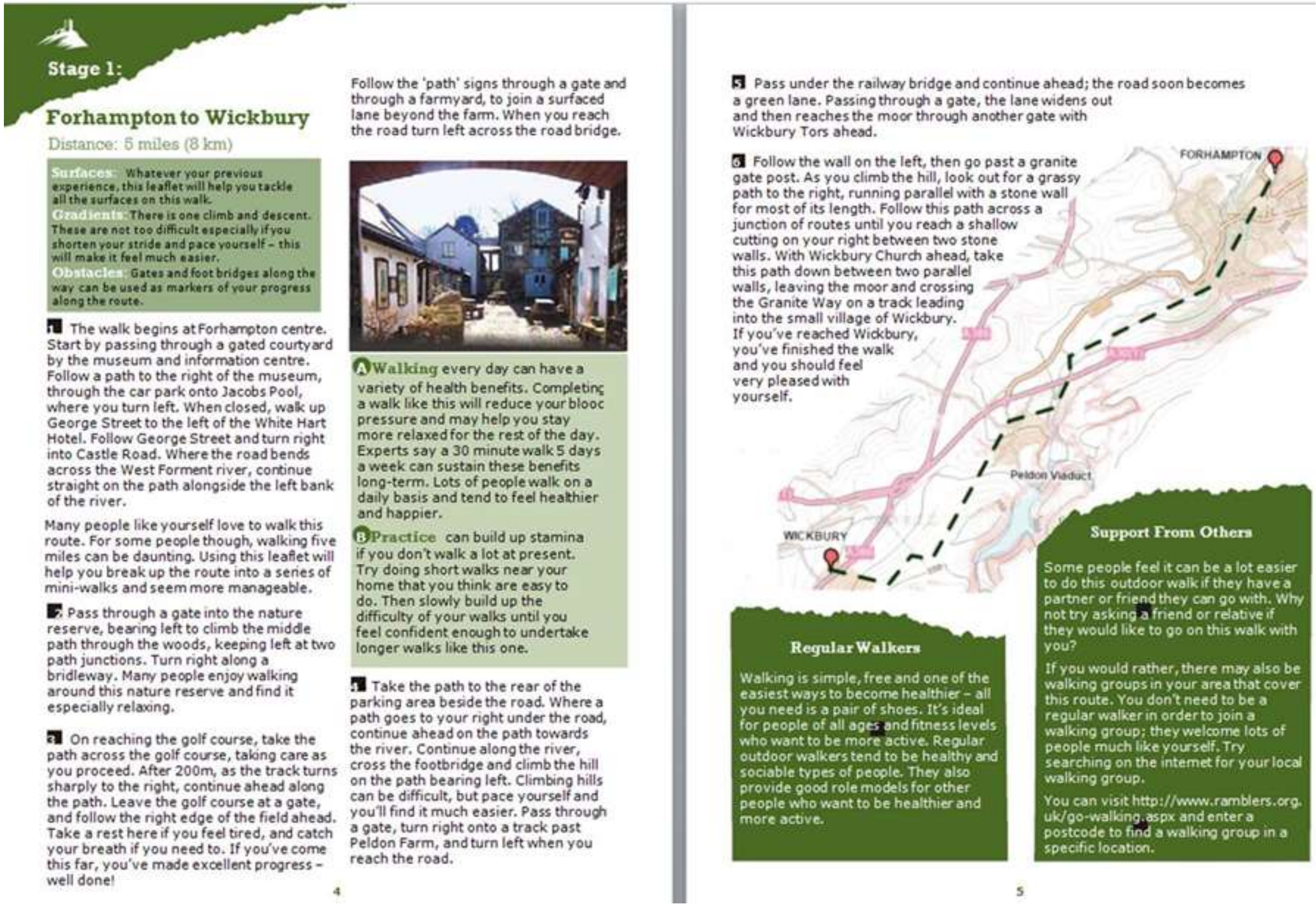
To cross the spectacular Peldon Viaduct, turn left after the road bridge, 4, and opposite the parking area onto a bridleway through woods.

Follow the path straight ahead at any path junctions, walk under the viaduct and climb the steps. At the top, turn sharp left across the viaduct, and follow the Granite Way along the old railway path to a point where it crosses a road.

Turn left here to rejoin the main walk, 5, with the route heading up the lane to the right.

5

Figure 6.2 The brochure extract used for the standard brochure condition.


Stage 1:

Forhampton to Wickbury

Distance: 5 miles (8 km)

Surfaces: Whatever your previous experience, this leaflet will help you tackle all the surfaces on this walk.
Gradients: There is one climb and descent. These are not too difficult especially if you shorten your stride and pace yourself – this will make it feel much easier.
Obstacles: Gates and foot bridges along the way can be used as markers of your progress along the route.

1 The walk begins at Forhampton centre. Start by passing through a gated courtyard by the museum and information centre. Follow a path to the right of the museum, through the car park onto Jacobs Pool, where you turn left. When closed, walk up George Street to the left of the White Hart Hotel. Follow George Street and turn right into Castle Road. Where the road bends across the West Forment river, continue straight on the path alongside the left bank of the river.

Many people like yourself love to walk this route. For some people though, walking five miles can be daunting. Using this leaflet will help you break up the route into a series of mini-walks and seem more manageable.

2 Pass through a gate into the nature reserve, bearing left to climb the middle path through the woods, keeping left at two path junctions. Turn right along a bridleway. Many people enjoy walking around this nature reserve and find it especially relaxing.

3 On reaching the golf course, take the path across the golf course, taking care as you proceed. After 200m, as the track turns sharply to the right, continue ahead along the path. Leave the golf course at a gate, and follow the right edge of the field ahead. Take a rest here if you feel tired, and catch your breath if you need to. If you've come this far, you've made excellent progress – well done!

Follow the 'path' signs through a gate and through a farmyard, to join a surfaced lane beyond the farm. When you reach the road turn left across the road bridge.

A Walking every day can have a variety of health benefits. Completing a walk like this will reduce your blood pressure and may help you stay more relaxed for the rest of the day. Experts say a 30 minute walk 5 days a week can sustain these benefits long-term. Lots of people walk on a daily basis and tend to feel healthier and happier.

B Practice can build up stamina if you don't walk a lot at present. Try doing short walks near your home that you think are easy to do. Then slowly build up the difficulty of your walks until you feel confident enough to undertake longer walks like this one.

4 Take the path to the rear of the parking area beside the road. Where a path goes to your right under the road, continue ahead on the path towards the river. Continue along the river, cross the footbridge and climb the hill on the path bearing left. Climbing hills can be difficult, but pace yourself and you'll find it much easier. Pass through a gate, turn right onto a track past Peldon Farm, and turn left when you reach the road.

4

5 Pass under the railway bridge and continue ahead; the road soon becomes a green lane. Passing through a gate, the lane widens out and then reaches the moor through another gate with Wickbury Tors ahead.

6 Follow the wall on the left, then go past a granite gate post. As you climb the hill, look out for a grassy path to the right, running parallel with a stone wall for most of its length. Follow this path across a junction of routes until you reach a shallow cutting on your right between two stone walls. With Wickbury Church ahead, take this path down between two parallel walls, leaving the moor and crossing the Granite Way on a track leading into the small village of Wickbury. If you've reached Wickbury, you've finished the walk and you should feel very pleased with yourself.

Regular Walkers

Walking is simple, free and one of the easiest ways to become healthier – all you need is a pair of shoes. It's ideal for people of all ages and fitness levels who want to be more active. Regular outdoor walkers tend to be healthy and sociable types of people. They also provide good role models for other people who want to be healthier and more active.

Support From Others

Some people feel it can be a lot easier to do this outdoor walk if they have a partner or friend they can go with. Why not try asking a friend or relative if they would like to go on this walk with you?

If you would rather, there may also be walking groups in your area that cover this route. You don't need to be a regular walker in order to join a walking group; they welcome lots of people much like yourself. Try searching on the internet for your local walking group.

You can visit http://www.ramblers.org.uk/go-walking.aspx and enter a postcode to find a walking group in a specific location.

5

Figure 6.3 The brochure extract used for the enhanced brochure condition.

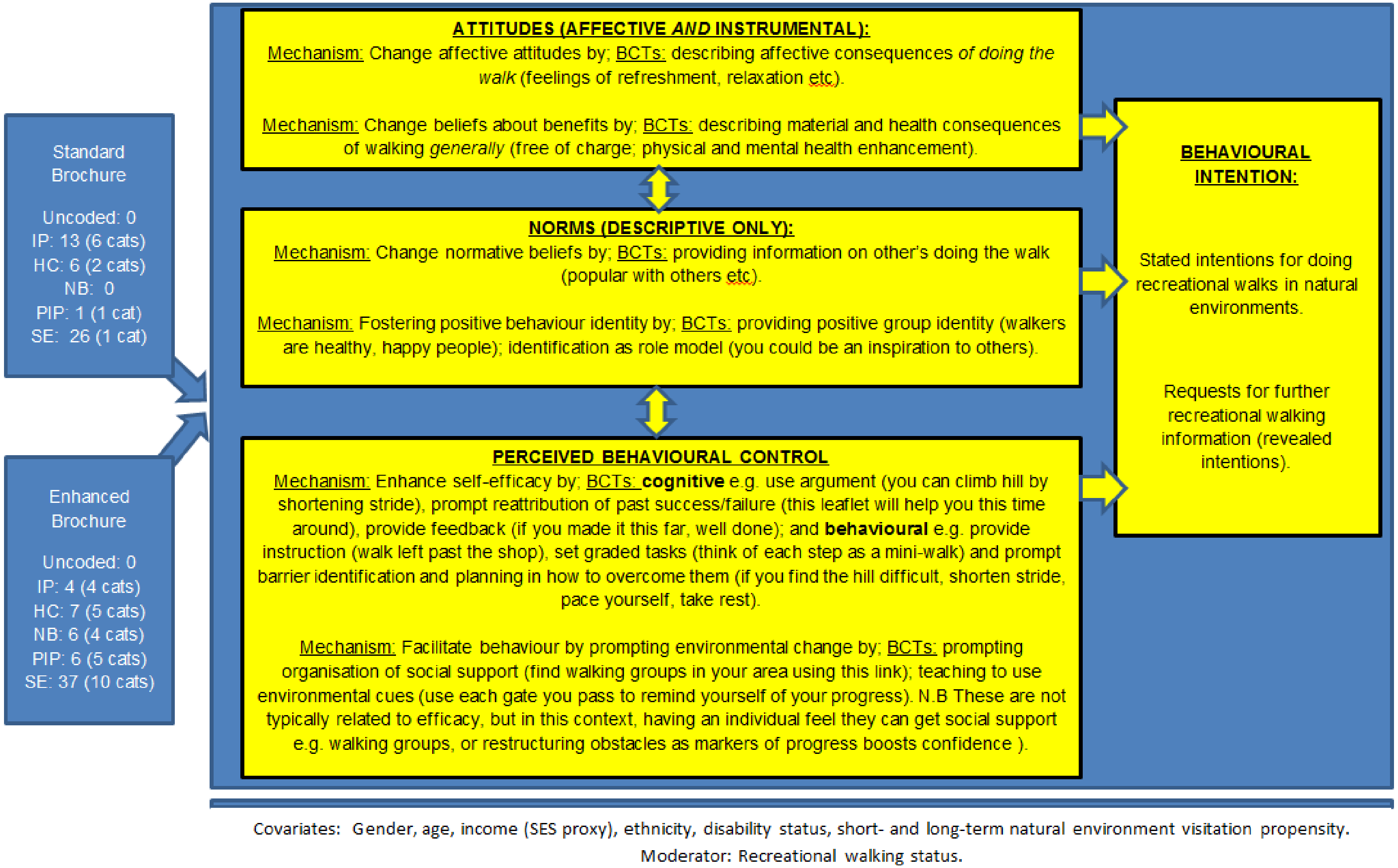


Figure 6.4 A logic model for how the two brochure conditions could differently influence intentions to undertake recreational walking in natural environments. The techniques in the central box are the ones employed in the enhanced brochure. Also note the more even distribution of superordinate constructs (the left of the diagram) in the enhanced brochure as identified by using the taxonomy developed in Chapter 5 (PI=providing information, HC=Highlighting potential consequences and opportunities, NB=raising normative beliefs, PIP=Promoting intentions and planning, SE=enhancing self-efficacy, "*n* cats" refers to the number of subordinate categories utilised).

6.2.3 Measures

A table of the main measures used in this study is displayed in Table 6.1.

6.2.3.1 Outcome variables

Using Ajzen's (2015) guidance for creating a theory of planned behaviour questionnaire, we used two items to assess stated intentions for completing outdoor recreational walking routes (see Table 6.1). These two items were reverse-coded, so higher scores represented stronger intentions, and collapsed in the analysis because of their high internal consistency (α=.91). Our second outcome measure concerned a binary measure of revealed intentions (see Table 6.1) and represented the proportion of people selecting the option "show me walking information and submit." These two outcome variables are analogous to stated and revealed preferences used in economics literature and researchers in this field often combine the two when attempting to ascertain the value of an intervention (e.g. Adamowicz, Swait, Boxall, Louviere & Williams, 1997; Ben-Akiva et al., 1994; Whitehead, Haab & Huang, 2000).

Table 6.1

All quantitative measures used in the survey.

Construct	Item(s)
Recreational walking status	When we refer to “walking routes” we mean walking through trails/routes/paths for pleasure in outdoor natural environments such as open spaces in and around towns and cities, the coast and the countryside. These could be short or long, circular or linear, easy or difficult, marked or unmarked, walking routes. We do not mean walking these routes for transport purposes (to get to and from places) or walking around your own private garden or land. **Please check the statement that most applies to yourself:** “I <u>do not</u> regularly complete walking routes and <u>am not thinking about starting</u>” “I <u>do not</u> regularly complete walking routes but I <u>am thing about starting (but not in the next month)</u>” “I <u>do not</u> regularly complete walking routes but <u>am thinking about starting in the next month</u>” “I <u>do</u> regularly complete walking routes and have <u>done so for less than 6 months</u>” “I <u>do</u> regularly complete walking routes and have <u>done so for over 6 months</u>” *Respondent selects one option.*
Short-term propensity for visiting natural environments	**We would like to know when you made out of doors visits in the <u>last two weeks</u>.** By out of doors we mean open spaces in and around towns and cities, the coast and the countryside. This could be anything from a few minutes to all day. It may include time spent close to your home, further afield or while on holiday. However this does not include routine shopping trips or time spent in your own garden. **How often did you make this type of visit in the last two weeks?** *Respondent types a number.*

Long-term propensity for visiting natural environments	**Thinking about the last 12 months, how often, on average, have you spent your leisure time out of doors, away from your home?** Again, by out of doors we mean open spaces in and around towns and cities, the coast and the countryside. More than once per day Every day Several times a week Once a week Once or twice a month Once every 2-3 months Once or twice Never *Respondent selects one option.*
Instrumental attitudes	"Doing this outdoor walking route would be…" *1 (bad) to 7 (good)* "Doing this outdoor walking route would be…" *1 (very worthwhile) to 7 (not at all worthwhile)*
Affective attitudes	"Doing this outdoor walking route would be…" *1 (pleasant) to 7 (unpleasant)* "Doing this outdoor walking route would be…" *1 (exciting) to 7 (boring)*
Descriptive norms	"Other people like me complete walking routes like this." *1 (strongly agree) to 7 (strongly disagree)* "A wide range of people complete walking routes like this." *1 (strongly agree) to 7 (strongly disagree)*
Efficacy beliefs	"I am confident I could complete walking routes like this." *1 (true) to 7 (false)* "Completing walking routes like this would be…" *1 (very difficult) to 7 (very easy)*
Stated intentions	"I would be willing to complete walking routes like this." *1 (strongly agree) to 7 (strongly disagree)* "In the future, I intend to complete walking routes like this." *1 (strongly agree) to 7 (strongly disagree)*

Revealed intentions	**If you would like further information on walking in your area, please select "show me walking information and submit" below. If you do not wish to be shown this, please just select "take me to submission page."** Show me walking information and submit Take me to submission page *Respondent selects one option.*

6.2.3.2 Demographic covariates

Respondents were then asked items which recorded their ethnicity and disability status (i.e. if they had any long-standing illness or disability which limited their daily activities); both of these items were derived from MENE (Natural England, 2015). Income was used as a partial measurement of socio-economic status; respondents were asked to indicate which of five quintiles referred to their annual household income before tax (Office for National Statistics, 2013) and there was also a “don’t know” option for respondents who did not know, or did not wish to report their income. Gender and age were automatically logged by the online surveying system (age being an approximate estimate as the software recorded year of birth only). Age was recoded into tertiles (18 to 34, 35 to 48, 49 to 65), and ethnicity dichotomised into “white-British” and “all other ethnicities”. As noted in Chapter 3, gender, age, ethnicity, disability, and socio-economic status have all been shown to moderate relationships concerning physical activity in natural environments (Bedimo-Rung et al., 2005; Cohen, McKenzie, Sehgal, Williamson, Golinelli & Lurie, 2007; Giles-Corti & Donovan, 2002; Maas et al., 2008). Thus, they could reasonably moderate intentions to undertake recreational walking in natural environments.

6.2.3.3 Visits to natural environments

Accounting for past behaviour in any intervention using the theory of planned behaviour is vital (Hagger et al., 2002). Therefore, respondent’s propensity for visiting natural environments was controlled for. Respondents were asked how many “out of doors” visits they made in the last two weeks. This measure was used to determine the respondent's short-term propensity for visiting natural environments (see Table 6.1) and reflected a similar measure used in Natural England's Monitor of Engagement with the Natural Environment Survey (MENE; Natural England, 2015).This was used as a linear predictor in analysis. Further to this, they were asked how often they made this type of visit in the last 12 months (with nominal response options) to assess their long-term propensity for visiting natural environments (also derived from the MENE survey; see Table 6.1). People who reported visiting several times a day, every day, or several times a week were categorised as more frequent visitors; people reporting less than this were classed as less frequent visitors. This enabled approximately equal groups (52.5% versus 47.6% respectively)[r].

6.2.3.4 Recreational walking status

As a more definitive measure of past behaviour, respondents were asked to report the regularity with which they undertook outdoor recreational walks in natural environments (see Table 6.1). This was proposed to moderate results (see section 6.1.1). Specifically, an item was devised based on the transtheoretical model of behaviour change (Prochaska & DiClemente, 1984). This consisted of five statements corresponding to the precontemplation, contemplation, preparation, action, and maintenance stages of behaviour change, but with regards to "regularly completing walking routes." This behaviour was defined as walking for pleasure along trails, paths or other routes in natural environments. Natural environments were described in the same way the MENE survey uses (Natural England, 2015). Respondents who self-

[r] The fact that these add up to more than 100% is due to rounding error.

reported being in the former three stages were categorised as “non-walkers”, and those who reported being in the latter two stages were categorised as “walkers.”

6.2.3.5 Mediators

The mediators in this analysis pertained to the attitudes, descriptive norms, and efficacy beliefs constructs (see 6.2.2) proposed by the theory of planned behaviour as antecedents to intention formation. All of these items were constructed using Ajzen’s (2015) guidance on creating a theory of planned behaviour questionnaire (see Table 6.1). Where necessary, items were reverse-coded prior to analysis so that higher scores represented more favourable attitudes, normative beliefs, and efficacy beliefs. Responses to the descriptive norm items were collapsed because of their high internal consistency (α=.79) as were responses to the efficacy beliefs items (α=.70) and all four (instrumental and affective) attitude items (α=.86). Whilst we could have analysed instrumental and affective attitudinal items separately, principal component analysis with the four items revealed that a one-factor solution explained 70.79% of the overall variance, with a two-factor solution only explaining a further 13.65%. Thus, we decided to collapse all four into one mediator variable. All three variables were entered linearly into the statistical models.

Descriptive norms and efficacy items were generalised to read “similar walking routes” (see Table 6.1) as opposed to the exact walking route they had just read about or imagined because the enhanced brochure content was designed to raise normative beliefs and enhance efficacy for recreational walking in natural environments more generally. Affective and instrumental attitudes were, in general though not exclusively, more often tied to the walking route advertised. Despite this subtle difference in the target behaviour, it is likely participants responses were anchored on the walk they had just read about or imagined anyway (Tversky & Kahneman, 1974).

6.2.4 Procedure

Respondents were invited to participate via email and on proceeding to the study webpage, were randomly allocated to one of the three potential conditions. They first read background information about the study and completed a consent form. On the next six screens, respondents answered items on their: (a) recreational walking status; (b) short-term propensity for visiting natural environments; (c) long-term propensity for visiting natural environments; (d) ethnicity; (e) disability status; and (f) household income, respectively. On the next screen, respondents in the no-brochure condition read the following text which was derived from Weinstein, Przybylski and Ryan's (2009) study concerning immersion in natural environments (p.1328):

> "Please read the following information carefully:
>
> We would now like you to imagine an outdoor recreational walking route. Pay attention to the colours. Notice the textures. Imagine yourself breathing in the air; notice any smells that may be present.

> Shut your eyes for a minute or two and imagine yourself on this walk. Think carefully about the details before proceeding as we will ask you some questions about the walk in the next section.
>
> When you're ready, click next to continue...”

Whilst the two brochure groups read the following:

> “Please now read the following leaflet about an outdoor recreational walking route.
>
> As you read the leaflet, try to imagine yourself on this walk. Pay attention to the colours. Notice the textures. Imagine yourself breathing in the air; notice any smells that may be present. Think carefully about the details before proceeding.
>
> It's really important that you read the whole leaflet from start to finish and understand what the leaflet is saying so that you can answer the questions in the next section. Reading the leaflet should take around 4 to 5 minutes.”

For the no-brochure group, this text was chosen to maximise the likelihood that they would spend an amount of time imagining the walk that was comparable to the time needed to read brochures. In the brochure groups, similar text was chosen so a comparable level of immersion was induced.

Respondents in the no-brochure group could now proceed to the next screen whilst respondents in the two brochure groups opened the brochure extract in a new browser window and could take as much time as desired to read it. After closing the window, participants were asked whether they had read the brochure extract fully. If they indicated that they had not, they were redirected to a debriefing screen. If they indicated that they had, they could proceed to the next screen.

On the proceeding screens, the attitude, descriptive norm, efficacy beliefs, and stated intention items were administered, respectively. On the penultimate screen, participants in the brochure conditions had the option of reporting if any of the text in the brochure had changed their motivation to go on outdoor recreational walks, and if so they could explain why (see Appendix Q for a summary of responses to this item). On the final screen, the revealed intention measure (as detailed in section 6.2.3.1) was administered. Regardless of the option selected, the next screen displayed a debriefing statement informing the respondents of the nature of the study and of further walking information.

6.2.5 Analytical strategy

Respondents completing the survey in fewer than three minutes were excluded as it was deemed they did not pay sufficient attention to the task. The lower value was chosen because pre-testing the brochure revealed that it would take at least two minutes to read meaning that insufficient attention was paid to the survey items. Furthermore, both the no-brochure groups and the brochure groups were instructed to spend a few minutes on the main task meaning that they would have been paying insufficient attention. After these exclusions, respondents with a survey completion time over one standard deviation above the mean completion time were also excluded; this is considered good practice in the analysis of online surveys (Malhotra, 2008).

Linear regression was used to analyse stated intentions and binary logistic regression to analyse revealed intentions. In the first block, we entered dummy variables for the experimental conditions using the standard brochure as a reference category because this is analogous to ‘usual care’ in behavioural interventions (Freedland, Mohr, Davidson & Schwartz, 2011). In the second we added the five demographic variables using males, the youngest age tertile, respondents of black or minority ethnicity, respondents with a disability, and respondents with the lowest household income as reference categories. In the third block, we added long- and short-term propensity for visiting natural environments. In the fourth block we added respondents’ recreational walking status using “non-walkers” as the reference category. The models would then be stratified by recreational walking status (assuming that it would play a strong predictive role – see section 6.1.1) to see how this moderated relationships between the conditions and the two outcome variables. In a final step, the linear predictors representing composite attitudes, descriptive norms, and efficacy beliefs scores were added to the model to see if these mediated relationships between the brochures and the outcome variables.

6.3 Results

In total, 788 participants were originally recruited to take part (no-brochure n=253, standard n=269; enhanced n=266), in the knowledge that excluding participants based on their survey completion time would reduce these numbers to nearer the target sample size. Eight people assigned to the original leaflet, and 14 people assigned to the enhanced leaflet, dropped out after indicating that they had not read the leaflet in full. Five respondents were excluded whose gender and age were not recorded resulting in a sample size of 761.

Survey completion times ranged from 43 seconds to over four-and-a-half hours. Following section 6.2.5, respondents who completed the survey in fewer than three minutes were excluded. The consequent sample size was 575. At this stage the mean completion time was 8.6 minutes with a standard deviation of 15.5 minutes. Therefore, following section 6.2.5, respondents who completed the survey in greater than 24.1 minutes (over 1 standard deviation) were also excluded. This resulted in a further 18 exclusions and a resultant sample size of 557 (no-brochure n=155, standard n=205, enhanced n=197)[s]. This exceeded the number needed for power of 0.8 and actually equated to power of 0.86. Fifty-five percent of the sample was female and the mean age was 42. Importantly, respondents were not excluded differentially by recreational walking status. Before exclusions, 410 respondents (53.88%) were “walkers” and 351 (46.12%) were “non-walkers.” After exclusions, 300 (53.86%) were “walkers” and 257 (46.14%) were “non-walkers.”

There were no differences between the three conditions in terms of age (F(2, 554)=0.01, p=.99), gender (X^2(2, N=557)=0.12, p=.94), ethnicity (X^2(2,

[s] See section 6.4.2 for an explanation of this differential exclusion by condition.

N=557)=0.38, *p*=.83), household income (X^2(10, N=557)=11.48, *p*=.32) or disability status (X^2(2, N=557)=0.85, *p*=.66). There were also no differences regarding propensity to visit natural environments in the last two weeks (*F*(2, 554)=0.01, *p*=.99), in the last 12 months (X^2(14, N=557)=12.39, *p*=.58), or recreational walking status (X^2(8, N=557)=9.52, *p*=.30).

6.3.1 Descriptive statistics

Descriptive statistics for both dependent variables and the three mediator variables are displayed in Table 6.2. The descriptive statistics show that mean intention scores after reading the enhanced brochure were higher than after reading the standard brochure, though not notably higher than the no-brochure condition. These differences did not change systematically with recreational walking status. Overall however, stated intention scores, as expected, were lower for non- walkers, and higher for walkers. Furthermore, the standard deviations for stated intentions scores show that scores were generally less dispersed for walkers, and more dispersed for non-walkers, signifying more individual differences among this group. Overall, there appeared not to be a big difference in revealed intentions, but once split by recreational walking status, non-walkers were more likely to request information in the no-brochure condition and after reading the enhanced brochure than after reading the standard brochure. Conversely, walkers were more likely to request information following a reading of the standard brochure compared to reading the enhanced brochure or in the no-brochure condition.

Table 6.2

Means and standard deviations (in parentheses) for dependent and mediator variables overall and split by recreational walking status.

	Overall (n=557)			Non-walkers (n=257)			Walkers (n=300)		
	No-brochure (n=155)	Standard brochure (n=205)	Enhanced brochure (n=197)	No-leaflet (n=69)	Standard brochure (n=91)	Enhanced brochure (n=97)	No-leaflet (n=86)	Standard brochure (n=114)	Enhanced brochure (n=100)
Stated intentions	5.35 (1.68)	4.97 (1.77)	5.30 (1.55)	4.67 (1.83)	4.19 (1.67)	4.74 (1.63)	5.90 (1.32)	5.60 (1.59)	5.85 (1.24)
Revealed intentions (%)	41.29	43.90	39.09	42.03	23.08	42.27	40.70	60.53	36.00
Attitudes	5.58 (1.06)	5.26 (1.18)	5.50 (1.27)	5.41 (1.08)	4.89 (1.22)	5.20 (1.38)	5.72 (1.03)	5.58 (1.05)	5.81 (1.08)
Normative beliefs	5.16 (1.42)	5.15 (1.39)	5.32 (1.46)	5.11 (1.34)	4.67 (1.36)	4.96 (1.52)	5.21 (1.50)	5.53 (1.30)	5.67 (1.32)
Self-efficacy	5.16 (1.52)	4.95 (1.51)	5.30 (1.47)	4.71 (1.84)	4.34 (1.64)	4.84 (1.62)	5.52 (1.09)	5.43 (1.21)	5.75 (1.15)

[N.B] Mean stated intention scores represent the average of two 7-point rating scales (“I would be willing to complete walking routes like this” and “In the future, I intend to complete walking routes like this”). These were recoded such that 1=strongly disagree and 7=strongly agree.

[N.B] Revealed intentions reflect the percentage of people who clicked “show me walking information and submit” on the final page of the survey as opposed to “take me to submission page”.

[N.B] Mean attitude score comprised the average score of four 7-point attitudinal items see section 6.2.3.5. Mean descriptive norm score and mean self-efficacy score also comprised the average of two 7-point items each (see section 6.2.3.5).

[N.B] Recreational walking status was dichotomised into two groups representing those self-reporting themselves as being in the precontemplation, contemplation, and preparation stages of readiness to change (non-recreational walkers) and those self-reporting being in the action and maintenance stages of readiness to change (recreational walkers).

Attitude and efficacy scores tended to be higher after reading the enhanced brochure and in the no-brochure condition regardless of recreational walking status, though descriptive norm scores showed more mixed relationships. As expected, mean scores on theory of planned behaviour items overall were generally lower and more dispersed for non-walkers, and higher and less dispersed for walkers. In a similar way to intention scores, this demonstrates that there may be more individual difference in responses to these items for people who are not recreational walkers at present.

6.3.2 Overall stated and revealed intentions

Table 6.3 displays results of the overall regression models; consult Appendix R for full results. In the unadjusted model, reading the enhanced brochure elicited significantly higher stated intentions than reading the standard brochure (*b*=0.33, 95% CI 0.01, 0.66). However, reading no brochure was equally as effective in terms of raising stated intentions (*b*=0.38, 95% CI 0.04, 0.73). There were no differences between conditions in terms of raising revealed intentions. After adjusting for demographic covariates, propensity for visiting natural environments, and recreational walking status, the difference in stated intentions between reading no brochure and reading the standard brochure was only marginal. However, reading the enhanced brochure elicited still significantly higher intentions than reading the standard brochure (*b*=0.33, 95% CI 0.03, 0.62). There remained no significant differences between conditions in terms of revealed intentions. Table 6.3 also demonstrates the importance of recreational walking status. After adjustments, walkers rated their intentions one point higher than non-walkers (*b*=1.08, 95% CI 0.81, 1.35) and were 1.59 times more likely to request more walking information (e^b=1.59, 95% CI 1.09, 2.31). Recreational walking status was the biggest predictor of stated intentions and the second biggest predictor of revealed intentions. In line with our hypothesis, we therefore stratified each regression model by recreational walking status.

Table 6.3

Unadjusted and adjusted regression coefficients for stated and revealed intentions (whole sample n=557).

	Stated Intentions			Revealed Intentions		
	b	LB	UB	e^b	LB	UB
Unadjusted						
Constant	4.97	4.74	5.20	0.78	-	-
Brochure (Standard brochure=ref)						
No brochure	0.38*	0.04	0.73	0.90$^{n.s}$	0.59	1.37
Enhanced brochure	0.33*	0.01	0.66	0.82$^{n.s}$	0.55	1.22
R^2	0.01			0.00 (Cox & Snell)		
				0.00 (Nagelkerke)		
Adjusted for demographics, propensity for visiting natural environments, and recreational walking status						
Constant	1.83	0.90	2.76	0.45	-	-
Brochure (Standard brochure=ref)						
No brochure	0.30†	-0.01	0.62	0.93$^{n.s}$	0.60	1.44
Enhanced brochure	0.33*	0.03	0.62	0.81$^{n.s}$	0.53	1.21
Recreational walking status (Non-walkers=ref)						
Walkers	1.08***	0.81	1.35	1.59*	1.09	2.31
R^2	0.22			0.05 (Cox & Snell)		
				0.07 (Nagelkerke)		

$^{n.s}$ not significant; † p<.1; * p<.05; *** p<.001; $^{N.B}$ “LB” and “UB” refer to 95% confidence intervals; for revealed intentions, these are not symmetrical around the odds ratio because the confidence intervals are exponentiated from the confidence intervals around the log of the odds.

6.3.3 Stratified intentions

Table 6.4 displays results of the stratified regression models, full results can be viewed in Appendix S. After adjustment for demographic variables and propensity for visiting natural environments, non-walkers reading the enhanced brochure were significantly more likely to have higher stated intentions (b=0.50, 95% CI 0.04, 0.96) and 1.4 times more likely to request further walking information (e^b=2.40, 95% CI 1.24, 4.66) compared to if they had read the standard brochure. Non-walkers reading no brochure had the same stated intentions as non-walkers reading the standard brochure, but reading no brochure did significantly raise the likelihood of requesting further walking information (e^b=2.42, 95% CI 1.19, 4.95). Interestingly, for non-walkers, the inclusion of mediator variables representing theory of planned behaviour constructs fully mediated the difference in stated intentions between reading the enhanced and standard brochures, and partially mediated the significant differences in revealed intentions. In both models, attitudes and self-efficacy were more significant predictors than descriptive norms.

Table 6.4

Partially and fully adjusted (including mediator variables) regression coefficients stratified by recreational walking status.

	Stated Intentions						Revealed Intentions					
	Non-walkers (n=257)			Walkers (n=300)			Non-walkers (n=257)			Walkers (n=300)		
	b	LB	UB	*b*	*LB*	*UB*	e^b	LB	UB	e^b	LB	UB
Adjusted for demographics and propensity for visiting natural environments												
Constant	2.29	0.99	3.58	4.61	3.38	5.83	-1.43	-	-	1.18	-	-
Brochure (Standard brochure=ref)												
No brochure	$0.37^{n.s}$	-0.13	0.88	$0.25^{n.s}$	-0.15	0.65	2.42^{*}	1.19	4.95	0.48^{*}	0.26	0.86
Enhanced brochure	0.50^{*}	0.04	0.96	$0.25^{n.s}$	-0.13	0.64	2.40^{**}	1.24	4.66	0.36^{***}	0.20	0.64
R^2	0.20			0.06			0.10 (Cox & Snell)			0.08 (Cox & Snell)		
							0.13 (Nagelkerke)			0.11 (Nagelkerke)		
Additionally adjusted for mediators												
Constant	-0.30	-1.31	0.70	0.34	-0.86	1.53	0.03	-	-	2.08	-	-
Brochure (Standard brochure=ref)												
No brochure	$-0.03^{n.s}$	-0.39	0.33	$0.20^{n.s}$	-0.13	0.53	$2.03^{\dagger}$	0.95	4.32	0.46^{*}	0.26	0.85
Enhanced brochure	$0.12^{n.s}$	-0.21	0.45	$0.05^{n.s}$	-0.26	0.36	$1.93^{\dagger}$	0.96	3.88	0.35^{***}	0.20	0.63
Mediators												
Attitudes	0.38^{***}	0.23	0.53	0.52^{***}	0.35	0.69	$1.34^{\dagger}$	0.96	1.86	$1.18^{n.s}$	0.86	1.62
Descriptive norms	0.15^{*}	0.02	0.27	0.13^{*}	0.00	0.25	$1.06^{n.s}$	0.81	1.38	$1.01^{n.s}$	0.80	1.26
Self-efficacy	0.50^{***}	0.39	0.61	0.24^{***}	0.11	0.38	1.49^{**}	1.16	1.90	$0.91^{n.s}$	0.71	1.17
R^2	0.61			0.40			0.19 (Cox & Snell)			0.09 (Cox & Snell)		
							0.26 (Nagelkerke)			0.12 (Nagelkerke)		

$^{n.s}$ not significant; † *p*<.1; * *p*<.05; ***p*<.01; *** *p*<.001; $^{N.B}$ "LB" and "UB" refer to 95% confidence intervals; for revealed intentions, these are not symmetrical around the odds ratio because the confidence intervals are exponentiated from the confidence intervals around the log of the odds.

After adjustment for demographics and propensity for visiting natural environments, there were no significant differences between the three conditions in terms of raising stated intentions for walkers. However, walkers reading no brochure were 0.52 times less likely to request further walking information than walkers reading the standard brochure (e^b=0.48, 95% CI 0.26, 0.86). Walkers reading the enhanced brochure were 0.65 times less likely to request further walking information than walkers reading the standard brochure (e^b=0.36, 95% CI 0.20, 0.64). While the inclusion of mediator variables strongly influenced intentions in both models, for walkers, it had no effect on the difference between brochures. Overall, for both walkers and non-walkers, theory of planned behaviour constructs influenced stated intentions more strongly than revealed intentions.

6.4 Discussion

This study investigated the effects of modifying text in recreational walking brochures to include persuasive messages targeting theory of planned behaviour constructs on intentions to do recreational walking in natural environments. It was predicted that there would be a linear trend whereby reading the enhanced brochure elicited higher intentions than reading the standard brochure which in turn elicited higher intentions than reading no brochure. This hypothesis was disconfirmed. Reading the enhanced brochure elicited significantly higher stated intentions than reading the standard brochure, but was no more effective than reading no brochure. There were no differences between conditions regarding revealed intentions. It was also predicted that frequent recreational walkers (walkers) would report higher intentions when reading a brochure but that the two brochures would not perform differently from one another. Again, this hypothesis was disconfirmed because, while there were no differences between conditions regarding stated intentions, walkers more often requested walking information when reading the standard brochure compared to the other two conditions. Lastly, it was predicted that non-recreational walkers (non-walkers) would exhibit equivalent intentions to reading the standard brochure as they did no brochure, but that reading the enhanced brochure would raise intentions considerably. This was mostly confirmed. In terms of stated intentions, this was precisely the pattern found. In terms of revealed intentions, non-walkers more often requested walking information after reading the enhanced brochure compared to the standard brochure, but also did after reading no brochure. For non-walkers, the addition of theory of planned behaviour constructs to the models mediated the impact of reading the enhanced brochure on both stated and revealed intentions (to differing extents).

6.4.1 The effect of enhanced versus standard brochures on intentions

The most encouraging result from this study concerns the effect of the enhanced brochure on non-walkers. Non-walkers were individuals that self-reported not currently completing outdoor walking routes in natural environments. After reading the enhanced brochure, non-walkers reported significantly higher stated intentions for completing outdoor walking routes and were 1.4 times more likely to request further walking information compared to when they had read the standard brochure. In part, the study is able to explain why this is the case. The enhanced brochure was designed specifically to alter instrumental and affective attitudes towards, descriptive normative beliefs about, and self-efficacy for, completing recreational walking routes in natural environments. The inclusion of variables that measured these constructs mediated the impact of reading the enhanced brochure on stated intentions such that the comparison between it and reading the standard brochure was non-significant. This provides strong evidence that the enhanced brochure altered these three antecedents and caused the differences in stated intentions. Judging by the coefficients, attitudes and self-efficacy for completing outdoor recreational walking routes were most affected. Whilst these constructs did not appear to have as greater influence on revealed intentions, they still partially mediated the significant differences. This lesser effect on revealed intentions would be expected because the theory of planned behaviour is better at predicting intentions than it is behaviours (Hagger et al., 2002) and this particular measure (requesting further walking information or not) could be considered more proximal to an outward measure of behaviour than stated intentions (in line with traditional revealed preference theory; Samuelson, 1948; Houthakker, 1950).

This is somewhat in contrast to findings from qualitative literature. Infrequent users of greenspace (who are also more likely to be inactive; Coombes et al., 2010) report being motivated by physical attributes of greenspaces (Dallimer et al., 2014; Irvine et al., 2013) or physical attributes in general (McCormack et al., 2010). Conversely, we find that people that walk infrequently in natural environments are more motivated by messages which build confidence and highlight health-enhancing and affective consequences of walking. Previous research may explain why this is the case. For example, neighbourhood aesthetics and physical attributes predict walking behaviour, but these associations are mediated by having favourable instrumental and affective attitudes towards walking (Rhodes et al., 2006). In a similar way, the findings from the present study and from qualitative research may be complementary rather than incompatible; perceiving attributes of environments as pleasant may predict having more positive attitudes towards walking which in turn predicts higher intentions for walking (and potentially actual behaviour).

Consistent with the hypotheses, frequent recreational walkers stated no greater intentions to undertake outdoor recreational walking routes when reading the standard brochure and the enhanced brochure; they had equal effects. However, when examining revealed preferences, these individuals were significantly less likely to request further walking information at the end of the study after having read the enhanced brochure, suggesting that this did not encourage this group to complete outdoor walking routes. In part this is consistent with the findings of the previous chapter. Chapter 5 suggested that recreational walking brochures were designed to appeal to people who already undertook walking in natural environments (see section 5.4.2). This study has revealed that this may well be the case; regular recreational walkers appear to be more motivated by the standard brochure because it contains the sort of information (e.g. outcome expectancies related to heritage features) that motivates them to undertake walking currently. It could be that the enhanced brochure lowered intentions for regular recreational walkers because they found the language within to be patronising[t]. This is akin to the phenomenon of 'baby talk' in health psychology where the provider of healthcare underestimates the knowledge of the patient and uses language perceived by the patient to be patronising which could lead to patient disengagement (McKinlay, 1975; Waitzkin, 1985).

6.4.2 Why does reading no brochure raise intentions?

In this study, reading no brochure appeared to raise stated intentions overall, and revealed intentions for non-walkers compared to reading the standard brochure. One reason this could be the case is because people may have reference points for what a recreational walk in a natural environment should be like that are not matched by the content of the brochures. "Mental contrasting", as proposed by Oettingen, Pak and Schnetter (2001) and expanded on later by Oettingen (2012) is where people imagine the fulfilment of a desired future and then reflect on the present reality which stands in the way of attaining this. Consequently, the individual recognises the need to take action to overcome obstacles which stand in the way of the desired future and thus expectations of how successful they might be become activated. If the individual envisions a high likelihood of success, their intentions are strengthened, and if the individual envisions a low likelihood of success, their intentions are weakened. In contrast, "indulging" is where individuals fantasise about a desirable future. In this mode

[t] There were five mentions to this effect in the qualitative responses of walkers reading the enhanced brochure: "The tone of the leaflet was quite condescending;" "Found the leaflet patronising;" "I found it a bit patronising to be honest;" "Leave the motivational stuff to a separate section…it is annoying and patronising;" "It's a bit patronsising [sic] in places." Having said this, there were also three instances of non-walkers finding the content of the enhanced brochure patronising too. It is important to note, that these comments were in the minority of overall responses (see Appendix Q).

of thought, there is no comparison with reality, thus the individual does not recognise that actions are needed to attain the desired future and expectations of success are not activated. Consequently, intentions are unchanged.

Perhaps when non-walkers had no brochure to read, they “indulged” in an idealistic walk when asked to imagine and outdoor recreational walking route and thus reported relatively high intentions. When reading the standard brochure they may have “mentally contrasted” its content with that of their ideal walk, realised that its content did not facilitate their idea of an ideal walk (triggering lower expectations of success), and thus reported lower intentions, hence the significant differences found. If one interprets the results in this way, then when non-walkers “mentally contrasted” the enhanced brochure with their idea of an ideal walk, the fact that there were no significant differences in stated or revealed intentions between these two conditions implies that the enhanced brochure facilitated their idea of an ideal walk, triggered higher expectations of success, and thus heightened intentions.

Another related explanation for why reading no brochure often raised intentions for non-walkers is revealed through examining the numbers of individuals excluded using the cut-off points for survey completion time. Respondents were differentially excluded by condition with 98 excluded from the no brochure condition compared to 64 and 69 from the standard and enhanced brochure conditions respectively. The task given to respondents with no brochure to read was to close their eyes and imagine a walking route for a minute or two. It is likely that the respondents excluded from the no brochure condition because of completing the survey too quickly either did not, or could not, imagine such a walking route. Therefore, the respondents remaining in the no brochure group were likely to be the individuals who successfully "indulged" in the thought of walking an ideal walking route. Therefore, it could be because of the exclusions that non-walkers' reported intentions after reading no brochure were significantly higher than after reading the standard brochure.[u]

6.4.3 Strengths, limitations and future research

The main strength of this study is that it could inform guidelines regarding how to produce recreational walking brochures. These results, and the previous chapter, demonstrate that as it stands, the production of recreational walking brochures does not conform to the guidelines set out by NICE (2012), in that they do not appear to be informed by behavioural theory and consequently, fail to raise the walking intentions of people who are not regular walkers. Whilst information regarding directions must be included in order to facilitate successful completion of the walk, this study demonstrates that making this information more concise, and replacing repetitive or less persuasive content with content targeting attitudes, normative beliefs, and self-efficacy, can raise walking intentions amongst people who do not regularly undertake walking in natural environments. However, it may be that more regular walkers are better persuaded by content related to pleasant attributes and deterred by, what to them may be perceived as, overly patronising text. In the future, complementary versions of the same brochure could be produced to appeal to these two

[u] A cursory examination of the mean values reveals that before exclusions non-walkers in the no brochure conditions had a mean average stated intentions score of 4.55. After exclusions, this mean score was 4.67, suggesting that this interpretation has some value to it.

demographics. What is clear is that designers may want to use behavioural theories to inform brochure development if they are to attract new walkers.

Only text was manipulated in this study as we were interested in the effects of manipulating written content on individual's intentions to undertake walking in natural environments. However, the style and format of brochures play a role in the processing of this information. For example, tourism research has demonstrated that maps are, generally speaking, difficult to interpret (Molina & Esteban, 2006). The salience of this feature in the brochures could reasonably inhibit the potential persuasiveness of the rest of the content. Previous research from health literacy has demonstrated that health texts utilising graphical illustrations of specific behaviours aid recall of instructions on how to perform behaviours (Kools et al., 2006). Coloured tabs and pictorials can also make for more efficient brochure searching and better comprehension (Kools et al., 2007). Some evidence suggests that additional heading in health texts results in more favourable evaluation of brochures too (Kools, et al., 2008). Thus, there are numerous stylistic features which may aid or inhibit processing and comprehension of the written text that were not present in the brochure extracts used here. Manipulating these in future research may have even greater influences upon intentions because of their ability to enhance processing of the text.

The walking route chosen from this study was a linear one in a semi-rural riverside location. Thus it was a geographically specific location and type of walking route. These may not be the most appealing types of walks, or locations of walks, for some people. Davies, Lumsdon & Weston (2012) conducted eight focus groups to discuss the development of new recreational trails and people's motivations for using them. Generally people reported preferences for short, circular walks near urban areas. The brochure used in this study did not describe such a route, and may explain why levels of stated intentions never averaged the upper intervals of the scale. The same study also identified other individual differences. For example, only male participants reported preferences for independent walking (not in a group). While it is not practical to create a tailored brochure for every individual, future brochure designers could more closely examine the walking preferences of their target audience by using similar focus group methodology.

6.4.4 Conclusion

This study demonstrates that adapting recreational walking brochures to include more persuasive messages based on theory of planned behaviour constructs heightens intentions to undertake recreational walking in natural environments, but only for those who do not regularly undertake such behaviour at present. Conversely, people who are regular recreational walkers appear to be dissuaded by such content, instead favouring standard brochures where theory of planned behaviour content is absent and content regarding pleasant attributes of environments is present. Future brochure design needs to appreciate these distinct demographics and learn to incorporate persuasive messages based on theoretical explanations of behaviour change into their text in order to persuade irregular walkers to undertake walking in natural environments. Doing so could positively influence the outdoor walking intentions of people nationwide, potentially leading to population-level changes in recreational walking and engagement with the natural environment.

7. General Discussion

7.1 Chapter overview

Section 7.2 of this chapter revisits the overall research questions posed in the literature review and briefly summarises the findings of each study in the thesis. Section 7.3 details each chapter's contribution to the literature base while section 7.4 describes the wider implications of each study's findings. Section 7.5 presents a new approach to the study of PA in natural environments based on a model of cultural ecosystem services and reviews each study's findings in light of it. Section 7.6 notes general strengths and limitations with the thesis. The thesis is summarised in section 7.7 and overall conclusions are made in section 7.8.

7.2 Summary of previous chapters

The literature review revealed that a host of systematic reviews of prospective cohort studies have established the physical and mental health benefits associated with undertaking PA. Although the evidence base is weaker, there is consistent evidence that exposure to natural environments also provides physical and mental health benefits. Accordingly, a body of evidence has established that exposure to nature when being physically active provides additive health benefits. Four questions arose from this evidence. Firstly, how does the visual attractiveness of natural environments affect these additive health benefits? Secondly, do natural environments provide spaces for health-enhancing PA attainment, and if so, what intensities and durations of PA do they provide? Thirdly, how is PA in natural environments currently promoted?

Lastly, in the future, how can the promotion of PA in natural environments be optimally promoted?

The literature review found that exposure to scenes of anthropogenic degradation of natural environments could lead to worse psychophysiological outcomes of moderate-intensity, short-duration exercise. However, the evidence for this had methodological weaknesses and failed to identify mechanisms as to how these effects worked. The review also found that on a population level, visits to natural environments were associated with health-enhancing PA attainment. However, no studies to date were able to control for the intensity and duration of PA conducted in natural environments; that is, the type, intensity and duration of PA. The review also found that promoting outdoor PA through printed materials such as brochures may be an effective way of promoting PA in outdoor environments for a large number of people. However, no research had systematically categorised the content of such brochures in terms of how they persuade people to be active outdoors. Lastly, the literature review identified that such brochures could be enhanced using the principles of behaviour change theories. However, to date, no experimental studies had been conducted which examined the effects of manipulating such brochure content on people’s intention to be physically active in natural environments.

Chapter 3 hypothesised that exposure to beach environments with anthropogenic degradation during moderate-intensity, short-duration, walking exercise would result in poorer psychophysiological responses and less recovery compared to exposure to clean natural environments. It also hypothesised that these differences would be due to difference in visual attention to the two scenes. These two predictions were explored in a laboratory simulation study with a randomised, counterbalanced, repeated measures design involving 32 participants drawn from community and online channels. Participants undertook two sessions where physiological responses (blood pressure, heart rate) and psychological responses (valence, activation, perceived exertion, time estimation) were measured after the administration of a psychosocial stressor (Stroop task), at four timepoints during ten minutes of treadmill walking, and after ten minutes rest. Eye movements to the beach's tideline (where litter was present or absent) were monitored throughout the exercise.

There was little evidence to suggest that psychophysiological responses or recovery from psychosocial stress were less positive when exposed to beach scenes with anthropogenic degradation, though there was evidence that time seemed to drag more when such scenes were viewed. Patterns of visual attention (characterised by fixations and the total duration of fixations – so-called 'dwell time') were different across the two scenes, but these differences did not explain any differences in immediate post-exercise psychological outcomes. Unplanned analyses revealed that findings were dependent on an order effect. Significant psychophysiological recovery occurred when exercising in exposure to clean beach scenes, but only if these were viewed first. Greater differences in visual attention were observed when litter was 'added' to scenes in the second session. However, moderated mediation models did not support the idea that the indirect effect of the scene on immediate post-exercise psychological responses through differences in visual attention was conditional on the order of sessions.

Regarding the first prediction, while one could accept the null hypothesis, it is plausible that the subtlety of the environmental manipulation meant that the effects of exercise on psychophysiological responses and recovery 'washed out' the effects of the environmental manipulation. Furthermore, a post-hoc power analysis on psychological outcomes at 10 minutes rest post-exercise revealed that the study was underpowered to find differences on these variables, but also that achieving the required power would be impractical considering temporal and financial constraints. There were at least two possible reasons why the second hypothesis was disconfirmed. Firstly, it may be the exercise itself which drives differences in eye movements. Secondly, a low proportion of time was spent dwelling on the tideline, meaning there may have been a floor effect present. This could have been because more attention is generally paid to moving objects (e.g. the waves) than stationary objects (e.g. the beach litter). The order effects are consistent with previous psychophysics research that additions of objects to similar scenes are more noticed than deletions, but because moderated mediation models provided no evidence that these effects were related to psychological outcomes, the chapter offered another explanation concerning affective judgements (see section 3.4.3). Future 'green exercise' studies should use dimensional measures of affect and ecologically valid natural stimuli. Field studies and the validity of the eye-tracking method for assessing directed attention restoration need to be considered in the future as well.

Chapter 4 posed three research questions regarding the amount of PA conducted in natural environments. These concerned the intensity, duration, and consequent energy expenditure involved when visiting different natural environments. In a cross-sectional analysis of the MENE survey, over 72,000 visits to the natural environment were analysed. Each was ascribed a standardised unit of intensity related to the reported activity undertaken (a MET rate), a measure of duration (interpreted as how long in minutes the respondent was in the natural environment), and a measure of energy expenditure (the MET rate multiplied by the duration). Regression models were constructed which controlled for various demographic and visit-related characteristics. Four types of natural environment were scrutinised: urban green spaces, the countryside, seaside resorts and towns, and other seaside coastline. Regression models were also stratified by urbanity/rurality and the distance the respondent travelled to the destination.

Visits to the countryside were associated with higher intensity activities than visits to urban green spaces, but visits to the two coastal categories were associated with the longest visit durations. Consequently, energy expenditure on visits to the countryside, seaside resorts and towns, and other seaside coastline was significantly higher than energy expenditure on visits to urban green spaces. Stratification by urbanity/rurality revealed different patterns of energy expenditure across the four environments, but both groups still expended the most energy in one of the two coastal environments. Stratification by travel distance revealed that people situated within a mile of the coast expended the most energy in such environments; respondents travelling farther afield tended to expend more energy in the countryside.

In summary, the study demonstrated that visits to natural environments afforded PA that has the potential to be health-enhancing. Furthermore, the size of the effects of the environment on energy expenditure is comparable with the effects of gender. The results could be explained by environmental affordances which reflect perceived barriers i.e. fewer barriers to higher intensity activities in countryside environments; more opportunities for longer visit durations in coastal environments. The subtly different relationships between environments and energy expenditure for urban and rural populations could be explained by the different groups' willingness to travel for recreational opportunities. The stratified results for travel distance could explain why previous research has found that coastal residents report better health and a higher likelihood of meeting PA guidelines. They could also reflect a distance-decay effect whereby the proportion of people who perceive a particular activity affordance associated with an environment declines with increasing travel distance to that environment. Future research could seek to use longitudinal designs which elucidate whether moving to more expansive natural environments such as the countryside or coast results in increases in PA. Future research should also be critical of the standardised nature of the MET rate, the possibility of behavioural spill-over effects (moral self-licensing), and the fact that access to more expansive natural environments is impractical for large numbers of the population.

Chapter 5 posed two questions regarding the potentially persuasive content of recreational walking brochures. The first was can the content of recreational walking brochures be reliably categorised? The second was if so, what persuasive messages are included in recreational walking brochures? A coding scheme to facilitate quantitative content analysis was developed. This had five superordinate headings and 88 individual categories of potentially persuasive message arranged hierarchically. The five superordinate headings reflected a range of behaviour change theories whilst the individual categories were derived from broader behaviour change technique taxonomies and refined using initial readings of brochures. A coding manual was developed (see Appendix L) which included definitions of all categories as well as coding instructions to facilitate inter-coder reliability testing. A line-by-line reliability protocol similar to that of Gainforth et al., (2011) was created. Twenty-six brochures were sourced from local councils and holiday organisations from Devon, UK.

Only 35 of 88 categories contained enough data to confidently confirm reliability and six of these did not meet the thresholds required for reliability to be confirmed, but agreements were found for all disagreed instances under these categories. After coding for all brochures was completed by the primary coder, only 33 of the original 88 categories appeared in more than three brochures and accounted for 94% of all brochure content. Messages enhancing self-efficacy appeared most frequently, but this was mainly explainable through brochures' frequent use of one particular category providing guidance on directions. Messages providing information also appeared frequently and often detailed the course, distance and terrain of the route. Messages highlighting potential opportunities and consequences also appeared frequently with historical points of interest and scenery popularly used to promote walking. Messages promoting behavioural intentions appeared a lot less while messages establishing normative beliefs barely featured at all. The chapter highlights one brochure which appeared to be informed by behaviour change theories to demonstrate how a range of categories could be incorporated into a brochure.

In summary, the content of recreational walking brochures can be reliably coded according to a series of persuasive messaging categories, although admittedly, many of the categories for which there was not sufficient data require further testing in the future and should be excluded if there are not frequent examples of their use. Nonetheless they were retained here to highlight possibilities for future brochures. Thirty-three categories formed a useful taxonomy of techniques. The content analysis revealed that messages providing guidance for directions, providing information about the walking route, and highlighting potential consequences and opportunities were the most common strategies employed by recreational walking brochures for promoting walking in natural environments. This demonstrates that only a narrow range of potentially persuasive messages are employed. Moreover, the range of messages used may not be sufficient for changing the behaviour of the least active, which is in contrast with national guidance. Further testing of the taxonomy's reliability and convergent validity with other behaviour change technique taxonomies could be undertaken in the future. The taxonomy is also flexible to allow for culturally-specific categories to be incorporated in any iterations of the taxonomy in the future. Controlled trials could use the taxonomy prospectively to create intervention materials which target a range of potential antecedents of behaviour change.

Chapter 6 outlined an experimental survey design where a pre-existing standard recreational walking brochure was modified to include persuasive techniques designed to influence intention to complete outdoor walking routes. It was predicted that reading this enhanced brochure would lead to stronger stated and revealed intentions to undertake outdoor walking routes compared to reading the standard brochure which in turn would elicit stronger intentions than reading no brochure at all. We also expected this pattern to be moderated by whether the respondent was a self-reported recreational walker or not with non-recreational walkers being more sensitive to the informational manipulations. Adults from the UK were recruited online to complete one of three experimental conditions featuring one of the three brochures. The surveys collected a number of demographic data (to be used as covariates) and then presented respondents with one of the two brochures (or no brochure). After reading it, respondents answered questions concerning attitudes, normative beliefs, and self-efficacy surrounding completing outdoor walking routes. They then answered questions on their ‘stated intentions’ for walking in natural environments (the main dependent variable) and finally responded to a dichotomous choice on the final screen which allowed them to opt in for more information on outdoor walking routes or not (‘revealed intentions’; this acted as a secondary dependent variable).

Controlling for a series of covariates, respondents reported higher stated intentions after reading the enhanced brochure compared to reading the standard brochure and marginally higher stated intentions after reading no brochure. When observing non-recreational walkers only, the enhanced brochure elicited significantly higher stated intentions than the standard brochure ($p<.05$). Stated intentions did not differ in any of three conditions for frequent recreational walkers. Regarding revealed intentions (whether the respondent requested more walking information or not) there were no overall differences between brochure conditions. However, when observing non-recreational walkers, the likelihood of requesting more walking information was significantly higher after reading the enhanced brochure compared to the standard brochure ($p<.01$), although exposure to no brochure had a similar effect ($p<.05$). Frequent recreational walkers had significantly higher intentions after reading the standard brochure compared to both the enhanced brochure ($p<.001$) and 'no brochure' ($p<.05$). Importantly, the inclusion of variables representing theory of planned behaviour constructs mediated the significant effect of the enhanced brochure on non-recreational walkers' stated intentions. This suggests that the enhanced brochure changed non-recreational walkers' attitudes towards, normative beliefs about, and self-efficacy for, walking in natural environments.

Therefore, non-recreational walkers were more likely to have stronger stated and revealed intentions after reading an enhanced brochure compared to reading a standard brochure. By contrast, people who already complete outdoor walking routes were more likely to have stronger intentions after reading the standard brochure. This suggests that different factors might motivate active and inactive people to go for a walk in a natural environment when reading a brochure. Active people might be more persuaded by natural features of the environment and points of interest. Inactive people might be more persuaded with messages that boost their confidence for walking more generally, raise subjective norms for walking, and enhance positive attitudes for walking. That the enhanced brochure only performed as well as no brochure for raising revealed intentions is likely due to the fact that, consistent with the notion of "mental contrasting", respondents in the no brochure condition imagined an idealistic walk and then reported subsequent intentions based on this idealised conception. Furthermore, frequent recreational walkers may have been dissuaded by perceiving the enhanced brochure to be overly patronising with its language. The results provide guidance on how designers of recreational walking brochures may want to produce materials in the future. The study recognises that the format of the brochure may play a greater role in processing of the messages than the content of those messages themselves, and optimal brochures should also be informed by research to this end. The promotion of different types of walk (e.g. in different environments; with circular rather than linear routes) may need to be explored in the future to investigate if the effects of persuasive message content differ with regard to the type of walk being promoted.

7.3 Contributions to the literature

The main contribution to the literature that Chapter 3 makes is that it challenges and extends the findings of previous research. Pretty et al., (2005) found that exposure to unpleasant rural scenes (often featuring anthropogenic degradation) whilst undertaking moderate-intensity treadmill exercise promoted less reduction in mean arterial blood pressure and less pre-post improvement in three mood states compared to when participants were exposed to pleasant rural scenes. The findings of Chapter 3 challenge both of these findings. Manipulating exposure to two beach scenes featuring natural or anthropogenic degradation had no bearing on reductions in mean arterial blood pressure or in changes in valence or activation. This may be because of the more ecologically valid and subtle manipulations employed in the natural environment stimuli meaning such differences were unable to be detected. It may also be because different measures of affect, which are potentially more valid for the experience of exercise (Ekkekakis & Petruzzello, 2002), were employed. However, Pretty et al.'s (2005) findings are partially supported by Chapter 3's findings if the participants undertook the clean condition first. With this order, participants experienced significant reductions in mean arterial blood pressure and activation when viewing clean scenes but not when viewing littered scenes. These findings are more consistent with Pretty et al., (2005), but are limited by a lack of statistical power associated with such analysis.

The only outcome variable to differ significantly between the two conditions regardless of the order in which they were seen was perceptions of elapsed time. Estimations grew less steeply when viewing clean scenes compared to littered scenes. This is consistent with White et al., (2015) who found that exposure to coastal scenes during moderate-intensity cycling resulted in lower estimates of elapsed time across the exercise in comparison to a control (blank wall) condition. However, it is in contrast to Berry et al., (2015) who report that exposure to natural as opposed to built scenes result in longer subjective time perceptions in a sedentary scenario[v]. Future studies could elucidate whether time perceptions when exposed to natural scenes are moderated by the active or passive type of exposure.

Furthermore, Chapter 3 extends previous controlled studies on the beneficial mental well-being effects of exercise in natural environments (e.g. Thompson-Coon et al., 2011), by investigating a potential mechanism that the effects may work through. Specifically, it hypothesised that the detrimental effects of littered scenes on psychological outcomes would occur because such scenes attracted more ‘effortful’ visual attention (characterised by more fixations and longer dwell time). While the littered scenes did attract more visual attention, this did not mediate differences between the conditions. Nevertheless, this extends the findings of Berto et al., (2008) who showed that less restorative urban scenes attracted more ‘effortful’ visual attention than more restorative natural scenes. Chapter 3 demonstrated that even when controlling approximately for the amount of stimuli in a given scene, supposedly less restorative scenes still attract more ‘effortful’ visual attention.

Since completion of this study, Valtchanov and Ellard (2015) have advocated the use of ‘blink rates’ (number of blinks) as a psychophysiological measure of restoration because firstly, blink rates increase when cognitive load increases (Siegle, Ichikawa & Steinhauer, 2008) and in Valtchanov and Ellard’s (2015)

---

[v] Participants were undertaking a delay discounting task where they made choices about immediate or delayed hypothetical monetary outcomes.

study scenes of urban environments elicited significantly more blinks than scenes of natural environments. In a manipulation, Valtchanov and Ellard (2015) removed mid-to-high spatial frequencies of their urban and natural images[w]. When these frequencies were removed, there were no significant differences in affective responses to urban and natural scenes suggesting that affective responses to natural environments rely on mid-to-high spatial frequencies of an image. However, even when removing mid-to-high spatial frequencies, differences between natural and urban scenes in terms of blink rates, remained. Taken together, these results suggest that the affective responses to natural environments rely on high-level visual properties (sharpness, edges etc.), but their restorative potential is dependent on low-level visual properties (brightness, contrast, shapes etc.).

The main contribution that Chapter 4 makes to the literature base is that, for the first time, the energy expended (intensity and duration of PA) in natural environments, can be determined. White et al.'s (2014) analysis of the Monitor of Engagement with the Natural Environment Survey suggested that coastal residents could be using coastline environments for health-enhancing sessions of PA. Mitchell's (2013) analysis of Scottish survey data suggested that forests were used regularly for PA, but again the exact amount of activity that was being conducted in that environment could not be determined. Chapter 4 was able to answer what intensities and durations of PA are conducted in four

---

[w] Removing mid-to-high visual spatial frequencies (but maintaining low visual spatial frequencies) maintains the brightness and contrast of the image as well as the shape of objects in the images, but effectively 'blurs' the overall scene. In contrast, removing low spatial frequencies but maintaining high spatial frequencies would 'whiten' images by removing colour contrasts between objects while maintaining sharpness and edges of objects.

different categories of natural environment across England. In all types of natural environment, the most frequently undertaken physical activities were either walking (at an intensity of 3.5 METs) or walking with a dog (at an intensity of 3.0 METs). There is a suggestion that in some sense countryside environments might be said to “afford” more intense activities that urban green spaces, but that coastal environments might “afford” less intense activities. Coastal environments may though “afford” significantly longer bouts of activity than countryside or urban green space environments (see below for further discussion of affordances).

Consequently, energy expenditure (which could be thought of a composite measure of PA intensity and duration) was significantly higher in countryside *and* coastal environments compared to urban green space environments, with coastal environments resulting in the most energy expenditure. That these relationships persisted when examining only respondents who walked *to* the natural environments and walked *within* the natural environment (whether with a dog or not), means that coastal environments could be said to afford the most health-enhancing quantities of PA of all the natural environment categories studied[x].

The findings of Chapter 4 also contribute to the growing recognition of the theory of affordances (J. J. Gibson, 1979; E. J. Gibson, 2000) in research on environment perception. These were originally thought of as possibilities for

[x] Indeed in the “walkers only model,” visits to the two coastal categories, whilst not significantly different from one another in terms of energy expenditure, did appear to afford significantly higher energy expenditure than visits to countryside environments as well as urban green space environments.

actions that existed in the environment, but Heft (2003) describes affordances as real properties of the environment that have functional and psychological significance for the perceiver, i.e. the possibilities for action that the perceiver is aware of. He also describes affordances as ‘prereflective,’ that is, occurring before conscious awareness of a thought. Heft (1999) provides the example of a twig that is smaller than the hand span of a child and which the child therefore perceives as being able to be grasped. Thus the twig ‘affords’ grasping. This affordance occurs before awareness of the thought about grasping because, presumably, dorsal visual systems which guide actions are triggered initially (Goodale, Milner, Jakobson, & Carey, 1991)[y]. To the extent that the child realises the twig can be used as a tool, the twig could also be said to afford the child *opportunities* for, for example, scratching or digging. Ward Thompson and Travlou (2009) review the literature on the affordances of different natural environmental settings and find a number of studies examining children’s perceptions of natural environments as having functional meanings (e.g. streams and rivers being perceived as play areas which afford a number of different opportunities; Said & Bakar, 2005).

Considering the above, the notion posited in Chapter 4 that different natural environments *afford* different amounts of PA is more of an inference than a finding. For this to be the case there must be intrinsic aspects of those environments that have a functional and psychological significance to the perceiver which inherently (and pre-reflectively) involve a physically active action (or at least an opportunity for one). However, a cursory examination of

[y] It is worth noting that Heft does not make reference to the dorsal visual system in either of the publications cited; this is my interpretation of affordances as being pre-reflective.

ecological or evolutionary literature concerning PA behaviour and environment preference suggests this position is at least conceivable. Before the domestication of animals and the use of wind and water as a means of power, all human activities depended on physical exertion (Eaton & Eaton, 2003). In the same time period, humans lived in mostly natural environments. The supposedly innate need to affiliate with natural environments has been popularised by the *biophilia* hypothesis (see Kellert & Wilson, 1993; Wilson, 1984). In an evolutionary sense then, humans have evolved to be active in natural environments in order to sustain their lives (e.g. through hunting and gathering). Thus, it is conceivable that different natural environments afford different amounts of PA pre-reflectively (i.e. they necessitate PA merely by *being* natural) because humans evolved to be active in these environments in order to survive. It is hoped that future research observes the relationships between natural environments and PA through the lens of affordances as this will aid designers in selecting environmental features that are most likely to elicit physically active behaviour.

The findings of Chapter 5 contribute to literature from two disciplines. Firstly, it extends the use of the CAATSPEC approach to quantitative content analysis (Abraham et al., 2007) to texts which promote health behaviour but are not primarily concerned with health promotion. Whilst many content analyses have been performed on non-health texts like newspapers (Faulkner et al., 2007) and magazines (Cook et al., 2014), these materials are not designed to promote health behaviour necessarily. Recreational walking brochures are designed to promote a health behaviour (walking), even though their primary aim may be to promote a destination. One of the disadvantages of adapting CAATSPEC in this way is, unlike the original CAATSPEC which aimed to identify the extent to which health promotion texts were in line with research-based recommendations, the taxonomy presented in Chapter 5 lists many categories which may not have strong empirical support as to their effectiveness in changing walking behaviour (or the antecedents of this).

However, the advantage of being more flexible with the taxonomy meant that we were able to be informed by predictors of natural environments visitation more generally such as physical qualities of environments (Dallimer et al., 2014; Irvine et al., 2013). Promoting the physical qualities of natural environments as outcome expectancies might not change an individual's attitude towards walking outdoors for example, but as there is evidence that these qualities predict visitation, it was deemed worthwhile to include them in the taxonomy as potentially persuasive. The frequent use of text advertising heritage-based outcomes for example, is testament to the notion that the designers of these brochures might consider heritage features a persuasive factor for the reader.

Since the brochures studied in Chapter 5 are produced by councils and tourism organisations primarily for the purposes of tourism, the findings also contribute to research on destination marketing in tourism. Brito and Pratas (2015) assert that written brochures are frequently used for advertising destinations in tourism and contain a multitude of messaging strategies which convey interest in a place and help the reader to "answer place-specific questions such as what to see and why, and how to get there" (p.124). Despite the rise of online means of destination marketing, the authors cite much literature suggesting that the types of message strategy used have remained stable (p.125). The authors present a model of message strategies, message attributes and executional tactics used in tourism brochures.

Message strategies refer to the main method by which the advert is presented. For example, “ego-affective” strategies refer to the brochure’s ability to convey the sense that the advertised product or experience can change an individual’s affective state. “Sensory” strategies refer to the elicitation of a sense in the reader (e.g. a picture of food eliciting a sense of taste or smell). Executional tactics refer principally to formatting characteristics i.e. how those message strategies are executed in the layout of the brochure (typeface, facial cues). Message attributes refer to the destination-specific attributes of a message such as the weather or nightlife associated with a place.

In a content analysis of the front covers of 400 tourism brochures sourced from an International Tourism Trade Fair, the authors found that while multiple messaging strategies were used, the most popular were “pre-emptive” strategies which outline a pioneering claim as to the benefits of the product or experience; or “positioning” strategies which identify distinct competitive features. The most common destination attributes to feature on front covers were natural: 58.5% of front covers featured a landscape; 20% featured the weather; 10.8% featured sports undertaken in natural settings; 10.8% featured wildlife; 7.2% featured rare animals; and 16.3% featured adventure activities in natural settings. The type of executional tactic used was highly dependent on the message strategy employed (e.g. pre-emptive strategies were associated with dominant text of pronounced colour), but executional tactics were unrelated to message attributes. This study highlights how the tourism marketing discipline approaches the analysis of persuasive communicative materials. Broad taxonomies of messaging strategies, attributes, and formatting characteristics are taken into account but although this method tells us much about the nature of the content in tourism materials, it does not tell us what is most persuasive for the reader. It does tell us about how advertisements convey awareness of brands, but not about changing behaviour. In this sense, the findings of Chapter 5 could contribute to the analysis of tourism brochures in terms of how they aim to change behaviour as well as raise awareness of brands and destinations.

The main contribution to the literature from Chapter 6 is that it demonstrates that replacing content which highlights pleasant features of natural environments, as well as repetitive content, with persuasive messages based on theory of planned behaviour constructs, heighten intentions to walk in natural environments for infrequent recreational walkers. This was the case both for stated intentions (Likert scale responses) and revealed intentions (selecting an option to view more information on outdoor walking). Conversely, removing such content lessened intentions to walk in natural environments for frequent recreational walkers. This appears to be in contrast with some qualitative literature. Dallimer et al., (2014) suggests infrequent green space users are motivated by qualities of the natural environment. Irvine et al., (2013) also suggest such qualities (flora, fauna, and scenery) are important motivators of green space use. Nonetheless, the findings of Chapter 6 suggest such qualities are only important for frequent active users. It also adds to the already extensive literature base suggesting that the antecedents of intention formation proposed by the theory of planned behaviour are important for changing intentions to be physically active (Hagger et al., 2002).

The validity and utility of the theory of planned behaviour has been thoroughly criticised. Sniehotta, Presseau & Araújo-Soares (2014) cite experimental tests whose observations have been consistently out of line with the predictions of the theory of planned behaviour. They also note the frequent use of ‘extended’ theories of planned behaviour as support for the idea that the original theory has little utility in predicting behaviour change. The aim of Chapter of six however was not to test the pathways of the theory of planned behaviour. Rather it was to use the theory to design persuasive messages aimed at changing intentions. Abraham’s (2015) commentary on Sniehotta et al.’s (2014) critique also highlights the idea that, “developing persuasive messages that target change of particular mechanisms specified by the theory of planned behaviour can be effective in promoting intention change which, in turn, can promote behaviour change” (p.161-162). While the study in Chapter 6 does not examine explicit behavioural outcomes, previous meta-analyses of experiments have suggested that medium-sized changes in intention (d=0.66) result in small but significant changes in behaviour (d=0.36; Webb & Sheeran, 2006). Thus, despites concerns about the validity of the theory, it still has utility in terms of designing persuasive messages to change intentions.

Finally, the chapter adds to the literature that adapting written brochures to include persuasive behavioural techniques results in changes in intentions to perform health behaviours. France et al., (2008) demonstrated that enhancing a brochure to include messages addressing prospective blood donors' concerns resulted in favourable changes in attitudes, anxiety about blood donation, self-efficacy and intentions to donate. Bishop et al., (2005) demonstrated that enhancing a smoking cessation brochure with detailed explanations about physiological outcomes of smoking on the cervix heightened intentions to stop smoking for women who had received an abnormal cervical smear test result. In a similar way, enhancing recreational walking brochures with messages designed to affect instrumental and affective attitudes, perceived descriptive norms, and self-efficacy for walking in natural environments heightened infrequent recreational walkers' intentions to walk in natural environments. NICE (2012) recommend that such behavioural theories are included in programmes and materials produced by local authorities to increase walking for the least active. Chapter 6 provides support for the notion that doing so can be effective at least in forming stronger intentions to walk.

7.4 Practical and policy implications

As well as making contributions to the literature base, the studies within this thesis have potential practical and policy implications. The order effects in Chapter 3 suggest that when a previously 'clean' natural environment becomes littered with anthropogenic degradation, an individual will not experience the same psychophysiological benefits from exercising there as they once did. Of course, such effects need much further examination in adequately powered studies to confirm these initial findings. Nonetheless, such a finding has important implications in terms of environmental conservation. It suggests that conserving a ‘clean’ environment maintains potential opportunities for beneficial exercise experiences.

Recently, the duality of health promotion and environmental conservation have been combined in a number of academic papers which advocate that the promotion of one can aid the other (Lovell, Husk, Cooper, Stahl-Timmins, & Garside, 2014; Nurse et al., 2010; Sandifer et al., 2015). To take the oldest example, Nurse et al., (2010) suggest that the wider determinants of poor mental health and poor environmental health are related. For example, the development of internal combustion engines have both reduced the need for human physical exertion and also negatively affected air quality with pollutants. If the causes of poor human and environmental health are related, then it implies there are common solutions. Relating to Chapter 3, marine litter is an increasing environmental problem (Marine Conservation Society, 2014; Obbard et al., 2014; Thompson, et al., 2009; Woodall et al., 2014; Zettler et al., 2013) which can also diminish the psychological outcomes of exercise (Chapter 3). Thus, tackling marine litter can both mitigate the numerous problems it creates for environments and marine wildlife, and also potentially restore opportunities for psychologically beneficial exercise experiences.

As noted in Chapter 4, knowing a wider range of affordances of different types of natural environments may help public health bodies in decision making. For example, from the findings of the study, it is now known that coastal environments in England afford visits associated with the highest amounts of energy expenditure of all general types of natural environment. A decision maker can then see how it may be worthwhile to invest resources in protecting coasts as this will also mean health-enhancing PA experiences are also protected which will in turn reduce the economic burden on publically financed health services. However, to this end, policymakers may need to know how much an individual visit to a natural environment potentially saves the health service.

Mourato, Atkinson, Collins, Gibbons, MacKerron & Resende (2010) developed a method of converting MET minutes into quality-adjusted life years (QALYs). QALYs are “measures of health benefit that combine length of life with quality of life, where quality of life is assessed on a scale where zero typically represents death and one represents full health” (Mourato et al., 2010, p.63). QALYs have a monetary value of between £6,414 to £21,519 meaning that one extra year of life in good health for one individual is worth between £6,414 and £21,519 to the National Health Service (Mason, Jones-Lee & Donaldson., 2009). Mourato et al., (2010) use regression to determine how the achievement of MET minutes in natural environments (as well as other factors such as having a view of a natural environment) contributes to increases in SF-6D scores. The SF-6D is a “single summary preference-based measure of health derived from the SF-36[z], and the EQ-5D[aa]” (Walters & Brazier, 2005, p.1524). Crucially, the SF-6D can be used to derive estimates of QALYs. Mourato et al., (2010) found that 24 MET hours per week contribute to a 0.2% increase in SF-6D scores which equate to around £12 to £39 considering the low and high estimates of the value of a QALY (Mason et al., 2009). Using such calculations, future research could convert the MET-minute estimates determined in Chapter 4 into monetary

[z] A commonly used measure of general health.
[aa] A commonly used measure of health-related quality of life.

estimates[bb]. Doing so would allow decision makers to know how much each type of natural environment contributes not only in terms of health gains, but in terms of monetary cost savings.

The main practical applications of Chapter 5 and Chapter 6 are that they contribute to the optimal design of recreational walking brochures. As mentioned in the literature review, the National Institute of Health and Care Excellence have guidelines concerning the promotion of local walking and cycling. These state that local authority directors for countryside management, environment, leisure services, parks, public health etc. “ensure programmes are based on an understanding of…general factors influencing people's behaviour such as their attitudes, existing habits, what motivates them and their barriers to change, taking into account NICE's recommendations on *behaviour change: the principles for effective interventions*” (NICE, 2012, p.14). Additionally they state that those directors, “ensure programmes include communications strategies to publicise the available facilities (such as walking or cycle routes) and to motivate people to use them” (NICE, 2012, p.14). Moreover, they state that such directors, “develop walking programmes for adults who are not active enough, based on an accepted theoretical framework for behaviour change” (NICE, 2012, p.18). As such, the brochures produced by these organisations to promote local walking and cycling routes should employ behavioural techniques in order to convey their message to the least active.

[bb] While also weighting these in order to capture estimations for the whole of the population of England.

Chapter 5 demonstrated that the brochures in the sample selected, generally speaking, did not conform to these guidelines. In the same vein, Chapter 6 found that, in line with NICE's (2012) guidelines, including behaviour change principles into the brochure text in place of repetitive information facilitated changes in walking intentions for less frequent recreational walkers. In the future, brochure content could perhaps be designed in partnership with behaviour change experts, or alternatively designers could be trained to understand the important antecedents of behaviour change and how to incorporate such techniques into text. Indeed, practical guides are already available to facilitate this (see Abraham & Kools, 2012). Importantly, the theory of planned behaviour (used in Chapter 6 to inform brochure content) is just one of a number of behavioural theories that attempt to explain the influences on behaviour change. As such designers of brochures that aim to change walking behaviour may benefit from referring to taxonomies of behavioural techniques from a range of behavioural theories that can be successful in changing physical activity behaviour (e.g. Michie et al., 2011).

7.5 A cultural ecosystem services perspective

Although each study in this thesis can be seen as distinct, they collectively form different approaches to the study of PA in natural environments. However, merely seeing each study as part of a collection around a theme does not explain how they link together to have wider societal or policy implications. As an example, the conclusions of Chapter 4 suggest that the study's findings could inform public health decisions regarding what sorts of environments need protecting and promoting for the benefit of human health; protecting the environmental conditions of the UK coastline for example may allow more people to visit and consequently expend energy and receive physical health benefits. However, it is impossible to see this recommendation in isolation from, for example, the effects that increasing visitor pressures might have on a coastal ecosystem, and by consequence, the extra resources required to then protect it further. On a more cultural level, if such recommendations were implemented, this may change how current visitors value these environments. For example, some visitors may value the lack of other people as it allows them to have a restorative experience and these benefits may be lost if more people were using these environments for PA. Therefore, it is necessary to present a framework which links the studies in the thesis together in a way which allows readers to understand how each impacts a wider cultural and ecological system. In turn, this should aid better decision making.

To this end, the chapter now turns to frameworks of cultural ecosystem services which may fulfil this need. Section 2.3 outlined the original UKNEA's conceptualisation of cultural ecosystem 'goods' (Church et al., 2011). This comprised religious, heritage, recreation/tourism, health and education and ecological knowledge 'goods'. In a refinement of the meaning of cultural ecosystem services, Church et al., (2014) developed a conceptual framework which demarcates cultural ecosystem services, goods, and benefits (see Figure 7.1 for this framework). Distinct from the main pathways of the framework are 'cultural values' which are the meanings people ascribe to ecosystems (similar to 'cultural identities' described in the Millennium Ecosystem Assessment – see above). The 'biophysical domain' refers to the constituent parts of ecosystems e.g. soil, water. These create the ‘conditions’ for, and ‘qualities’ of, ‘environmental settings’ such as parks, beaches and woodland and the biota living within them. They also create the ‘opportunities’ for ‘cultural practices’ like gardening and exercising. Environmental settings ‘enable’ these cultural practices and in turn the cultural practices ‘shape’ how these settings appear, the biota within them etc. In turn, the biophysical domain is further altered. This reciprocal relationship between environmental spaces and cultural practices is what cultural ecosystem services represent. Together this relationship gives rise to cultural ‘goods’ like organised recreational activities, local festivals, and local wildlife conservation charities. The relationship also elicits cultural ecosystem benefits which represent benefits to human well-being such as enhancing health, increasing knowledge, being ‘inspired’, being spiritual etc.

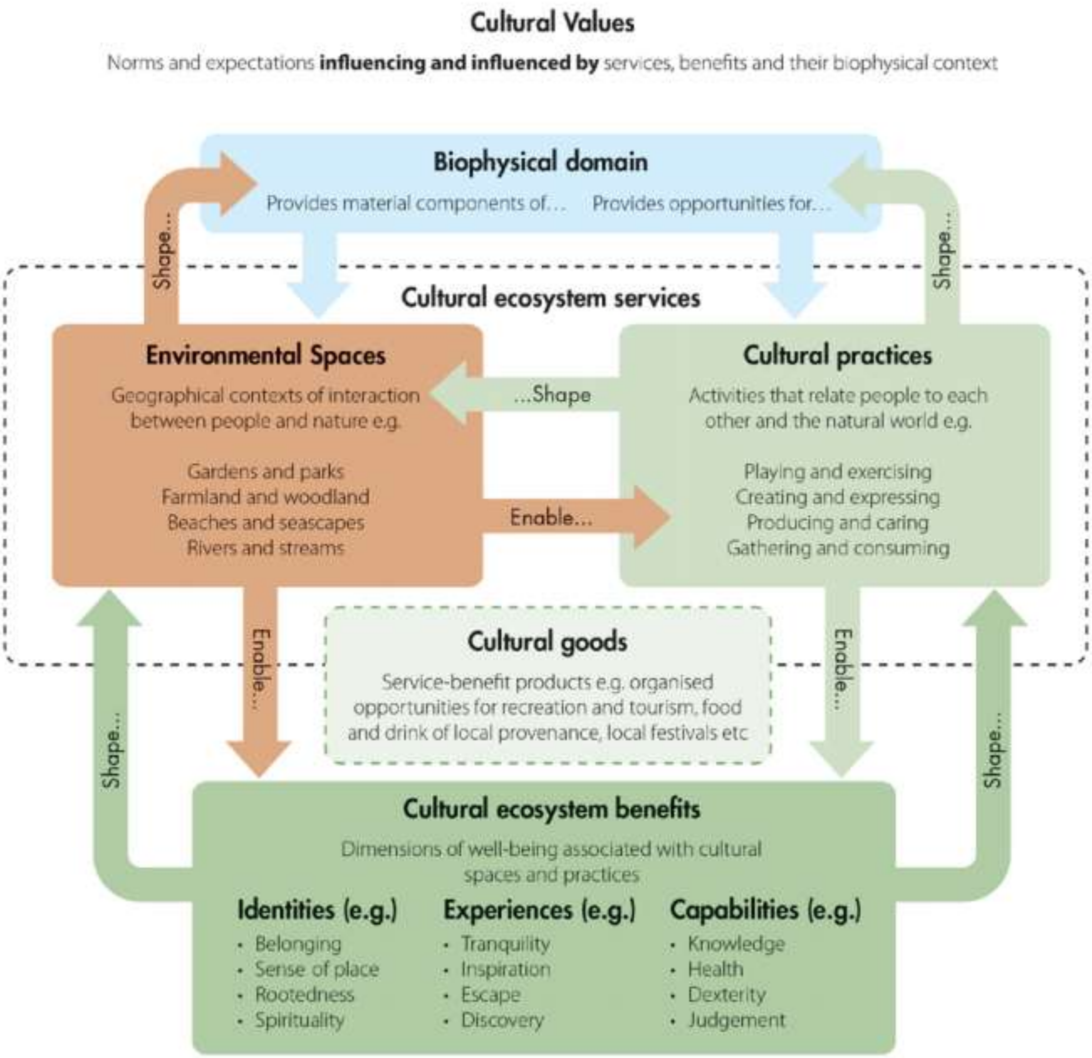


Figure 7.1 A conceptual framework of cultural ecosystem services (taken from Church et al., 2014).

Milcu, Hanspach, Abson & Fischer (2013) conducted a systematic review of publications which explicitly mention the term “cultural ecosystem services” to discover the temporal, geographical, and methodological trends involved in cultural ecosystem services research. Secondly, the authors aimed to cluster groups of publications in the way that they address cultural ecosystem services. Using both of these methods of enquiry, the authors aimed to highlight challenges for the future of cultural ecosystem services research. The systematic search revealed 84 peer reviewed articles, two Millennium

Ecosystem Assessment chapters, four conference papers, three book chapters, five postgraduate theses, three working publications and six reports that met the inclusion criteria. The authors found that the number of publications on the topic has increased rapidly since 2008, most were European, and 45 publications were from a biodiversity, conservation or ecology discipline. Cluster analysis revealed five groups of studies: (a) theoretical or conceptual; (b) descriptive reviews; (c) localised outcomes from case studies; (d) social and participatory (e.g. preferences and perceptions of stakeholders) and; I economic assessments. One of the key findings from this review was that the social sciences (such as psychology, anthropology, and other behavioural sciences) have had relatively low involvement with cultural ecosystem services research.

Much of the literature reviewed in Chapter 2 would suggest this is not the case. Many behavioural science studies have detailed the benefits arising from cultural ecosystem services such as the mental well-being benefits of exercising in natural environments (Thompson-Coon et al., 2011), or viewing indoor nature (McSweeney et al., 2014). However these studies rarely refer to the interaction between the human and the natural environment as an ‘ecosystem service’, or the benefit as an ‘ecosystem benefit’ as the framework in Figure 7.1 would. In part, this could be because behavioural and social science disciplines prefer constructs and processes to be easily operationalised. It is not easy to think of an operational definition of the verbs ‘shape’ and ‘enable’ in the framework presented in Figure 7.1 and despite the evolution of the definition of cultural ecosystem services, the demarcation between services, goods, values, benefits, and practices is still unclear. Indeed, Milcu et al., (2013) note that some research conflates cultural practices and benefits. For example, being physically active could be seen both as a cultural practice (walking in natural environments is a popular pastime), but also as a benefit (being active is a beneficial outcome of walking in natural environments).

7.5.1 A cultural ecosystem services perspective on physical activity in natural environments

For these reasons, I apply but revise the framework of cultural ecosystem services presented in Figure 7.1 to the practice of PA in natural environments. It is necessary to do this firstly because, as explained above, the studies in this thesis cannot be seen in isolation if they are to form part of a more informed public health decision making process. Secondly, it is necessary to revise some aspects of the framework so that constructs and processes can be better operationalised. This is because it will help researchers from behavioural and social sciences (who traditionally have engaged less with the concept of cultural ecosystem services) to better design research hypotheses and studies based on the proposed pathways of the framework. See Figure 7.2 for the revised version of this framework.

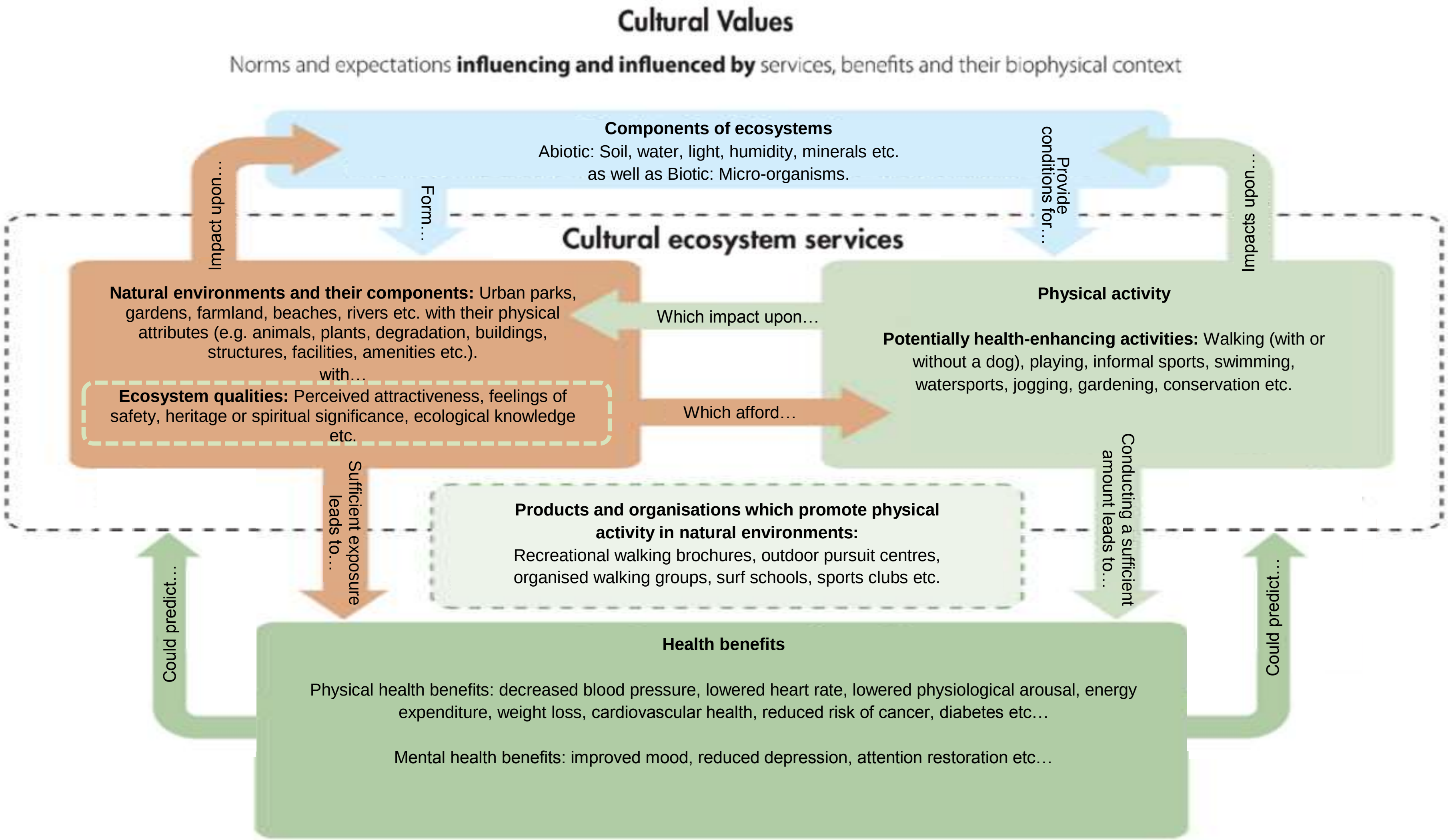


Figure 7.2 A revised cultural ecosystem services framework based on PA in natural environments.

The revised framework maintains the idea of cultural values influencing and being influenced by the whole system. This part of the framework is meant to be synonymous with the original Millennium Ecosystem Assessment idea that the natural environments one is exposed to affects their cultural identity, and that current cultural practices impact the meaning that someone ascribes to the natural environment. The biophysical domain in the original framework is renamed “components of ecosystems” to more clearly state that this box represents the most basic biotic and abiotic components of ecosystems such as micro-organisms, soil, water, light, radiation, humidity etc.

The original ‘environmental spaces’ box is more clearly labelled natural environments and their components (natural and manmade qualities). These natural environments conform to the Natural England (2015) definition which is “all green open spaces in and around towns and cities as well as the wider countryside and coastline.” Components refer to all aspects of the environments which are not the irreducible biotic and abiotic components. For example, the biota within the environments (animals, plants, humans), degradation of the environments, and manmade features and amenities (running tracks, bins, refreshments, fountains etc.) Natural environments and their components have “ecosystem qualities” for the perceiver. These can be common predictors of PA such as perceived attractiveness or feelings of safety, or can be similar to the “cultural goods” outlined in the original UKNEA (2011) such as ecological knowledge, heritage, or religious and spiritual significance.

Cultural practices are limited for the purposes of this thesis as just PA. The activities listed could be health enhancing if conducted with the correct intensity and duration, but may equally be not (e.g. a small ‘pocket’ park may not facilitate sufficient bouts of PA).

Rather than talking of ‘goods,’ I focus more definitively in the same part of the framework on the organisations and products (so-called “service-benefit products” in the original framework) that promote the experience of PA in natural environments. Examples include surf schools and outdoor pursuit centres. However, these could also include brochures that promote outdoor walking. In short, these products and organisations are the result of the popularity of PA in natural environments, but also aim to influence the popularity of PA in natural environments. The findings of Chapters 5 and 6 support the notion that these products and organisations exist and aim to influence the popularity of the central ecosystem service (the relationship between PA and natural environments) via their written content. Lastly, instead of cultural ecosystem benefits, the box at the bottom of the diagram is labelled “health benefits” in order to definitively state that the focus of research into the benefits of both PA and exposure to natural environments has predominantly focussed on benefits to aspects of physical and mental health.

One distinction that needs to be made is between components of the natural environment and products or organisations that promote PA in natural environments. Take the example of a sign in the countryside which outlines a walking path. The sign could be considered a manmade component of the natural environment. Alternatively, it could be considered a product that promotes PA in natural environments. The way to distinguish between the two is by considering the affordance of the object. If the object affords PA (or PA opportunities) of some kind (that is, it necessitates PA pre-reflectively or provides an opportunity for PA because of its characteristics – see section 7.3), then it is not a product promoting PA, but a component of the natural environment. In the case of the sign, this would mean it is a product promoting

PA in natural environments. This is because the information on the sign requires conscious thought in order to prompt action. The characteristics of the sign do not prompt action without higher-order processing[cc]. Of course, not all components of natural environments *need* to afford PA; some elicit it, others may inhibit it, and others may have no effect.

This chapter will now briefly outline the meaning of the arrows in the diagram and provide empirical support for each process. Firstly, components of ecosystems collectively form natural environments and their components. This is logical; soil, light, water etc. enable environmental spaces and the biota within them to form. Components of ecosystems also provide conditions for PA. These could be adequate or inadequate conditions. For example, excessive heat and humidity may limit the length for which one can exercise (Galloway & Maughan, 1997).

Natural environments and their components afford potentially health-enhancing physical activities. This process is supported by Chapter 4 which finds that different natural environments afford different amounts of energy expenditure. By ‘afford,’ the framework refers to Heft’s (2010) notion of affordances which are the opportunities for action that the perceiver is aware of. Ecosystem qualities may predict the likelihood of PA in those natural environments. For example, feelings of safety in parks or perceived attractiveness of parks are associated with the use of those places for PA (Bedimo-Rung et al., 2005; Ward Thompson, 2013). Additionally, Chapter 6 of this thesis demonstrates that some qualities such as heritage or historical significance may be more persuasive for more regular users of natural environments for walking.

[cc] This is unless of course, for example, a child was to perceive the sign as something which afforded climbing on.

Natural environments and their components can also impact upon the core components of ecosystems. For example, the introduction of a foreign shrub to an environmental space could result in, for example, increases in the nitrogen content of soil (Vitousek & Walker, 1989). Physical activities can also impact upon natural environments and their components. For example the degradation of parts of the environment from trampling (Lynn & Brown, 2003) or the addition of vegetation through gardening. In a similar way, physical activities can impact directly upon the core components of ecosystems, for example hiking can erode soil (Deluca, Patterson, Freimund & Cole, 1998). As was covered extensively in Chapter 2, exposure to natural environments in various ways can result in health benefits. Hartig et al., (2014; see Figure 2.2) list the multitude of ways in which direct exposure to natural environments can lead to health (stress reduction, air quality etc) and these are the things to which this process refers. As was also extensively reviewed in Chapter 2, the practice of PA (in sufficient quantities) leads to physical health benefits such as enhanced cardiovascular health (Nocon et al., 2008) and also enhanced mental health benefits such as reduced depression (Mammen & Faulkner, 2013). The arrows feeding back from health benefits to the central cultural ecosystem service represent the fact that outcomes of certain experiences predict the likelihood that they will be repeated. For example, the affective benefits of PA in natural environments can predict the likelihood that you will repeat the behaviour (Focht, 2009; Rhodes & Kates, 2015).

Although the processes have just been explained in terms of one aspect's effect on another, of course the framework proposes that all the processes are in constant motion. Chapter 3, for example, focuses on how a quality (anthropogenic degradation) of an environmental space (a beach) affects the health benefits (affective, physiological) of PA (short duration, moderate-intensity walking). However, increased numbers of active visits to beaches could result in more anthropogenic degradation of the environment and the components of the beach ecosystem. The affective outcomes could also affect willingness to visit the beach and repeat the activity. Thus, in any study researching part of the process, other pathways are implicated.

7.5.2 Strengths and limitations of this framework

The main strength of this framework is that it may aid decision making. In section 7.4, a method of calculating monetary estimates from the MET minutes calculated in Chapter 4 is outlined. This would allow decision makers to know how much each type of natural environment is worth in terms of health cost savings. The framework presented in Figure 7.2 allows decision makers to realise that this is not the only cost to be considered. For example, one pathway depicts that physical activities impact upon natural environments (e.g. Lynn & Brown, 2003). As such, whilst being active in natural environments saves on health costs, it also produces costs in terms of repairing the damage inflicted upon the environment. In a similar way, Figure 7.2 allows decision makers to realise that the physical health benefits in terms of MET minutes are not the only benefits to arise from being physically active in natural environments; a number of mental health benefits are also possible (Mitchell, 2013; Thompson-Coon et al., 2011). The calculations presented in section 7.4 overlook the potential cost savings generated by mental health gains of being physically active, but a decision maker, using this framework, would know to estimate these too[dd].

Moreover, the framework inherently invites interdisciplinary collaboration. This was evident in the wide variety of citations used when describing the pathways of the framework in section 7.5.1. For example, an environmental epidemiologist may be able to ascertain the ways in which different components of natural environments afford different quantities of PA, but they may require collaboration with an ecologist if they also want to understand how those components might affect the core components of ecosystems (and thus, the adequacy of the conditions for PA). It has been previously noted that the idea of ecosystem services has “helped ecology to make links with many disciplines” (Reyers, Roux, & O’Farrell, 2010, p.501) and the need for interdisciplinary understanding of personal-level and environmental-level influences on PA has long been advocated (King, Stokols, Talen, Brassington & Killingsworth 2002).

However, despite the interdisciplinary approach that it invites, the framework is focused entirely on the ecological influences on PA behaviour. The framework suggests that PA behaviour is entirely influenced by environmental conditions, the environments within which one is situated, and the qualities of those environments. There is a concession that certain health benefits may influence the repetition of PA behaviour, but the framework overlooks the role of individual motivations and cognitions and well as the role of behavioural support in influencing PA. In defence of the framework, the ultimate aim is to provide an overview of the reciprocal relationship implicated when studying the effect of the natural environment on PA, and not to comprehensively state all of the possible

[dd] Notwithstanding the difficulty of being able to do this in a comparable way.

influences on PA behaviour (an issue returned to in section 7.7.4). Nonetheless, potential users of the framework should recognise that even if a body of research were to suggest the optimal conditions that a natural environment should be in in order to facilitate PA, this does not necessarily mean that PA will occur. Many individuals will still require behavioural support for PA aimed at changing their beliefs, attitudes etc. towards PA if those environments are to be used for PA. In a similar way, even if a sufficient amount of PA/nature is experienced in order to elicit mental or physical health benefits, readers should recognise that psychosocial and biological factors may influence the amount of benefit that they receive. To this end, readers are referred to other models of mediators and moderators of PA and its health benefits which aid understanding of such influences (e.g. Taylor & Faulkner, 2014).

One further limitation which can be applied to both the original and this adapted framework of cultural ecosystem services is how the cultural 'goods' (or in this version, the products and organisation promoting PA in natural environments) 'arise' from the central cultural ecosystem service. Goods have often been conflated with services so that they are seen as synonymous (e.g. de Groot, Wilson, & Boumans, 2002). However, the more recent classifications delineate goods (service-benefit products) and services (the environmental spaces enabling and being shaped by cultural practices) differently (Church et al., 2014) and this dichotomy is maintained in the adapted framework. In the case of health benefits, it is simpler to see how these (physiologically) 'arise' from the practice of PA or from the experience of natural environments by observing changes in cardiovascular physiology or brain physiology etc. In the case of products and organisations 'arising' from the cultural ecosystem service it is more difficult because they are proposed to develop as the popularity of the activity develops, and thus there are no immediate and objective changes which one can observe.

At present there no satisfactory explanations from the cultural ecosystems services literature about how ‘goods’ ‘arise’ from the service, and it may be that in future frameworks, these are omitted. Therefore, the inclusion of products and organisations promoting PA in natural environments in the adapted framework is problematic. Nonetheless, it is maintained not least because these products and organisations can eventually lead to policy changes. For example, the Marine and Coastal Access Act (2009) aims to improve enjoyment of the English coastline by creating public rights for open-air, on-foot recreation. The act has placed a duty on Natural England to secure a route around the whole of the English coast in order to do this. While the footpath itself should be classed as a component of a natural environment (as their features i.e. gradient, terrain may afford walking and exploration), the popularity of related products and organisations (walking groups, walking brochures, the Rambler’s etc.) have influenced the development of this act. Thus, whilst the process by which they ‘arise’ is difficult to explain, they are nonetheless important in terms of practical and policy implications.

7.6 Future research

7.6.1 Controlled laboratory work

Future studies assessing the psychophysiological outcomes of exercising in different environments may benefit from taking a step back from the method presented in Chapter 3. Only two studies at present have shown psychophysiological differences to exercising in exposure to different types of natural environment in a laboratory setting (Pretty et al., 2005; White et al., 2015). The problems with the former have been noted in Chapter 2, and the latter used a cycling task for a specific, relatively inactive, population (older women). A similar simulation study could first investigate whether psychophysiological responses to acute bouts of moderate-intensity walking are different when exposed to different outdoor environments (urban, green, and coastal). Additionally, if future researchers wished to find out if differences in psychophysiological responses are due to differences in attention restoration, they could make use of more recent research findings. Valtchanov & Ellard (2015) have effectively validated the blink rate as a measure of attention restoration (see section 7.3). Thus, future research could use this as a measure of directed attention restoration. If a researcher were to go on and test whether different qualities of natural environments also elicited different psychophysiological responses, they could use the results in Chapter 3 to help develop a power calculation to establish the sample size they would need to find a significant effect. A between-subjects design would also be recommended to eliminate the prospect of order effects.

Furthermore, if one wished to further validate the use of blink rates (or other eye-tracking metrics in general) for use as proxy measures of directed attention restoration, they could investigate their predictive validity (something which was unexplored by Valtchanov & Ellard, (2015)). Many cognitive tasks have been used in controlled studies of restorative environments such as the Necker Cube Pattern Control task (Hartig et al., 2003) or the backward digit span task (Berto, 2005). Researchers could test whether blinks, fixations, or dwell time to supposedly restorative/non-restorative scenes was related to performance on these tasks. If it was found, for example, that non-restorative scenes elicited a greater number of blinks which in turn was related to poorer performance on such cognitive tasks, then the measure of blink rates could be said to be a measure of directed attention restoration that has good predictive validity, further justifying its use in experiments of this kind.

Whilst a between-subjects design eliminates the possibility of order effects, researchers may also want to follow-up the intriguing possibility of order effects found in Chapter 3. For example, within one acute exercise session, participants, while walking on a treadmill, could view a point-of-view video of a walk through a natural environment which begins ‘clean’ and halfway through becomes degraded (or vice versa). This would allow researchers to monitor how psychophysiological responses change from just before the change, to just after. More sensitive physiological measures could be employed such as cardiac output (amount of blood pumped by the heart), ventricular contractility (force of the contraction of the left ventricle), or total peripheral resistance (a measure of net constriction versus dilation of the arterial system) which have been shown to reflect small changes in underlying psychological states (Seery, 2011). Concurrently, changes in valence and activation could be monitored. If the cautious findings in Chapter 3 are correct, one might expect to find greater changes in these psychophysiological measures when someone views a clean environment immediately followed by a littered environment, compared to the other way around.

7.6.2 Secondary data analysis

One addition to the study presented in Chapter 4 would be to perform a robustness check on the results using better measures of PA type and duration. Ultimately, Chapter 4 assumes that participants are reporting the duration of time they spent in the natural environment rather than the total trip time (i.e.

including travel time). Since publication of the study presented in Chapter 4, the results of the Welsh Outdoor Recreation Survey (WORS; Natural Resources Wales, 2015) have been published for public accessibility for the first time. The WORS is a Welsh parallel of the Monitor of Engagement with the Natural Environment Survey which has collected data every four years since 2006, but only the latest wave (2014) has been made publicly available. It aims to recruit a representative sample of the Welsh population and asks respondents about their most recent trip to the natural environment. Importantly, after respondents list all the activities conducted on that visit it asks, “Which would you say was the *main* activity you did on your most recent visit to the outdoors?” It then follows this up by asking, “During this visit, how long did you spend in the outdoors?” Already, one can see that this survey provides a more rigorous way of assessing (a) the main activity conducted and; (b) the length of time actually spent in the natural environment. Furthermore, it proceeds to ask whether the effort put into the activity was: (a) enough to raise the respondent’s breathing rate and; (b) enough to make them out of breath or sweat. These are supposed to reflect whether the activity undertaken was of moderate of high intensity respectively. Taken together, these measures provide a much better assessment of the quantity of PA conducted within the natural environment. The compromise is the fact that the recruited sample size is substantially lower (around 6,000 for the latest wave) and thus the smaller effects found in Chapter 4 may not appear significant and it may not be appropriate to include as many statistical controls. Nevertheless, a better assessment of the amount of PA conducted in natural environments is a worthwhile avenue for future research.

Also, the study presented in Chapter 4 is cross-sectional and therefore is limited by possible selection effects – do visits to natural environments elicit bouts of

PA or do more physically active people choose to visit natural environments in order to carry out PA? A logical extension of this study then would be to exploit the use of secondary longitudinal datasets. In the UK, analysis of longitudinal data has already revealed that moving to greener urban areas results in lower mental distress (White, et al., 2013b) which can last in the longer-term (Alcock et al., 2014). Moving to more coastal locations in England also results in lower mental distress (White et al., 2013a). All of these effects could be explained by parallel increases in PA. Importantly, one longitudinal study in Australia has found that moving to areas with a greater number of accessible public open spaces is associated with increases in recreational walking (Giles-Corti et al., 2013). Considering this evidence, a researcher could use a dataset such as the British Longitudinal Household Panel Survey or Understanding Society panel to investigate whether moving to areas with a higher density of accessible greenspace (or greater proximity to the coastline) is associated with sustained increases in health-enhancing PA attainment. There are many national land cover datasets which now exist which would allow the researcher to capture green space coverage such as the Generalized Land Use Database or the CORINE Land Cover Map. Ideally, one would want to investigate whether such an association is mediated by an increase in visits to natural environments. Thus one could make an inference that moving to greener or more coastal areas results in sustained increases in PA because individuals are visiting natural environments in order to achieve this. However, to my knowledge no longitudinal datasets concerning visits to natural environments exist at present.

Furthermore, an emerging research methodology surrounding the effects of natural environments on health outcomes is that of the twin study. Although longitudinal designs provide better evidence of causality, they are still unable to control for the possibility of non-random selection of residents into neighbourhoods (i.e. they may be unable to measure potentially common characteristics of the people who choose to move to greener or more coastal areas). Cohen-Cline, Turkheimer, Duncan (2015) used a twin study as a way of addressing potential genetic and environmental confounds. Twins' shared upbringing may influence both mental health and residential self-selection. In a cross-sectional secondary data analysis of same-sex twin pairs from the USA, the authors found that the monozygotic twin who lived in an area with a greater density of greenspace[ee] was less depressed[ff] than the twin living in an area with a lower density. This association held after adjustment for potential confounds. A similar result was found regarding self-reported stress, but this association did not remain after adjustment for, among other variables, moderate-to-vigorous PA attainment. In a similar way, researchers could use twin registry databases to deduce whether one monozygotic twin living in greener or more coastal areas was more physically active than their twin living in a less green or coastal area. If this hypothesis is supported, it would suggest that PA attainment is associated with quantity of green space in one's local area irrespective of genetic confounds or confounds related to common upbringing.

One further extension of the study presented in Chapter 4 would be to conduct an economic analysis from the estimates of energy expenditure derived. This process is already outlined within the practical and policy implications in section 7.4. To reiterate, standard procedures for converting estimates of MET-minutes into QALYs already exist (Mourato et al., 2010). Using pre-existing weights

---

[ee] Measured using the Normalised Difference Vegetation Index – a measure of the quantity of vegetation around an individual's home calculated from satellite imagery. In this study, a 1km buffer around the individual's home was used.
[ff] Using the PHQ-2 – a two-item clinical screening tool for depression.

included in the Monitor of Engagement with the Natural Environment dataset, one could estimate the value of the natural environment to physical health across the whole of England in terms of potential cost savings. Of course, any analysis would have to recognise that such calculations underestimate mental health benefits and cannot account for the costs associated with, for example, injuries that result from visits to the natural environment, or the cost of preserving the natural environment in a state which will facilitate physically active visits.

7.6.3 The promotion of physical activity in natural environments

The study presented in Chapter 6 shows that enhancing recreational walking brochures with certain behavioural techniques can influence the intentions of infrequent recreational walkers (and therefore, potentially, their behaviour). Future studies may wish to test if such recreational walking brochures work in the real world at influencing walking behaviour in natural environments. In section 2.7.2, two studies were described (Peels et al., 2014; Pleguezuelos et al., 2013) which used outdoor walking brochures as an aid to influencing walking behaviour for clinical populations. These had inconsistent results suggesting that the behavioural content of brochures may play a role. In a randomised controlled trial a sample of self-reported inactive individuals who wished to change their PA behaviour could be recruited. Half of the sample could receive standard walking brochures collected from their local authority and instructed by the experimenters to read them and consider undertaking the walks in a specified time period. The other half of the sample could receive the same set of brochures but where the text had been manipulated to include behavioural techniques relevant to creating stronger intentions to walk. Face-to-face or other forms of facilitation could be employed to enhance individual's attention to the brochures across the pre-defined study period. Participant’s movement could be captured using accelerometers and their location tracked using GPS monitoring. This way the amount of activity conducted in the advertised natural environments could be assessed before and after the brochures are administered. Clearly, analysis would have to control for known barriers to the behaviour such as the weather (Tucker & Gilliland, 2007).

In a more natural intervention, the effects of enhanced brochures on walking participation in natural environments could be explored independent of a facilitated intervention. For example, a standard brochure may advertise a walking route around a local country park and be provided to guests at a holiday park as part of a welcome pack. The amount of visitors engaged in walking the route within that country park could be examined across a week-long period during the summer. Then, these brochures could be replaced for the next cohort of holiday visitors with enhanced ones created by the experimenters to influence consumer’s intentions to undertake walking in that country park. Again, within a week-long period, the number of people engaged in walking the route could be monitored. An increase in the number of people using the country park walking route for walking behaviour would be hypothesised. Furthermore, feedback questionnaires could be completed by visitors to the holiday park which ask specific questions prompting respondents to indicate whether they had read the brochure and undertaken the walk as part of their holiday. This would also allow experimenters to know how often such materials are actually read and remembered. Again, potential confounds such as weather would have to be controlled for, and in this scenario the experimenter has far less control over whether the walking materials are accessed. Nonetheless, if findings are successful, the production and administering of brochures in such a way would represent a cost-effective way of increasing PA in natural environments, at least in the short-term.

7.7 General limitations of the thesis

7.7.1 Fundamental issues with individual studies

In part, the motivation for the study presented in Chapter 3 was to address the inadequacies from previous research. The only study that I was aware of that dealt with the issue of the effects of degradation in natural environments on the benefits of exercise was that of Pretty et al., (2005). In Chapter 2, this study was criticised for including natural stimuli that perhaps were rather extreme (e.g. pictures of burnt-out cars in a natural environment), incorporating measures of mood that were not validated in the context of exercise, and for overlooking the reasons why the effects they found may have occurred. However, it is arguable that the findings of Chapter 3 have similar criticisms. Firstly, although the measures of valence and activation that were used in this study were validated for repeated use across exercise sessions, the study failed to find many differences in either measure as a result of the environmental manipulation. In Chapter 3 many potential explanations for this are offered. However, the point remains that not much can be concluded regarding the effects of viewing anthropogenic degradation on the affective outcomes of exercise. It is difficult to interpret what reductions in tension-anxiety scores, or improvements on vigour-activity scores, really mean, but the fact that these scores did differ between environmental conditions in Pretty et al.'s (2005) study mean that the measures may at least be representing some fundamental differences in affect when exposed to degraded or non-degraded natural environments. Nonetheless, unless such measures can be validated in an exercise context, the use of the affect circumplex is advocated; it may be simply that there are no affective differences between viewing littered and clean natural scenes while exercising, and this contention should at least be falsified first.

Secondly, although Pretty et al., (2005) did not study any mechanisms by which the quality of the environment affected the outcomes of exercise, the measures of visual attention used in Chapter 3 also provided no clear answers as to whether the restoration of attention played a role in how anthropogenic degradation affected psychological outcomes of exercise. Again, possible reasons for this are provided in the Chapter, but it remains to be seen whether different quality environments are differently restorative thus influencing psychological outcomes. As noted earlier, the eye-tracking method offers promise as Valtchanov and Ellard (2015) have identified the use of blink rates as a measure of attention restoration.

Taken together, these limitations mean that Chapter 3 may not have addressed the weaknesses with previous research as strongly as was intended. Nevertheless, this Chapter uses more sound measures of affect, more subtle manipulations of the natural environment (which have potentially more ecological validity), and a method (eye-tracking) for investigating mechanisms which holds much promise for future research. It also cannot be ruled out that the largely null results are informing us on the true nature of the relationship – that litter does not affect psychophysiological outcomes of exercise in comparison to clean environments.

A fundamental issue with the study presented in Chapter 4 was that it did not explore the fact that many people still do not visit natural environments. According to the 2014-2015 data from the Monitor of Engagement with the

Natural Environment Survey, 58.7% of people surveyed did not visit the natural environment in the past week, and 9.8% have not visited it even once in the last year[gg]. Firstly, it is possible that those 59% who did not visit in the past week, visited other types of environment (urban, gyms) in which they achieved PA[hh]. Depending on the amount achieved, the importance of natural environments as a public health resource could be undermined. Also, one cannot be sure that the quantities of PA identified in Chapter 4 are the sorts of amounts that would be undertaken by people who do not visit the natural environment if they were to begin visiting. Evidence already suggests that those people who visit green spaces less frequently are also the least likely to achieve PA guidelines (Coombes et al., 2010). However, at present, there is no evidence that beginning to visit the natural environment results in increases in PA. Thus if non-visitors to the natural environment began visiting, they may only undertake sedentary behaviours rather than physically active ones. Again this could undermine natural environments' purpose as a public health resource because it means they may only be providing PA opportunities for people who are already active. To this end, longitudinal research is needed which identifies whether increasing visits to natural environments is related to increases in PA.

The main issue with Chapter 5 is that many of the categories included in the taxonomy may not necessarily be persuasive for the reader. However, this problem is mostly overcome in Chapter 6 by demonstrating which categories might be persuasive for frequent/infrequent recreational walkers. Considering previous research we can assume that around half of people who report an intention to be physically active in natural environments will actually go on to

[gg] I ran this analysis independently on the latest wave of the MENE survey (2014-2015).
[hh] Indeed, an upcoming study suggests that 10.2% of the population of England achieve PA guidelines without visiting natural environments (White et al., in preparation).

undertake that activity (Webb & Sheeran, 2006). However, this does not inform on what proportion of people will maintain that behaviour. Indeed, one could criticise the use of the theory of planned behaviour in informing message development as the theory does not propose any mechanisms regarding behavioural maintenance (Kwasnicka, Dombrowski, White & Sniehotta, 2016). This means if ‘enhanced’ brochures were distributed to infrequent recreational walkers, it may only instigate short-term behaviour change and not long-term participation in PA in natural environments.

There are existing behavioural theories that attempt to predict maintenance of behaviour. One example is the model of behavioural maintenance (Rothman, 2000). The theory suggests that maintenance of health behaviour change is determined by the perceived level of satisfaction with outcomes of the initial behaviour change. The satisfaction with an experience is theorised to be an indicator that the initial behaviour change was correct, and satisfaction is hypothesised to be the result of whether an experience meets the expectations the individual had before changing their behaviour. This theory implies that individuals should be prompted to reflect on the positive aspects of behaviour after it has been initiated. Thus, in addition to messages designed to change intentions for walking, brochures advertising recreational walking in natural environments should encourage individuals to reflect on the positive aspects of walking after the walk is completed. Additionally, it could invite individuals to reflect on their mood whilst they are walking as this has been shown to predict future behaviour too (Rhodes & Kates, 2015). In the context of natural environments this could prove to be especially effective as they generally induce more positive affect (McMahan & Estes, 2015). Indeed, this ‘self-monitoring' approach to behavioural maintenance has shown promise in the maintenance of exercise behaviour previously (Izawa et al., 2005).

7.7.2 Strength of the literature base

One general limitation with this thesis is that it is based upon a literature base which is still in its infancy. As highlighted in the introduction, the two systematic reviews which look at controlled studies discerning the mental well-being benefits of exercise in urban and natural environments (Bowler et al., 2010; Thompson-Coon et al., 2011) both find a series of limitations with almost all of the included studies. Thompson-Coon et al., (2011) in particular note the lack of high-quality evidence on this topic, citing small sample sizes, the use of single acute episodes of PA, the possibility of bias and confounding resulting from the lack of description on randomisation, and the heterogeneity of outcome measures as key limitations with the literature base. Therefore, the premise upon which this thesis is based – that PA in natural environments has additive health benefits over PA in other sorts of environment – remains unclear.

Nonetheless, there is a significant body of research providing evidence for the affective benefits of being exposed to natural environments more generally. McMahan and Estes (2015) recently reviewed studies comparing the effect of natural versus other environments on positive and negative affect. In a meta-analysis, they found a significant relationship between brief exposures to natural environments (in real or laboratory scenarios) and higher positive affect (r=0.31) compared to brief exposures to other environments. This effect was only slightly compromised by evidence of publication bias (r=0.30 after trim and fill procedures). The effect was also moderated by country of study, measure of affect, and whether the study took place in a laboratory or the outdoors.

However, in all possible subdivisions, a significant relationship remained. Furthermore, there was a small but significant relationship between brief exposures to natural environments and lower negative affect (r=-0.12) which did not appear to be compromised by publication bias. Taken together, despite the fact that there are limitations with the evidence base surrounding the real nature of the mental well-being effects of exercising in natural environments, there remains robust evidence that exposure to natural environments in general elicits more positive affect and less negative affect.

There is perhaps a stronger body of evidence concerning cross-sectional evidence on natural environmental supports for PA. In scoping and systematic reviews for example, James et al., (2015) identified strong cross-sectional evidence linking neighbourhood greenness with PA, cardiovascular disease, mental health outcomes, and mortality. Lee et al., (2015) also identified a consistent body of evidence associating access to green spaces with PA attainment. Along with emerging studies examining contact with the natural environment and PA attainment (Mitchell, 2013; White et al., 2014), the evidence base supporting the notion that natural environments support physically active behaviour is strong. Perhaps more than any of the above studies, the findings of Chapter 4 highlight the idea that natural environments are supportive of health-enhancing PA behaviour. Therefore, whether exposure to natural environments adds to the mental well-being benefits of exercise or not, attempts to promote PA in natural environments is justified as they support uninterrupted bouts of health-enhancing PA which may be particularly beneficial for the least active members of the population (Ball et al., 2015; Rowe et al., 2012; Sellens et al., 2012; see also Chapter 4 and section 6.1).

7.7.3 Physical activity by 'stealth'

An implicit assumption contained within the studies presented in Chapters 3 and 4 is that recreational PA in natural environments is a purposeful activity. That is, that people visit natural environments with the express purpose of being active. However, in their overview of research, Ward Thompson and Aspinall (2011) conclude that, “there is some evidence that visiting green or natural outdoor environments is associated with higher levels of PA, and walking in particular, regardless of the primary purpose or attraction of the visit” (p.254). Thus, they suggest that, “this suggests that understanding what attracts or deters people in visiting natural environments may be as important as any measure of physical activity associated with such visits” (Ward Thompson & Aspinall, 2011, p.254). In other words, the PA practiced in natural environments might be a secondary outcome of the visit.

In the literature, this is termed incidental PA, and some scholars include stair use, active travel, and play as types of incidental PA (Reynolds, McKenzie, Allender, Brown & Foulkes, 2014) as this is activity that is conducted without the desire to be active, but with the purpose to reach a destination or to have fun. However, it may also be that recreational or leisure-time PA is also done without the desire to be active. The studies in Chapters 5 and 6 are of greater relevance to this idea as they propose that for some people, the desire to view scenery, wildlife, or sites of historical interest may motivate a walk in a natural environment and not the desire to be physically active. In Chapter 6, the conclusion is made that messages highlighting such factors are motivating for more frequent recreational walkers and messages affecting attitudes, subjective norms, and self-efficacy for walking are more motivating for less frequent recreational walkers. However, it could be the case that both demographics are motivated by these scenic aspects of natural environments, but that less frequent recreational walkers simply need some information which reduces their perceived barriers to undergoing this sort of experience.

This is important as incidental PA is positively associated with cardiorespiratory fitness (Ross & McGuire, 2011; Tonello, Reichert, Oliveira-Silva, Del Rosso, Leicht & Boullosa, 2015), and thus could reduce the risks of a number of physical health conditions. There is growing interest in how best to promote PA by incidental means. Reynolds et al., (2014) systematically reviewed 43 studies on the topic (importantly, not including recreational forms of PA), and found that 34 reported a significant increase in incidental PA with active travel interventions being the most effective. One example of an incidental PA intervention not included in this review is Brockman and Fox's (2011) evaluation of the effectiveness of workplace travel plan on physically active commuting behaviour. In the year 2000, the University of Bristol limited the number of parking places and permits available to staff, increased charges for parking, improved changing facilities for walkers and cyclists, subsidised a new cycling scheme, car-sharing scheme and free university bus service, and discounted bus passes. The authors then used the University of Bristol Staff Travel Survey to show that from 1998 to 2007, contrary to national patterns, the percentage of people walking to work significantly increased from 19% to 30%. Additionally, in 2007, 70% of respondents who usually walked or cycled to work reported achieving over 80% of the recommended PA guidelines through their active commuting.

This study shows that by implementing structural changes to environments, PA can occur incidentally as a result. The changes were never designed to improve health, but to reduce congestion within the city and parking at the campus. In a similar way, promoting a curiosity in what others refer to as biophysical properties of natural environments (Dallimer et al., 2014; Irvine et al., 2013) might be as effective in terms of getting people active in natural environments, than promoting walking behaviour itself. This is because experiencing these properties necessitates PA inherently. Therefore, while the studies prior to Chapter 5 imply that people go to natural environments and deliberately undertake certain forms of physical activity, these could just as easily be incidental, or indeed be based on multiple motives (e.g. PA and the chance to see wildlife). In the future, interventions could test whether physical changes to natural environments to enhance such biophysical properties attract new visitors (and particularly new visitors undertaking PA). Whilst this has been done to some extent (Hunter et al., 2015), better quality controlled trials of this nature are needed.

In a similar way, the findings from this thesis have implications for forms of walking other than recreational walking. Research has already demonstrated that the presence of trees on streets is related to the perceived attractiveness of those streets for neighbourhood walking (Borst, Miedima, de Vries, Graham & van Dongen, 2008). Natural elements and fountains are also related to the perceived total walkability (i.e. suitability for all forms of walking including travel, recreational etc.) of urban areas (Brown, Werner, Amburgey & Szalay, 2007). Chapter 4 suggests that features of coastal environments prompt higher episodes of energy expenditure. This could be because the gentle, open terrain of a beach environment affords longer bouts of walking. In a similar way the likelihood of longer bouts of walking for transport could be enhanced by having flatter, wider travel routes. Indeed, gentler street slopes have been associated with more walking and bicycling for transport among American adults previously (Cain et al., 2014) and wider pavements have been identified as important for walking for transport in a UK city (Kelly, Tight, Hodgson & Page, 2011). These kinds of comparisons again highlight the importance of understanding the activity affordances of a range of natural environments (see section 4.4.6); because it is possible that these can translate into the design of everyday environments to elicit higher volumes of PA.

7.7.4 Ecological public health and its complexity

In a much broader sense than has been covered so far, the foundations, results and conclusions of the background research and the studies within this thesis make assumptions about the kind of public health that would be effective in producing sustained changes in PA behaviour. Specifically, they assume that an ecological public health approach would be most effective where everyday environments and contexts are shaped (materially, biologically, culturally, socially etc.) so that they are conducive to PA. Rayner and Lang (2012) suggest that ecological approaches to public health do not provide linear pathways and they have numerous implied feedback loops, making public health recommendations extremely difficult to implement. However, Rayner and Lang (2012) also suggest that this complexity is an issue which can be confronted and analysed.

In their book, Rayner and Lang (2012) provide an example of how the Foresight report (a UK report on obesity) mapped the causes of obesity. The map that was produced implied ecological public health approaches were needed to address obesity as everything from biological factors to societal and food production factors were noted as important influences (see Figure 7.3). The UK government invested a large sum of money to translate these findings into public health policy (predominantly through the Change4Life social marketing campaign), but in reality the measures were what Rayner and Lang (2012) describe as ‘soft.’ This means that they failed to address things such as the car-based culture that makes PA difficult to incorporate into everyday life, and they overlooked the fact that their Change4Life campaign existed alongside conflicting commercial messages from food companies (Berry & Latimer-Cheung, 2013).

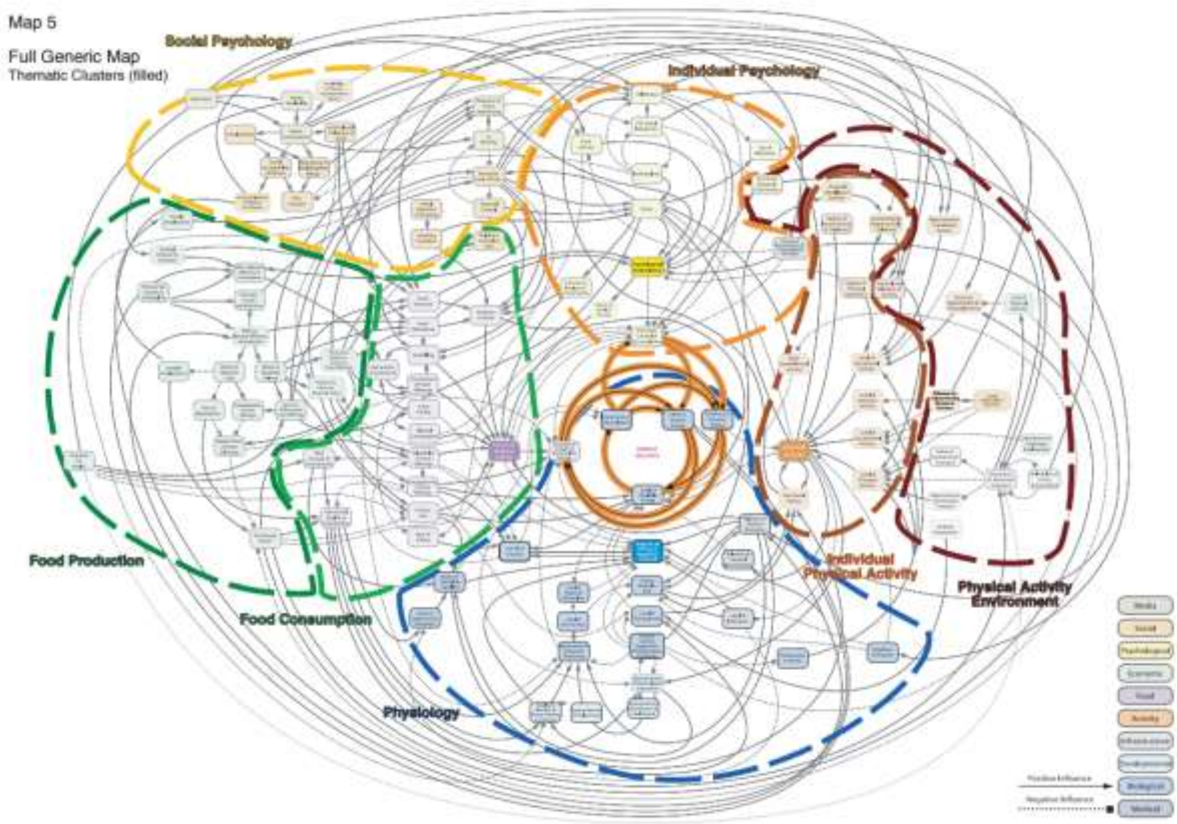


Figure 7.3 The clustered determinants of obesity taken from the Foresight Report: “Tackling Obesities: Future Choices – Obesity System Atlas” demonstrate the complexity of the public health issue and the need for ecological approaches to tackle it (Government Office for Science, 2007, p.12).

This example of obesity demonstrates just how complex an issue can be for public health to tackle and also how soft measures to address an issue often fail because they are not sufficient for change. In a similar way to the obesity epidemic, the physical inactivity epidemic requires ecological approaches in order to tackle it. Ultimately, this thesis implies that if natural ecosystems are protected, so is human health through the mechanism of increased opportunities for PA and increased likelihood that PA will be practiced when an individual is there. However, other determinants of PA and the choice to visit natural environments are arguably as plentiful as the number of determinants mapped in the above atlas of obesity. These will heighten the complexity of delivering multi-sectoral interventions which promote PA in natural environments to a point where the challenges involved in doing so could be insurmountable. If an ecological approach to the promotion of PA in the natural environment for the good of the public health is adopted, implementing successful interventions aimed at the sustainable use of natural environments for PA will be rife with challenges. Nonetheless, these challenges should be confronted if long-term changes in population PA, and population health, are to be achieved.

7.8 Overall conclusions

Physical inactivity and growing urbanisation threaten human health. Yet, with an expanding research base identifying associations between contact with natural environments and PA, and the physical and mental health benefits of being physically active in natural environments, there is a unique opportunity to address both. This thesis has provided evidence that different types of natural environment support different amounts of PA, that different qualities of natural environments elicit different psychophysiological responses and that with the right communication, even the least active members of the population can be persuaded to undertake PA in natural environments. With an ecological approach to PA promotion in the future, sustained population-level increases in PA can be achieved. What this thesis shows is that the conservation of natural environments is vital in accomplishing this.

Appendix A

Inclusion criteria and resultant sample size reductions for Chapter 4.

Exclusion criteria	Justification	Reduction	Sample size
Total number of visits	-	-	269,481
Visits not selected for follow-up.	Many variables in our analysis required information that was only available in the follow-up questions (e.g. visit dates).	175,717	93,764
People who reported undertaking 'any other activity' or 'none of the activities in the list.'	In order to create meaningful MET rates we needed activities that could be specified.	4,663	89,101
People reporting multiple visit activities.	Respondents could choose multiple activities that they undertook on their leisure visit. To ascribe more accurate MET rates, we selected only those who reported one of the activities in the available list.	16,341	72,760
People whose visit duration was more than 3 standard deviations above the mean.	We wanted to observe leisure visits that occurred within a 'day out.' This eliminated any visits over 555 minutes in length.	1,157	71,603

Appendix B

How MET rates were calculated for Chapter 4.

MENE Activity	Code(s)	Major Heading	Specific Activities	METS	Average METS
Eating or Drinking Out	13030	Self care	Eating, sitting	1.5	1.75
	13035	Self care	Talking and eating or eating only, standing	2.0	
Fieldsports	15150	Sports	Cricket, batting, bowling, fielding	4.8	6.3867
	15160	Sports	Croquet	3.3	
	15250	Sports	Frisbee, ultimate	8.0	
	15350	Sports	Hockey, field	7.8	
	15460	Sports	Lacrosse	8.0	
	15480	Sports	Orienteering	9.0	
	15560	Sports	Rugby, union, team, competitive	8.3	
	15562	Sports	Rugby, touch, non-competitive	6.3	
	15605	Sports	Soccer, competitive	10.0	
	15620	Sports	Softball or baseball, fast or slow pitch, general	5.0	
	15625	Sports	Softball, practice	4.0	
	15630	Sports	Softball, officiating	4.0	
	15640	Sports	Softball, pitching	6.0	
	15645	Sports	Sports spectator, very excited, emotional, physically moving	3.3	
	15725	Sports	Volleyball, beach, in sand	8.0	
Fishing	04001	Fishing and hunting	Fishing, general	3.5	3.5
Horse Riding	15370	Sports	Horseback riding, general	5.5	5.5
Off-Road Cycling or Mountain Biking	01009	Bicycling	Bicycling, mountain, general	8.5	8.5
Off-Road Driving or Motorcycling	15470	Sports	Moto-cross, off-road motor sports, all-terrain vehicle, general	4.0	4.0
Pickinicking	13030	Self care	Eating, sitting	1.5	1.75
	13035	Self care	Talking and eating or eating only, standing	2.0	
Playing with Children	05170	Home activities	Sitting, playing with child(ren), light effort, only active periods	2.2	3.575
	05171	Home activities	Standing, playing with child(ren), light effort,	2.8	

			only active periods		
	05175	Home activities	Walking/running, playing with child(ren), moderate effort, only active periods	3.5	
	15180	Home activities	Walking/running, playing with child(ren), vigorous effort, only active periods	5.8	
Road Cycling	01015	Bicycling	Bicycling, general	7.5	7.5
Running	12020	Running	Jogging, general	7.0	7.0
Appreciating Scenery from a Car	07021	Inactivity quiet/light	Sitting quietly, general	1.3	1.3
Swimming Outdoors	18300	Water activities	Swimming, lake, ocean, river	6.0	6.0
Beach, Sunbathing or Paddling	07011	Inactivity quiet/light	Lying quietly, doing nothing, lying in bed awake, listening to music (not talking or reading)	1.3	1.9
	18367	Water activities	Water walking, light effort, slow pace	2.5	
Visiting an Attraction	17160	Walking	Walking for pleasure	3.5	3.5
Walking without dog	17190	Walking	Walking, 2.8 to 3.2mph, level, moderate pace, firm surface[ii]	3.5	3.5
Walking with dog	17165	Walking	Walking the dog	3.0	3.0
Watersports	18010	Water activities	Boating, power, driving	2.5	5.7773
	18012	Water activities	Boating, power, passenger, light	1.3	
	18020	Water activities	Canoeing, on camping trip	4.0	
	18030	Water activities	Canoeing, portaging	7.0	
	18040	Water activities	Canoeing, rowing, 2.0-3.9mph, light effort	2.8	
	18050	Water activities	Canoeing, rowing, 4.0-5.9mph, moderate effort	5.8	
	18070	Water activities	Canoeing, rowing, for pleasure, general	3.5	
	18100	Water activities	Kayaking, moderate effort	5.0	
	18110	Water activities	Paddle boat	4.0	
	18120	Water activities	Sailing, boat and board sailing, windsurfing, ice sailing, general	3.0	

[ii] Bohannon, R.W., Williams Andrews, A. (2011). Normal walking speed: A descriptive meta-analysis. *Physiotherapy, 97(3),* 182-189. A 40-49 year old male average gait speed was 143.4cm/second which equates to just over 5km/h or 3 mph. Even though this is only for middle aged men in a straight walking task, this also matched other nationally recognised speeds (http://www.bhf.org.uk/get-involved/events/training-zone/walking-training-zone/walking-faqs.aspx).

	18140	Water activities	Sailing, Sunfish/Laser/Hobby Cat, Keel boats, ocean sailing, yachting, leisure	3.3	
	18150	Water activities	Skiing, water or wakeboarding	6.0	
	18160	Water activities	Jet skiing, driving, in water	7.0	
	18180	Water activities	Skindiving, fast	15.8	
	18190	Water activities	Skindiving, moderate	11.8	
	18200	Water activities	Skindiving, scuba diving, general	7.0	
	18210	Water activities	Snorkelling	5.0	
	18220	Water activities	Surfing, body or board, general	3.0	
	18225	Water activities	Paddle boarding, standing	6.0	
	18352	Water activities	Tubing, floating on a river, general	2.3	
	18370	Water activities	Whitewater rafting, kayaking, or canoeing	5.0	
	18380	Water activities	Windsurfing, not pumping for speed	5.0	
	18385	Water activities	Windsurfing or kitesurfing, crossing trial	11.0	
Wildlife Watching	04085	Fishing and hunting	Hunting large game, from a hunting stand, limited walking	2.5	2.5
Informal Games and Sport (Frisbee, Golf)	15135	Sports	Children's games, adults playing (e.g. hopscotch etc), moderate effort	5.8	4.4333
	15180	Sports	Darts, wall or lawn	2.5	
	15235	Sports	Football (American) or baseball, playing catch	2.5	
	15240	Sports	Frisbee playing, general	3.0	
	15255	Sports	Golf, general	4.8	
	15310	Sports	Hacky sack	4.0	
	15450	Sports	Kickball	7.0	
	15610	Sports	Soccer, casual, general	7.0	
	15465	Sports	Lawn bowling, bocce ball, outdoor	3.3	

Appendix C

Travel mode speed estimates used in the selection of respondents included in models 2 and 3 of Chapter 4 along with sources of information and model descriptions. N.B references and descriptions of model construction are in the footnotes of this table.

Travel mode	Frequency and proportion (%) of sample using travel mode	Speed Estimate	How estimate was calculated
Car/van/taxi	23,776 (33.2%)	41 miles per hour (mph)	Since minor roads make up the majority of road length in Great Britain (Department for Transport, 2013a), we used automatic traffic counter data from the Department of Transport (DfT; DfT, 2013b; 2013c) which suggested that in 2013, cars travelled at an average of 47mph on non-built-up single carriageways (based on 41,823,000 observations) and 35mph on built-up 40mph speed-limit roads (based on 44,654,000 observations). We used the average of these two figures (41mph) as the predicted average travel speed of respondents travelling by car or van.
Public bus and private bus	1,980 (2.8%)	39.5mph	We used the same data sources above to estimate the average speed of bus travel. In 2013, the same data suggests that buses on non-built-up single carriageways travelled at an average speed of 45mph (based 464,000 observations) and on built-up 40mph speed limit roads at a speed of 34mph (based on 474,000 observations; DfT, 2013b; 2013c). We used the average of these two figures (39.5mph) as the predicted average travel speed of respondents travelling by public or private bus.
Motorbike	144 (0.2%)	43.5mph	We used the same data sources above to estimate the average speed of motorbike travel. In 2013, the data suggests that motorbikes on non-built-up single carriageways travelled at an average speed of 51mph (based on 456,000 observations) and on built-up 40mph speed-limit roads at an average of 36mph (based on 665,000 observations). We used the average of these two figures (43.5mph) as the predicted average travel speed of respondents travelling by motorbike.
On foot	41,861 (58.5%)	3mph	In this study, walking without a dog is set at a MET rate of 3.5 (Ainsworth et al., 2011). This is based on code 17190 in the compendium of physical activities, “walking 2.8 to 3.2mph, level, moderate pace, firm surface.” We used the mid-point of this speed (3.0mph) as our estimated travel speed of those travelling by foot.

By bicycle	2,310 (3.2%)	12mph	Again we used the compendium of physical activities (Ainsworth et al., 2011) to derive an estimate of travel speed for those travelling by bicycle. Assuming that "bicycling, general" (code 01015; 7.5 METs) represents light to moderate effort cycling, we used the mid-point of two other codes (code 01020; bicycling, 10-11.9mph, leisure, slow, light effort; and; code 01030; bicycling, 12-13.9mph, leisure, moderate effort) to derive a predicted travel speed (12mph).
Wheelchair	70 (0.1%)	3mph	Under UK law, powered wheelchairs and mobility scooters must not travel above 4mph on pavements and in pedestrian areas (Government Digital Service, 2014). Assuming most wheelchair users travel in this way (using power assisted wheelchairs on pavements), we estimate a travel speed under the speed limit similar to a walking pace (3mph).
For all other transport modes, we were unable to identify academic or governmental sources pertaining to average speeds, so internet sources which retained face validity were used. In addition, these only make up 2% of the overall sample.			
Train	1,161 (1.6%)	62.5mph	"The average speed at which trains in the UK travel is between 60 and 65 mph" (Onaverage, n.d). We used the mid-point of this estimate 62.5mph as the predicted average travel speed of respondents travelling by train.
Horseback	68 (0.1%)	9.9mph	A horse trot is estimated at 13 to 19km/h (Speed of Animals, n.d). The mid-point of this range (16km/h) equates to 9.9mph. Thus, we used this as the predicted average travel speed of respondents travelling by horseback.
Boat	27 (0%)	14mph	Assuming that most trips taken by boat were by a ferry, we calculated that because the average Dover-Calais crossing time is 90 minutes (P&O Ferries, n.d) and the distance from port to port is 21 miles, the average speed of the ferry would be 14mph. Thus we use this as the predicted average travel speed of respondents travelling by boat.
Other	206 (0.3%)	28mph	As it was impossible to determine what transport mode respondents reporting "other" modes of transport were referring to, we took an average of all the other travel speed estimates in this table (28mph). We thus used this as the predicted average travel speed of respondents reporting "other" modes of transport.

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Tudor-Locke, C., ... & Leon, A. S. (2011). 2011 compendium of physical activities: a second update of codes and MET values. Medicine and science in sports and exercise, 43(8), 1575-1581.
Department for Transport (2013a). Table RDL0201: Road lengths (kilometres) by road type and region and country in Great Britain, 2013. Retrieved 12/01/2015 from https://www.gov.uk/government/statistical-data-sets/tsgb07.
Department for Transport (2013b). Table SPE0101: Free-flow vehicle speeds on non-built-up roads by road type and vehicle type in Great Britain, 2013. Retrieved 12/01/2015 from https://www.gov.uk/government/statistical-data-sets/spe01-vehicle-speeds.
Department for Transport (2013c). Table SPE0102: Free flow vehicle speeds on built-up roads by speed limit and vehicle type in Great Britain, 2013. Retrieved 12/01/2015 from https://www.gov.uk/government/statistical-data-sets/spe01-vehicle-speeds.
Government Digital Service (2014). Rules for users of powered wheelchairs and mobility scooters (36 to 46). Retrieved 12/01/15 from https://www.gov.uk/rules-powered-wheelchairs-mobility-scooters-36-46/on-pavements-38-to-40.
Onaverage. (n.d). Average train speed. Retrieved 12/01/2015 from http://www.onaverage.co.uk/speed-averages/58-average-train-speed.
P&O Ferries (n.d). Dover to Calais. Retrieved 12/01/2015 from http://www.poferries.com/en/dover-calais.
Speed of Animals (n.d). Horse: Equus ferus caballus. Retrieved 12/01/2015 from http://www.speedofanimals.com/animals/horse.
N.B. Model 1 contained the whole sample (n=71,603) and so did not concern the above speed estimates.
N.B. The “walkers only” model contained only individuals who walked to their destination, within five miles, and undertook walking or walking with a dog – for details of the questions pertaining to travel mode and travel distance, consult supplementary table C.
N.B. Model 2 took respondent’s visit duration and subtracted an estimate of two-way “there-and-back” travel duration. To calculate this new duration we used the equation $VD = VD - \frac{(2\times D)}{S}$ where VD=the respondent’s original visit duration; D=the respondent’s travel distance and S=the speed of the respondent’s travel mode. As travel distances were defined by ranges, we took the median estimate in miles from each range (0.5, 1.5, 4, 8, 15.5, 30.5, 50.5, 70.5, 90.5, 120).
N.B. Model 3 took respondent’s visit duration and subtracted an estimate of one-way travel duration (assuming travel to the natural environment before moving elsewhere). To calculate this new duration we used the equation $VD = VD - \frac{D}{S}$ using the same principles as model 2.

Appendix D

Descriptions of control variables, their definitions and their reference categories for Chapter 4.

Control Variable	Description	Number and definition of Levels for present study	Reference Category
Individual-level control variables			
Physical activity in the last 7 days	MENE asks: "In the past week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job."	2 – Reports meeting recommended PA guidelines / Reports not meeting recommended PA guidelines	Reports not meeting recommended PA guidelines
Gender	MENE records the gender of every respondent.	2 – Male / Female	Females
Age	MENE records the age of every respondent into eight categories: 16-17, 18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75 and over. These were condensed to three categories.	3 – 16-34 / 35-54 / 55+	55+
Socio-economic status	MENE records the socio-economic status of every respondent according to the Ipsos-MORI classification and uses four clusters in the dataset: AB (high/intermediate managerial, administrative or professional) C1 (supervisory, clerical and junior managerial, administrative or professional), C2 (skilled manual worker), and DE (semi and unskilled manual workers, state pensioners, casual or lowest grade workers, unemployed with state benefits only; Ipsos-MORI, 2009).	4 – AB / C1 / C2 / DE	AB
Work status	MENE records every respondents work status into eight categories: Full-time paid work (30+ hours per week); part-time paid work (8-29 hours per week); part-time paid work (under 8 hours per week); retired; still at school; in full time higher education; unemployed (seeking work); not in paid employment (not seeking work). These were condensed to five categories based on similarities.	5 – Full-time work / Part-time work / Retired / In education / Not working	Full-time work
Marital status	MENE records the marital status of every respondent into three categories: Married\living as married; single; widowed\divorced\separated. These were condensed to two categories.	2 – Married / Unmarried	Married

Ethnicity	MENE records the ethnicity of every respondent into a number of categories: White British; White Irish; Any other white background; White & Black Caribbean; White & Black African; White & Asian; Any other mixed background; Indian; Pakistani; Bangladeshi; Any other Asian background; Caribbean; African; Any other Black background; Chinese; Any other. Due to the high prevalence of White-British respondents, we condensed these to two categories.	2 – White-British / Black and minority ethnicities (BAME)	White-British
Disability status	MENE asks: "Do you have any long standing illness, health problem or disability that limits your daily activities or the kind of work you can do?"	2 – Yes (has work-limiting disability) / No (does not have work-limiting disability)	Yes (has work-limiting disability)
Visit characteristics			
Presence of other adults on the visit	MENE asks: "How many adults aged 16 or over, including yourself, were on this visit?"	2 – Any other adults / No other adults	No other adults
Presence of children on visit	MENE asks: "How many children aged under 16 were on this visit?"	2 – Any children / No children	Any children
Presence of dogs on visit	MENE asks: "Were you accompanied by a dog on this visit?"	2 – Yes / No	Yes
Weekend / weekday visit	MENE records the date of the randomly-selected visit for every respondent who visited a natural environment in the last week. The day of the week corresponding to the date was ascribed.	2 – Visit taken on a weekday / Visit taken on a weekend	Weekend visits
Visitation frequency	MENE asks every respondent the following: "I would like to record details of occasions when you made out of door visits during each of the last 7 days. How many times, if at all, did you make this type of visit yesterday?" Where 'out of doors' is described to the respondent as "open spaces in and around towns and cities, including parks, canals and nature areas; the coast and beaches; and the countryside including farmland, woodland, hills and rivers." The interviewer then goes on to survey every day in the last week.	2 – Only one visit taken in the last week / Multiple visits taken in the last week	Only one visit taken in the last week
Start point of the visit	MENE records the start point of every randomly selected visit into five categories: Your home; someone else's home; work; holiday accommodation; somewhere else. These were condensed to four categories due to the low frequencies of 'work' and 'somewhere else.' N.B 95% of visits started from home.	4 – Own home / someone else's home / holiday accommodation / work or elsewhere	Own home

Travel distance	MENE asks all respondents how far they travelled in order to reach the visited environment; “Approximately how far, in miles, did you travel to reach this place? By that I mean the one way distance from where you set off to the place visited.” Respondents choose one category; Less than 1 mile; 1 or 2 miles; 3 to 5 miles; 6 to 10 miles; 11 to 20 miles; 21to 40 miles; 41to 60 miles; 61to 80 miles; 81to100 miles; more than 100 miles. These were condensed to four categories. N.B 35% of visits involved a travel distance of less than a mile.	4 – Less than a mile / 1-5 miles / 6-20 miles / Over 20 miles	Less than a mile
Travel mode	MENE asks what form of transport the respondent used for the journey and classifies these into 12 categories: Car or van; train (includes tube/underground); public bus or coach (scheduled service); coach trip/ private coach; motorcycle/ scooter; bicycle/ mountain bike; on foot/ walking; wheelchair/mobility scooter; on horseback; boat (sail or motor); taxi; other. These were condensed into five categories.	5 – Personal motorised transport / Public transport / On foot (including wheelchair use) / By bicycle / Other	Personal motorised transport
Season	MENE records the date of every randomly selected visit. Crude definitions of seasons using 3 month time periods were used as opposed to defining them via equinoxes and solstices, as this more labour-intensive strategy was deemed to not hold any more explanatory power than the simpler method which is more easy to interpret. These time periods were: March to May (Spring), June to August (Summer), September to November (Autumn), and December to February (Winter).	4 – Spring / Summer / Autumn / Winter	Winter
Survey wave	The yearly wave of the survey was controlled for in case there were any systematic year-on-year differences in the outcome variables.	5 – 2009-10 / 2010-11 / 2011-12 / 2012-13 / 2013-14	2009-10

Appendix E

Full regression for all three outcome variables in Chapter 4 (model 1; N=71,603).

	METs			Duration			Log-transformed MET minutes		
	b	LB	UB	*b*	LB	UB	*b*	LB	UB
Unadjusted									
Constant	3.54	3.53	3.55	109.87	108.80	110.94	2.44	2.44	2.44
Visit location (urban green spaces=ref)									
Countryside	0.05***	0.03	0.07	12.04***	10.49	13.58	0.05***	0.04	0.06
Seaside resort	-0.21***	-0.24	-0.17	52.30***	49.34	55.26	0.14***	0.13	0.15
Other coast	-0.11***	-0.16	-0.06	37.76***	33.50	42.03	0.12***	0.11	0.14
R^2		0.003		0.020			0.012		
Constant	3.53	3.53	3.55	112.412	111.249	113.574	2.45	2.44	2.45
Visit location (urban green spaces=ref)									
Countryside	0.05***	0.03	0.07	12.63***	11.08	14.18	0.05***	0.05	0.06
Seaside resort	-0.21***	-0.24	-0.17	52.40***	49.44	55.35	0.14***	0.13	0.15
Other coast	-0.11***	-0.16	-0.06	38.21***	33.95	42.47	0.12***	0.11	0.14
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.03***	0.01	0.05	-8.75***	-10.31	-7.18	-0.02***	-0.03	-0.02
R^2	0.003			0.021			0.013		
Constant	3.51	3.47	3.55	112.837	109.349	116.326	2.42	2.41	2.43
Visit location (urban green spaces=ref)									
Countryside	0.08***	0.06	0.10	14.91***	13.29	16.53	0.06***	0.06	0.07
Seaside resort	-0.15***	-0.19	-0.12	54.69***	51.72	57.66	0.16***	0.14	0.17
Other coast	-0.07**	-0.12	-0.02	40.20***	35.93	44.46	0.14***	0.12	0.15
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.02*	0.01	0.04	-8.86***	-10.42	-7.29	-0.02***	-0.03	-0.02

Gender (male=ref)									
Female	-0.27***	-0.29	-0.25	-15.15***	-16.69	-13.61	-0.08***	-0.08	-0.07
Age (55+=ref)									
16-34	0.19***	0.16	0.23	7.69***	4.99	10.39	0.05***	0.04	0.06
35-54	0.15***	0.12	0.17	-1.08$^{n.s}$	-3.57	1.41	0.02***	0.01	0.03
Socio-economic status (AB=ref)									
C1	-0.09***	-0.12	-0.07	-0.57$^{n.s}$	-2.60	1.46	-0.01**	-0.02	-0.01
C2	-0.17***	-0.19	-0.14	-1.31$^{n.s}$	-3.52	0.90	-0.02***	-0.03	-0.02
DE	-0.20***	-0.22	-0.17	-3.16**	-5.36	-0.97	-0.03***	-0.04	-0.03
Work status (full-time=ref)									
Part-time	-0.01$^{n.s}$	-0.04	0.02	-2.57*	-4.92	-0.22	-0.00$^{n.s}$	-0.01	0.01
Retired	-0.07***	-0.10	-0.04	0.57$^{n.s}$	-2.20	3.34	0.01$^{n.s}$	-0.00	0.02
In education	0.14***	0.10	0.18	-0.46$^{n.s}$	-3.95	3.03	0.02*	0.00	0.03
Not working	-0.05***	-0.08	-0.02	-4.48***	-6.86	-2.10	-0.01*	-0.02	-0.00
Marital status (married=ref)									
Not married	0.07***	0.05	0.09	4.54***	2.91	6.16	0.01***	0.01	0.02
Ethnicity (white-British=ref)									
BAME	0.03**	0.01	0.06	7.13***	4.97	9.29	0.04***	0.03	0.05
Disability status (has work-limiting disability=ref)									
No disability	0.16***	0.14	0.19	4.47***	2.35	6.60	0.05***	0.04	0.06
R^2	0.038			0.031			0.036		
Fully-adjusted									
Constant	2.61	2.54	2.68	92.14	86.29	97.98	2.29	2.27	2.31
Visit location (urban green spaces=ref)									
Countryside	0.04***	0.03	0.06	3.39***	2.05	4.74	0.02***	0.02	0.03
Seaside resort	-0.17***	-0.20	-0.14	14.87***	12.41	17.34	0.03***	0.02	0.04
Other coast	-0.09***	-0.13	-0.05	9.80***	6.31	13.30	0.03***	0.02	0.05
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.01$^{n.s}$	-0.01	0.02	3.50***	2.20	4.80	0.02***	0.02	0.03
Gender (male=ref)									
Female	-0.15***	-0.16	-0.13	-10.63***	-11.89	-9.38	-0.05***	-0.06	-0.05
Age (55+=ref)									

16-34	0.17***	0.14	0.20	6.85***	4.65	9.05	0.05***	0.04	0.05
35-54	0.10***	0.08	0.12	1.03n.s	-0.99	3.06	0.02***	0.01	0.03
Socio-economic status (AB=ref)									
C1	-0.07***	-0.09	-0.05	0.48n.s	-1.17	2.13	-0.01*	-0.01	-0.00
C2	-0.12***	-0.14	-0.10	2.86**	1.06	4.66	-0.01n.s	-0.01	0.00
DE	-0.14***	-0.16	-0.12	4.09***	2.30	5.88	-0.01n.s	-0.01	0.00
Work status (full-time=ref)									
Part-time	-0.01n.s	-0.03	0.02	2.07*	0.16	3.98	0.01***	0.01	0.02
Retired	-0.04**	-0.06	-0.01	4.51***	2.25	6.78	0.02***	0.01	0.03
In education	0.12***	0.08	0.15	5.52***	2.68	8.36	0.04***	0.03	0.05
Not working	-0.03**	-0.06	-0.01	5.19***	3.24	7.13	0.03***	0.02	0.03
Marital status (married=ref)									
Not married	0.04***	0.02	0.05	3.51***	2.18	4.84	0.01***	0.01	0.02
Ethnicity (white-British=ref)									
BAME	0.03**	0.01	0.05	2.97**	1.20	4.74	0.02***	0.02	0.03
Disability status (has work-limiting disability=ref)									
No disability	0.12***	0.10	0.14	3.99***	2.27	5.72	0.04***	0.04	0.05
Presence of children on visit (any children=ref)									
No children	0.10***	0.07	0.14	-8.06***	-11.00	-5.13	-0.04***	-0.05	-0.03
Presence of other adults on visit (no other adults=ref)									
Other adults	0.21***	0.18	0.23	7.27***	5.36	9.18	0.04***	0.04	0.05
Presence of dog on visit (dog on visit=ref)									
No dog on visit	0.58***	0.55	0.62	24.50***	21.75	27.24	0.16***	0.15	0.17
Weekend / weekday visit (weekend visit=ref)									
Weekday visit	0.02*	0.00	0.03	-11.82***	-13.06	-10.59	-0.05***	-0.06	-0.05
Visitation frequency (one visit in the last week=ref)									
Multiple visits	-0.01n.s	-0.03	0.00	-15.88***	-17.17	-14.60	-0.07***	-0.08	-0.07
Start point (own home=ref)									
Someone else's home	-0.11***	-0.16	-0.06	-2.95n.s	-7.04	1.15	-0.01n.s	-0.02	0.01

Holiday accommodation	-0.04n.s	-0.14	0.07	87.22***	78.31	96.14	0.31***	0.27	0.34
Work or elsewhere	-0.00n.s	-0.09	0.08	-23.38***	-30.59	-16.17	-0.13***	-0.16	-0.10
Travel distance (less than a mile=ref)									
1-5 miles	0.07***	0.05	0.09	16.10***	14.63	17.57	0.10***	0.10	0.11
6-20 miles	0.16***	0.13	0.19	71.00***	68.66	73.34	0.26***	0.25	0.27
Over 20 miles	0.03n.s	-0.01	0.06	143.31***	140.40	146.21	0.38***	0.36	0.39
Travel mode (personal motorised transport=ref)									
Public transport	-0.31***	-0.35	-0.27	31.81***	28.64	34.99	0.02***	0.01	0.04
On foot (inc. wheelchair)	0.04***	0.02	0.06	-38.14***	-39.82	-36.46	-0.14***	-0.15	-0.14
By bicycle	3.39***	3.35	3.43	-29.32***	-32.82	-25.82	0.20***	0.18	0.21
Other mode of transport	0.33***	0.25	0.40	19.31***	12.75	25.87	0.03**	0.01	0.06
Season (winter=ref)									
Spring	0.01n.s	-0.01	0.03	9.72***	8.02	11.43	0.04***	0.03	0.04
Summer	0.03**	0.01	0.05	19.04***	17.33	20.75	0.07***	0.06	0.07
Autumn	0.02*	0.00	0.05	6.49***	4.74	8.25	0.03***	0.02	0.03
Survey year (2009-10=ref)									
2010-11	0.00n.s	-0.02	0.02	-0.63n.s	-2.51	1.25	0.01n.s	-0.00	0.01
2011-12	0.03*	0.00	0.05	-0.88n.s	-2.72	0.96	0.01n.s	-0.00	0.01
2012-13	0.01n.s	-0.01	0.04	9.10***	7.25	10.95	0.04***	0.03	0.05
2013-14	0.02n.s	-0.01	0.04	6.13***	4.29	7.96	0.03***	0.03	0.04
R^2	0.320			0.361			0.327		

LB Lower-bound.
UB Upper-bound.
*** *p*<.001.
** *p*<.01.
* *p*<.05.
n.s not significant.

Appendix F

Full regression model for all three outcome variables in Chapter 4 (model 2; N=56,568).

	METs			Duration			Log-transformed MET minutes		
	b	LB	UB	*b*	LB	UB	*b*	LB	UB
Unadjusted									
Constant	3.52	3.51	3.53	96.62	95.51	97.73	2.33	2.33	2.34
Visit location (urban green spaces=ref)									
Countryside	0.07***	0.05	0.09	9.65***	8.02	11.27	0.05***	0.04	0.06
Seaside resort	-0.21***	-0.25	-0.18	34.28***	31.25	37.32	0.12***	0.11	0.14
Other coast	-0.12***	-0.17	-0.06	25.77***	21.36	30.17	0.12***	0.10	0.14
R^2	0.004			0.011			0.007		
Constant	3.51	3.51	3.53	99.10	97.90	100.31	2.34	2.34	2.35
Visit location (urban green spaces=ref)									
Countryside	0.07***	0.05	0.09	10.20***	8.57	11.83	0.05***	0.04	0.06
Seaside resort	-0.21***	-0.25	-0.18	34.35***	31.32	37.38	0.12***	0.11	0.14
Other coast	-0.12***	-0.17	-0.06	26.20***	21.80	30.60	0.12***	0.10	0.14
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.04***	0.02	0.06	-8.78***	-10.44	-7.12	-0.04***	-0.05	-0.03
R^2	0.005			0.012			0.009		
Constant	3.46	3.41	3.50	100.378	96.70	104.06	2.32	2.30	2.33
Visit location (urban green spaces=ref)									
Countryside	0.10***	0.08	0.13	12.18***	10.47	13.89	0.07***	0.06	0.08
Seaside resort	-0.16***	-0.20	-0.13	36.28***	33.23	39.33	0.14***	0.13	0.16
Other coast	-0.08**	-0.13	-0.02	27.94***	23.53	32.35	0.14***	0.12	0.16
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.03**	0.01	0.05	-8.87***	-10.53	-7.21	-0.04***	-0.05	-0.03

Gender (male=ref)									
Female	-0.26***	-0.28	-0.24	-14.19***	-15.80	-12.57	-0.09***	-0.10	-0.08
Age (55+=ref)									
16-34	0.17***	0.13	0.20	7.26***	4.41	10.10	0.07***	0.05	0.08
35-54	0.13***	0.10	0.17	-0.79$^{n.s}$	-3.44	1.85	0.03***	0.01	0.04
Socio-economic status (AB=ref)									
C1	-0.07***	-0.10	-0.05	-0.76n.s	-2.90	1.38	-0.01**	-0.02	-0.00
C2	-0.13***	-0.16	-0.10	-0.27n.s	-2.61	2.06	-0.02**	-0.03	-0.01
DE	-0.16***	-0.19	-0.13	-3.05**	-5.36	-0.74	-0.04***	-0.05	-0.02
Work status (full-time=ref)									
Part-time	0.02$^{n.s}$	-0.01	0.06	-1.81$^{n.s}$	-4.26	0.65	0.01$^{n.s}$	-0.01	0.02
Retired	-0.05*	-0.08	-0.01	2.32$^{n.s}$	-0.62	5.27	0.02*	0.00	0.03
In education	0.17***	0.12	0.21	0.89$^{n.s}$	-2.73	4.51	0.03**	0.01	0.04
Not working	-0.01$^{n.s}$	-0.04	0.02	-4.53***	-7.02	-2.04	-0.00$^{n.s}$	-0.02	0.01
Marital status (married=ref)									
Not married	0.07***	0.04	0.09	4.51***	2.80	6.21	0.02***	0.01	0.02
Ethnicity (white-British=ref)									
BAME	0.02$^{n.s}$	-0.01	0.05	6.09***	3.86	8.32	0.05***	0.04	0.06
Disability status (has work-limiting disability=ref)									
No disability	0.16***	0.14	0.19	2.27*	0.04	4.51	0.04***	0.03	0.05
R^2	0.033			0.022			0.027		
Fully-adjusted									
Constant	2.78	2.70	2.86	84.29	77.71	90.87	2.23	2.20	2.26
Visit location (urban green spaces=ref)									
Countryside	0.07***	0.06	0.09	1.68*	0.16	3.20	0.02***	0.01	0.02
Seaside resort	-0.17***	-0.20	-0.14	7.57***	4.88	10.26	0.02**	0.01	0.03
Other coast	-0.09***	-0.14	-0.04	4.20*	0.36	8.03	0.03**	0.01	0.05
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.01$^{n.s}$	-0.01	0.02	1.44$^{n.s}$	-0.02	2.90	0.01**	0.00	0.02
Gender (male=ref)									
Female	0.15***	-0.17	-0.13	-11.17***	-12.57	-9.77	-0.06***	-0.07	-0.06
Age (55+=ref)									

16-34	0.13***	0.10	0.16	7.20***	4.74	9.76	0.06***	0.05	0.07
35-54	0.08***	0.06	0.11	1.09$^{n.s}$	-1.20	3.38	0.03***	0.01	0.04
Socio-economic status (AB=ref)									
C1	-0.07***	-0.09	-0.04	0.17$^{n.s}$	-1.68	2.02	-0.01*	-0.02	0.00
C2	-0.09***	-0.11	-0.07	2.08*	0.06	4.10	-0.00$^{n.s}$	-0.01	0.01
DE	-0.12***	-0.14	-0.09	2.77**	0.77	4.77	-0.01$^{n.s}$	-0.01	0.01
Work status (full-time=ref)									
Part-time	0.02$^{n.s}$	-0.01	0.04	2.19*	0.06	4.31	0.02***	0.01	0.03
Retired	-0.03$^{n.s}$	-0.06	0.01	4.10**	1.54	6.65	0.03***	0.01	0.04
In education	0.13***	0.10	0.17	5.93***	2.80	9.06	0.05***	0.04	0.07
Not working	-0.00$^{n.s}$	-0.03	0.02	4.12***	1.96	6.28	0.04***	0.03	0.05
Marital status (married=ref)									
Not married	0.04***	0.02	0.05	3.44***	1.96	4.93	0.01***	0.01	0.02
Ethnicity (white-British=ref)									
BAME	0.02$^{n.s}$	-0.01	0.04	2.35*	0.41	4.29	0.03***	0.02	0.04
Disability status (has work-limiting disability=ref)									
No disability	0.13***	0.10	0.15	3.08**	1.15	5.01	0.04***	0.03	0.05
Presence of children on visit (any children=ref)									
No children	0.06**	0.02	0.10	-5.42***	-8.58	-2.25	-0.05***	-0.07	-0.03
Presence of other adults on visit (no other adults=ref)									
Other adults	0.17***	0.14	0.19	7.04***	4.91	9.17	0.04***	0.03	0.05
Presence of dog on visit (dog on visit=ref)									
No dog on visit	0.54***	0.50	0.57	25.90***	22.77	29.04	0.18***	0.17	0.19
Weekend / weekday visit (weekend visit=ref)									
Weekday visit	0.01$^{n.s}$	-0.03	0.01	-10.39***	-11.76	-9.02	-0.06***	-0.06	-0.05
Visitation frequency (one visit in the last week=ref)									
Multiple visits	-0.01$^{n.s}$	-0.03	0.01	-11.53***	-12.94	-10.12	-0.08***	-0.08	-0.07
Start point (own home=ref)									
Someone else's home	-0.11***	-0.17	-0.06	-1.25$^{n.s}$	-5.85	3.35	-0.01$^{n.s}$	-0.03	0.02

Holiday accommodation	0.03n.s	-0.09	0.16	82.41***	72.12	92.70	0.38***	0.33	0.43
Work or elsewhere	-0.07n.s	-0.18	0.03	-20.18***	-28.81	-11.55	-0.17***	-0.21	-0.13
Travel distance (less than a mile=ref)									
1-5 miles	-0.01n.s	-0.03	0.02	14.37***	12.39	16.35	0.12***	0.11	0.13
6-20 miles	0.03n.s	-0.00	0.06	46.96***	44.23	49.69	0.18***	0.17	0.20
Over 20 miles	-0.07***	-0.11	-0.03	64.85***	61.43	68.26	0.19***	0.17	0.20
Travel mode (personal motorised transport=ref)									
Public transport	-0.29***	-0.32	-0.25	36.75***	33.52	39.97	0.04***	0.03	0.06
On foot (inc. wheelchair)	-0.05***	-0.08	-0.03	-47.25***	-49.38	-45.13	-0.25***	-0.26	-0.24
By bicycle	3.30***	3.25	3.35	-39.06***	-42.93	-35.18	0.08***	0.06	0.10
Other mode of transport	0.36***	0.28	0.44	12.23***	5.35	19.11	0.02n.s	-0.01	0.05
Season (winter=ref)									
Spring	0.02n.s	-0.01	0.04	9.48***	7.56	11.41	0.05***	0.04	0.06
Summer	0.03**	0.01	0.06	18.56***	16.65	20.48	0.08***	0.07	0.09
Autumn	0.03*	0.00	0.05	6.22***	4.24	8.19	0.03***	0.02	0.04
Survey year (2009-10=ref)									
2010-11	-0.00n.s	-0.03	0.02	-1.52n.s	-3.62	0.58	0.00n.s	-0.01	0.01
2011-12	0.02n.s	-0.01	0.04	-1.59n.s	-3.65	0.47	0.00n.s	-0.01	0.01
2012-13	-0.00n.s	-0.03	0.02	7.14***	5.08	9.20	0.04***	0.03	0.05
2013-14	0.00n.s	-0.02	0.03	4.17***	2.13	6.21	0.03***	0.02	0.04
R^2	0.313			0.273			0.276		

LB Lower-bound.
UB Upper-bound.
*** *p*<.001.
** *p*<.01.
* *p*<.05.
n.s not significant.

Appendix G

Full regression model for all three outcome variables for Chapter 4 (model 3; N=66,153).

	METs			Duration			Log-transformed MET minutes		
	b	LB	UB	*B*	LB	UB	*B*	LB	UB
Unadjusted									
Constant	3.52	3.51	3.54	98.88	97.81	99.94	2.36	2.35	2.36
Visit location (urban green spaces=ref)									
Countryside	0.06***	0.04	0.08	8.11***	6.57	9.66	0.03***	0.02	0.04
Seaside resort	-0.21***	-0.24	-0.17	41.50***	38.57	44.43	0.13***	0.12	0.15
Other coast	-0.11***	-0.16	-0.06	28.30***	24.09	32.50	0.10***	0.08	0.12
R^2	0.004			0.013			0.007		
Constant	3.52	3.50	3.53	101.63	100.47	102.79	2.37	2.36	2.37
Visit location (urban green spaces=ref)									
Countryside	0.06***	0.04	0.08	8.72***	7.18	10.27	0.03***	0.03	0.04
Seaside resort	-0.21***	-0.24	-0.17	41.61***	38.68	44.53	0.13***	0.12	0.15
Other coast	-0.11***	-0.16	-0.06	28.80***	24.59	33.00	0.11***	0.09	0.12
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.03**	0.01	0.05	-9.55***	-11.12	-7.98	-0.04***	-0.04	-0.03
R^2	0.004			0.015			0.009		
Constant	3.48	3.44	3.52	101.55	98.06	105.03	2.33	2.32	2.35
Visit location (urban green spaces=ref)									
Countryside	0.09***	0.07	0.11	11.25***	9.64	12.87	0.05***	0.05	0.06
Seaside resort	-0.16***	-0.19	-0.12	44.07***	41.13	47.01	0.15***	0.14	0.17
Other coast	-0.07**	-0.12	-0.02	31.08***	26.87	35.29	0.12***	0.11	0.14
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.02*	0.00	0.04	-9.59***	-11.15	-8.02	-0.04***	-0.04	-0.03

Gender (male=ref)									
Female	-0.27***	-0.29	-0.25	-14.03	-15.57	12.50	-0.08***	-0.09	-0.08
Age (55+=ref)									
16-34	0.17***	0.14	0.20	9.46***	6.76	12.16	0.07***	0.06	0.09
35-54	0.13***	0.10	0.16	0.24$^{n.s}$	-2.25	2.73	0.03***	0.02	0.04
Socio-economic status (AB=ref)									
C1	-0.08***	-0.11	-0.06	-0.17$^{n.s}$	-2.20	1.86	-0.01*	-0.02	-0.00
C2	-0.14***	-0.17	-0.12	-0.32$^{n.s}$	-2.53	1.89	-0.02***	-0.03	-0.01
DE	-0.17***	-0.20	-0.15	-2.50*	-4.69	-0.32	-0.03***	-0.04	-0.02
Work status (full-time=ref)									
Part-time	0.01$^{n.s}$	-0.02	0.04	-2.01$^{n.s}$	-4.36	0.33	0.00$^{n.s}$	-0.01	0.01
Retired	-0.06***	-0.09	-0.02	1.36$^{n.s}$	-1.42	4.13	0.01$^{n.s}$	-0.00	0.02
In education	0.15***	0.11	0.19	0.22$^{n.s}$	-3.26	3.70	0.02*	0.00	0.03
Not working	-0.03*	-0.06	-0.01	-4.97***	-7.34	2.60	-0.01$^{n.s}$	-0.02	0.00
Marital status (married=ref)									
Not married	0.07***	0.05	0.09	3.88***	2.26	5.50	0.01**	0.00	0.02
Ethnicity (white-British=ref)									
BAME	0.04**	0.02	0.07	7.27***	5.12	9.41	0.05***	0.04	0.06
Disability status (has work-limiting disability=ref)									
No disability	0.16***	0.13	0.19	2.47*	0.36	4.59	0.04***	0.03	0.05
R^2	0.035			0.025			0.028		
Fully-adjusted									
Constant	2.75	2.68	2.82	99.42	93.40	105.45	2.35	2.32	2.37
Visit location (urban green spaces=ref)									
Countryside	0.05***	0.04	0.07	1.30$^{n.s}$	-0.09	2.69	0.01**	0.00	0.02
Seaside resort	-0.17***	-0.20	-0.14	10.94***	8.43	13.45	0.03***	0.02	0.04
Other coast	-0.08***	-0.13	-0.04	5.56**	2.01	9.10	0.02**	0.01	0.04
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	0.01$^{n.s}$	-0.01	0.02	2.33***	1.00	3.67	0.02***	0.01	0.02
Gender (male=ref)									
Female	-0.14***	-0.16	-0.13	10.65***	11.94	9.36	-0.06***	-0.06	-0.05
Age (55+=ref)									

16-34	0.14***	0.12	0.17	7.88***	5.61	10.14	0.06***	0.05	0.07
35-54	0.09***	0.06	0.11	1.47n.s	-0.62	3.56	0.03***	0.02	0.03
Socio-economic status (AB=ref)									
C1	-0.06***	-0.08	-0.04	0.57n.s	-1.13	2.26	-0.01n.s	-0.01	0.00
C2	-0.10***	-0.12	-0.08	2.87**	1.02	4.72	-0.00n.s	-0.01	0.01
DE	-0.12***	-0.14	-0.10	3.82***	1.98	5.66	0.00n.s	-0.01	0.01
Work status (full-time=ref)									
Part-time	0.01n.s	-0.01	0.03	2.34*	0.38	4.30	0.02***	0.01	0.03
Retired	-0.03n.s	-0.05	0.00	4.36***	2.03	6.68	0.03***	0.02	0.04
In education	0.12***	0.09	0.16	6.27***	3.35	9.18	0.05***	0.03	0.06
Not working	-0.01n.s	-0.04	0.01	4.68***	2.69	6.67	0.03***	0.02	0.04
Marital status (married=ref)									
Not married	0.04***	0.02	0.05	3.45***	2.09	4.81	0.01***	0.01	0.02
Ethnicity (white-British=ref)									
BAME	0.04***	0.02	0.06	2.82**	1.01	4.63	0.03***	0.02	0.04
Disability status (has work-limiting disability=ref)									
No disability	0.12***	0.10	0.14	3.25***	1.48	5.02	0.04***	0.03	0.05
Presence of children on visit (any children=ref)									
No children	0.08***	0.04	0.11	-7.24***	10.23	-4.26	-0.05***	-0.07	-0.04
Presence of other adults on visit (no other adults=ref)									
Other adults	0.18***	0.16	0.21	7.35***	5.38	9.32	0.05***	0.04	0.06
Presence of dog on visit (dog on visit=ref)									
No dog on visit	0.55***	0.51	0.58	25.32***	22.48	28.16	0.18***	0.16	0.19
Weekend / weekday visit (weekend visit=ref)									
Weekday visit	0.02n.s	-0.00	0.03	-11.11***	-12.38	-9.85	-0.06***	-0.06	-0.05
Visitation frequency (one visit in the last week=ref)									
Multiple visits	-0.02*	-0.04	-0.00	-13.64***	-14.95	-12.32	-0.08***	-0.09	-0.08
Start point (own home=ref)									
Someone else's home	-0.11***	-0.16	-0.06	-1.29n.s	-5.54	2.97	-0.01n.s	-0.03	0.01

Holiday accommodation	0.02$^{n.s}$	-0.09	0.13	82.32***	72.91	91.73	0.36***	0.32	0.40
Work or elsewhere	-0.05$^{n.s}$	-0.14	0.04	-19.86***	-27.62	12.10	-0.15***	-0.19	-0.12
Travel distance (less than a mile=ref)									
1-5 miles	0.01$^{n.s}$	-0.01	0.03	3.32***	1.75	4.88	0.01**	0.00	0.02
6-20 miles	0.06***	0.03	0.09	45.72***	43.27	48.17	0.12***	0.11	0.13
Over 20 miles	-0.04*	-0.08	-0.01	84.88***	81.83	87.93	0.16***	0.15	0.17
Travel mode (personal motorised transport=ref)									
Public transport	-0.30***	-0.34	-0.27	34.37***	31.20	37.53	0.03***	0.01	0.04
On foot (inc. wheelchair)	-0.04***	-0.06	-0.02	-56.33***	-58.10	-54.55	-0.31***	-0.32	-0.30
By bicycle	3.38***	3.34	3.42	-44.59***	-48.15	-41.04	0.08***	0.07	0.10
Other mode of transport	0.33***	0.25	0.40	15.02***	8.35	21.69	0.02$^{n.s}$	-0.01	0.05
Season (winter=ref)									
Spring	0.02$^{n.s}$	-0.00	0.04	9.51***	7.75	11.27	0.04***	0.04	0.05
Summer	0.04***	0.02	0.06	18.92***	17.16	20.67	0.08***	0.07	0.09
Autumn	0.03*	0.01	0.05	6.58***	4.77	8.38	0.03***	0.02	0.04
Survey year (2009-10=ref)									
2010-11	-0.01$^{n.s}$	-0.03	0.02	-0.80$^{n.s}$	-2.73	1.13	0.00$^{n.s}$	-0.01	0.01
2011-12	0.01$^{n.s}$	-0.01	0.04	-0.99$^{n.s}$	-2.88	-0.90	0.00$^{n.s}$	-0.00	0.01
2012-13	0.00$^{n.s}$	-0.02	0.02	8.34***	6.44	10.24	0.04***	0.03	0.05
2013-14	0.00$^{n.s}$	-0.02	0.03	5.65***	3.77	7.53	0.03***	0.03	0.04
R^2	0.332			0.321			0.301		

^{LB} Lower-bound.
^{UB} Upper-bound.
*** *p*<.001.
** *p*<.01.
* *p*<.05.
$^{n.s}$ not significant.

Appendix H

Full regression model for all three outcome variables for Chapter 4 (walkers only model; N=33,408).

	METs			Duration			Log-transformed MET minutes		
	B	LB	UB	*b*	LB	UB	*b*	LB	UB
Unadjusted									
Constant	3.27	3.27	3.27	73.32	72.46	74.18	2.28	2.27	2.28
Visit location (urban green spaces=ref)									
Countryside	-0.08***	-0.08	-0.07	-0.82$^{n.s}$	-2.05	0.42	0.01$^{n.s}$	-0.00	0.01
Seaside resort	0.01*	0.00	0.03	14.91***	12.17	17.65	0.09***	0.07	0.10
Other coast	-0.01$^{n.s}$	-0.03	0.00	18.26***	14.34	22.18	0.11***	0.09	0.13
R^2	0.024			0.006			0.007		
Constant	3.30	3.30	3.30	72.92	71.98	73.87	2.27	2.27	2.28
Visit location (urban green spaces=ref)									
Countryside	-0.07***	-0.07	-0.06	-0.92$^{n.s}$	-2.16	0.32	0.00$^{n.s}$	-0.00	0.01
Seaside resort	0.02**	0.01	0.03	14.85***	12.11	17.59	0.09***	0.07	0.10
Other coast	-0.01$^{n.s}$	-0.02	0.01	18.17***	14.25	22.08	0.11***	0.09	0.13
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	-0.09***	-0.10	-0.09	1.23$^{n.s}$	-0.01	2.46	0.01$^{n.s}$	-0.00	0.01
R^2	0.054			0.006			0.007		
Constant	3.28	3.27	3.29	63.30	60.55	66.05	2.22	2.20	2.23
Visit location (urban green spaces=ref)									
Countryside	-0.05***	-0.06	-0.05	2.09**	0.81	3.37	0.02***	0.01	0.03
Seaside resort	0.03***	0.02	0.04	17.28***	14.55	20.02	0.10***	0.09	0.12
Other coast	0.01$^{n.s}$	-0.01	0.03	20.99***	17.09	24.90	0.13***	0.10	0.15
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	-0.08***	-0.09	-0.08	1.58*	0.35	2.82	0.01*	0.00	0.01
Gender (male=ref)									
Female	-0.03***	-0.03	-0.02	-6.15***	-7.39	-4.92	-0.04***	-0.04	-0.03

Age (55+=ref)									
16-34	-0.02***	-0.03	-0.01	7.42***	5.26	9.58	0.03***	0.02	0.04
35-54	-0.04***	-0.05	-0.03	1.68n.s	-0.25	3.60	0.01n.s	-0.01	0.02
Socio-economic status (AB=ref)									
C1	-0.02***	-0.03	-0.02	-0.42n.s	-2.11	1.28	-0.01n.s	-0.02	0.00
C2	-0.06***	-0.07	-0.06	-0.96n.s	-2.77	0.85	-0.02**	-0.03	-0.01
DE	-0.05***	-0.06	-0.04	0.71n.s	-1.05	2.48	-0.01*	-0.02	-0.00
Work status (full-time=ref)									
Part-time	0.02***	0.01	0.03	1.52n.s	-0.40	3.44	0.01*	0.00	0.02
Retired	0.06***	0.05	0.07	1.49n.s	-0.67	3.64	0.02***	0.01	0.03
In education	0.04***	0.03	0.05	6.30***	3.31	9.29	0.03***	0.01	0.05
Not working	0.02***	0.02	0.03	3.79***	1.89	5.70	0.02***	0.01	0.03
Marital status (married=ref)									
Not married	0.02***	0.01	0.02	4.38***	3.07	5.69	0.02***	0.01	0.03
Ethnicity (white-British=ref)									
BAME	0.16***	0.15	0.16	7.53***	5.68	9.38	0.06***	0.05	0.07
Disability status (has work-limiting disability=ref)									
No disability	0.02***	0.02	0.03	5.57***	3.92	7.22	0.05***	0.04	0.06
R^2	0.126			0.021			0.023		
Fully-adjusted									
Constant	2.98	2.96	3.00	60.11	54.52	65.71	2.18	2.15	2.21
Visit location (urban green spaces=ref)									
Countryside	-0.03***	-0.04	-0.03	0.95n.s	-0.29	2.19	0.01***	0.01	0.02
Seaside resort	0.01*	0.00	0.02	10.66***	8.02	13.30	0.07***	0.05	0.08
Other coast	-0.00n.s	-0.02	0.01	15.06***	11.30	18.81	0.10***	0.07	0.12
Physical activity in the last week (does not meet guidelines=ref)									
Meets guidelines	-0.05***	-0.05	-0.04	4.64***	3.43	5.85	0.03***	0.02	0.04
Gender (male=ref)									
Female	-0.02***	-0.03	-0.02	-5.12***	-6.30	-3.93	-0.03***	-0.03	-0.02
Age (55+=ref)									
16-34	-0.02***	-0.03	-0.01	6.73***	4.65	8.81	0.02***	0.01	0.04
35-54	-0.03***	-0.04	-0.02	1.83n.s	-0.02	3.68	0.01n.s	-0.00	0.02

Socio-economic status (AB=ref)									
C1	-0.02***	-0.02	-0.01	0.35n.s	-1.27	1.98	-0.00n.s	-0.01	0.01
C2	-0.05***	-0.05	-0.04	0.31n.s	-1.43	2.05	-0.01n.s	-0.02	0.00
DE	-0.04***	-0.05	-0.03	2.09*	0.39	3.78	-0.00n.s	-0.01	0.01
Work status (full-time=ref)									
Part-time	0.02***	0.02	0.03	1.78n.s	-0.06	3.63	0.01*	0.00	0.02
Retired	0.06***	0.05	0.06	1.36n.s	-0.71	3.43	0.02***	0.01	0.03
In education	0.03***	0.02	0.04	5.35***	2.48	8.22	0.02**	0.01	0.04
Not working	0.03***	0.02	0.04	4.65***	2.82	6.48	0.03***	0.02	0.04
Marital status (married=ref)									
Not married	0.01***	0.01	0.02	4.06***	2.80	5.32	0.02***	0.01	0.02
Ethnicity (white-British=ref)									
BAME	0.11***	0.11	0.12	4.95***	3.15	6.74	0.04***	0.03	0.05
Disability status (has work-limiting disability=ref)									
No disability	0.01***	0.01	0.02	3.67***	2.09	5.25	0.04***	0.03	0.05
Presence of children on visit (any children=ref)									
No children	-0.02*	-0.03	-0.00	-8.87***	-12.24	5.51	-0.06***	-0.07	-0.04
Presence of other adults on visit (no other adults=ref)									
Other adults	0.20***	0.19	0.20	7.33***	5.33	9.33	0.06***	0.05	0.07
Presence of dog on visit (dog on visit=ref)									
No dog on visit	0.38***	0.37	0.39	14.57***	12.09	17.04	0.12***	0.10	0.13
Weekend / weekday visit (weekend visit=ref)									
Weekday visit	-0.01***	-0.02	-0.01	-8.68***	-9.88	-7.49	-0.05***	-0.06	-0.04
Visitation frequency (one visit in the last week=ref)									
Multiple visits	-0.13***	-0.14	-0.13	-15.60***	-16.92	-14.29	-0.10***	-0.11	-0.10
Start point (own home=ref)									
Someone else's home	0.02n.s	-0.00	0.03	14.74***	10.52	18.95	0.06***	0.04	0.08
Holiday accommodation	-0.08***	-0.11	-0.04	98.89***	89.39	108.39	0.41***	0.36	0.46
Work or elsewhere	0.20***	0.18	0.23	-25.15***	-32.42	-17.89	-0.15***	-0.19	-0.11

Season (winter=ref)									
Spring	0.01***	0.01	0.02	4.93***	3.36	6.51	0.03***	0.02	0.04
Summer	0.01n.s	-0.00	0.01	7.26***	5.66	8.87	0.04***	0.03	0.05
Autumn	-0.00n.s	-0.01	0.00	2.52**	0.91	4.13	0.01**	0.00	0.02
Survey year (2009-10=ref)									
2010-11	-0.01n.s	-0.01	0.00	1.24n.s	-0.56	3.04	0.01*	0.00	0.02
2011-12	-0.01*	-0.02	-0.00	1.53n.s	-0.23	3.28	0.01n.s	-0.00	0.02
2012-13	0.00n.s	-0.01	0.01	6.36***	4.58	8.14	0.03***	0.03	0.04
2013-14	-0.01*	-0.02	-0.00	3.05***	1.28	4.81	0.02***	0.01	0.03
R^2	0.354			0.104			0.125		

LB Lower-bound.
UB Upper-bound.
*** p<.001.
** p<.01.
* p<.05.
n.s not significant.

Appendix I

Fully-adjusted regression coefficients and 95% confidence intervals for log-transformed MET minutes expended by visited environment and urban/rural residence (model 1, Chapter 4).

	Urban residence			Rural residence		
	b	LB	UB	*b*	LB	UB
Fully-adjusted						
Constant	2.27	2.25	2.30	2.33	2.28	2.38
Visit location (urban green spaces=ref)						
Countryside	0.03***	0.03	0.04	0.03***	0.01	0.04
Seaside resort	0.03***	0.02	0.05	0.04***	0.02	0.06
Other coast	0.04***	0.03	0.06	0.02†	-0.00	0.03
R^2		0.315			0.387	

LB Lower-bound

UB Upper-bound

*** *p*<.001

† *p*<.1

Appendix J

Fully-adjusted regression coefficients and 95% confidence intervals for log-transformed MET minutes expended by visited environment and distance travelled to destination (model 1, Chapter 4).

	<1 mile			1-5 miles			6-20 miles			20+miles		
	b	LB	UB	*b*	LB	UB	*b*	LB	UB	*b*	LB	UB
Fully-adjusted												
Constant	2.29	2.25	2.33	2.39	2.36	2.43	2.53	2.48	2.59	2.66	2.57	2.75
Visit location (urban green spaces=ref)												
Countryside	-0.00$^{n.s}$	-0.01	0.01	0.02***	0.01	0.03	0.07***	0.06	0.09	0.11***	0.09	0.13
Seaside resort	0.05***	0.03	0.07	0.03***	0.01	0.04	0.02†	-0.00	0.04	0.09***	0.06	0.11
Other coast	0.06***	0.04	0.09	0.04***	0.02	0.06	0.02$^{n.s}$	-0.01	0.05	0.07***	0.03	0.11
R^2		0.14			0.17			0.09			0.09	

^{LB} Lower-bound
^{UB} Upper-bound
*** p<.001
† p<.1
$^{n.s}$ Not significant

Appendix K

All brochures included in the study described in Chapter 5 along with publishing affiliations, number of pages, and number of walking routes contained within them.

Title	Publishing Affiliations	Pages	Number of walking routes
Avocet Ambles	Avocet Line Rail Users Group Devon County Council First Great Western	4	3
Bude Canal Trails	Discover Devon North Cornwall District Council CrossCut (Sustainable Development of Inland Waterways)	2	1
Dart Ferries Walk, Pines Pebbles and Plantations & Torridge Estuary Rail Trail	Devon County Council Travelwise	6	3
Devon Cliffs to Budleigh	Devon Cliffs Holiday Park South West Coast Path Association	2	1
Devon Cliffs to Exmouth	Devon Cliffs Holiday Park South West Coast Path Association	2	1
Devon Cliffs to Orcombe Point	Devon Cliffs Holiday Park South West Coast Path Association	2	1
Devon Cliffs to Otterton Mill	Devon Cliffs Holiday Park South West Coast Path Association	2	1
Discovery Trail	Tamar Valley AONB Devon County Council Cornwall Council Natural England	12	5
Dr’ke's Trail	Devon County Council West Devon Borough Council Plymouth City Council Sustrans National Trust Dartmoor National Park	3	1
Exe Explorer	Exe Estuary Management Partnership Devon County Council Exmouth Town Council Dawlish Town Council East Devon District Council Teignbridge District Council Natural England Royal Society for the Protection of Birds	2	1
Exeter Green Circ–e - The Alphin Brook Walk	Exeter City Council Devon County Council Sustrans	2	1
Exeter Green Circ–e - The Hoopern Valley Walk	Exeter City Council Devon County Council Sustrans	2	1
Exeter Green Circ–e - The Ludwell Valley Walk	Exeter City Council Devon County Council Sustrans	2	1
Exeter Green Circ–e - The Mincinglake Walk	Exeter City Council Devon County Council Sustrans	2	1

Exeter Green Circ–e - The Redhills Walk	Exeter City Council Devon County Council Sustrans	2	1
Exeter Medieval Trail	Exeter City Council	2	1
Exeter Walking Map	Exeter City Council Devon County Council Sustrans Travelwise	2	1
Exeter Woollen Trail	Exeter City Council	2	1
Explore Exmouth	Devon County Council Sustrans Travelwise	32	8
Tarka Trail Circular Routes	Devon County Council Travelwise	28	11
The City Wall Trail	Exeter City Council	2	1
The Exe Valley Way	Discover Devon Devon County Council Exmoor National Park Travelwise	28	10
Two Castles Trail Booklet	Devon County Council West Devon Borough Council Dartmoor National Park	24	8
Two Moors Way	Devon County Council South Hams District Council Dartmoor National Park Exmoor National Park Mid Devon District Council North Devon District Council	2	1
Walking Trails In Devon	Devon County Council Travelwise	36	10
West Devon Way	Devon County Council West Devon Borough Council Dartmoor National Park South Hams District Council	25	8

Appendix L

Coding manual to facilitate quantitative content analysis of recreational walking brochures (Chapter 5).

Coding Manual

Broad aims and overview of the coding manual:

The aim of this coding scheme is to facilitate reliable content analysis of text in recreational walking brochures. These are leaflets/booklets/brochures that promote walking routes, often through natural environments, or on national trails, frequently published by city and county councils as well as tourism organisations. Analysis should take place for **all text** included in the main body of the leaflet, and where applicable, pictures and maps will be coded too. Text such as main titles and publishing credits, addresses, phone numbers and website addresses should be categorised as 'uncoded text' **unless** these are preceded by text which advises the reader to use these as a means of gathering further information on walking or walking routes. Each category is exclusive (no text can be coded under two categories) and represents a semantic category or concept. Once identified, each category will be counted in order to assess the extent to which each superordinate and subordinate category is represented in the text; used repeatedly in texts; and is represented relative to other super-ordinate and subordinate categories. Category counting will begin from the first page (front cover) of the leaflet as single page leaflets will use this to convey their message.

Coding instructions:

Coders should be aware that the scheme aims to be comprehensive; that is, every piece of text in the brochures should be coded. Anything that it is impossible to categorise should be coded as 'uncoded text.' The first thing all coders should do is read through this manual and understand all categories especially the nuances between similar categories. Below are the steps a coder should go through when analysing an individual leaflet:

1. Read the leaflet all the way through twice carefully to get an idea of the common categories that may be included.
2. Re-read and code categories as you go through.
3. Revise step 2, making changes, adding missed instances etc.

Rules and tips for coders:

- A category would begin when the text suggests a semantic category and end only when the text changes semantic meaning to a different category, or changes semantic meaning to uncoded text.
- A **sentence** will be the basic unit of analysis.
    - Most sentences will only include one category (e.g.' you can see all manner of wildlife including deer, salmon and many species of bird'). This would be one instance of code 20 (despite the list of species) because the semantic meaning does not change. Similarly, lists of route directions in one sentence would only be counted as one instance of code 85.
    - This is unless a sentence is broken by a new category appearance, for example, 'experts recommend achieving 30 minutes of moderate intensity physical activity on at least 5 days a week and this is surprisingly easy to do.' The first part of the sentence would be an instance of code 28*,* whereas after the 'and' would be code 58*.*
    - In a similar way, the same category **can** appear twice in the same sentence if the sentence is broken by another category appearance. In a sentence such as 'physical activity can reduce your chances of diabetes, improve your mood and

protect against some cancers,' there is an appearance of physical health outcomes, then mental health outcomes and then physical outcomes again, **this would constitute 2 separate instances** of code 14 and one of code 15. Cases such as this appear to be rare.

- One difficult distinction to make is to distinguish between **promotion, encouragement** and **guidance** categories, so this will be made clear here.
    - **Promotion** categories (under the promoting intentions and planning superordinate) are anything that tells the reader to do something without telling them *how* to do it. For example, an instance of code 48 might appear as 'decide how far along the path you'll walk.' It won't say how to decide (e.g. analyse how far you can walk without getting too tired), or tell you how far to walk (try to walk for 2 miles). 'Use the waymarkers' would also be an example of code 51 as it does not tell you how to use the waymarkers.
    - **Encouragement** categories are *confidence building* by saying that it is *easy, simple* or *not very hard* etc to perform a behaviour. For example an instance of code 69 might appear like 'this 3 mile stretch is an **easy** amble' as this builds confidence for the reader that the distance goal is easy to complete.
    - **Guidance** categories are *confidence building* by instructing the reader on how to implement a strategy (analyse how far you can walk without getting tired before deciding) or, much more commonly, providing the reader with a direct option. For example, an instance of code 70 might appear like 'this can be shortened to 9km/5.5 miles by missing Lee Bay and Lee Village.' This directly provides the reader with a distance goal.
    - The key thing to look out for when a strategy is alluded to is if there is any encouragement or instruction in the sentence; if not, then it will be an example of promoting intentions and planning.

PROVIDING INFORMATION

Instances of providing information are when the text provides information about physical activity in general including government recommendations for physical activity **or** when the text provides general information about the advertised walk such as its length, the time it takes to complete the walk etc. "General information" in this instance means text that:

i. **Does not** describe any **benefits or outcomes** of physical activity, walking in general or the advertised walk;
ii. **Does not** say how **other people** feel about physical activity, walking or the advertised walk;
iii. **Does not** promote behavioural or other strategies for physical activity, walking or completing the advertised walk; and
iv. **Does not** say that physical activity, walking or the advertised walk is **easy** and does not **encourage or guide** on ways in which to do physical activity, walking or complete the advertised walk.

Instead, it means general statements about physical activity concerning the government's recommendation of '30 minutes of moderate intensity physical activity per day on at least 5 days in a week,' or its variations (e.g. 150 minutes per week). Or it refers to general statements about the walk such as its length, the time it takes to complete it, the state of the terrain (steep, flat, muddy etc), the route (e.g. circular; goes through Budleigh & Exmouth), or amenities on the route (parking, public transport connections, toilets; food outlets), or supplementary map information (e.g. ordinance survey map details). Pictorially, the presence of a map, however good or bad, could also be coded as an instance of providing information. Below are full descriptions of all subordinate categories for providing information.

LEVEL 4 CATEGORIES	DESCRIPTION
1. Providing	Any text which provides information on the Department of Health's 2004

information → Recommended physical activity/walking in general → Governmental recommendations → 30 minutes 5 days a week or equivalent Information about recommended physical activity guidelines	recommendations for adequate physical activity. At the most basic level, the text must describe the recommendation of 30 minutes of moderate intensity exercise on at least 5 days in a week – or an equivalent of this recommendation. Also count as an instance of this category if the text describes recommended muscle strengthening activity, which is also part of the guidelines. Also count as an instance of this category if the text provides information on recommendations, but it is incorrect (n.b. note instances of incorrect recommendations). Do not include in this category any text which attempts to build confidence for achieving recommended physical activity rates or provides ways in which recommended levels can be achieved (codes 58 and 59), or describes any outcome of completing such activity (codes 12-17). Also do not include text which states that 'experts recommend' or 'most people walk' or 'most people don't get enough physical activity' as these are all examples of Establishing normative beliefs.
2. Providing information → Advertised walk → Walk characteristics → Distance Information about the distance of the advertised route	Any text which provides information on the distance of the advertised walk or walks. This can be as simple as stating the length of the walk as a number and a distance unit (5 miles), or it can be a description of the length e.g. 'short walks,' as long as, in this instance, it is clear that it is describing the length as opposed to the time it takes to complete the walk. If it is unclear whether it is describing the length or the timing, leave the text uncategorised. Do not include in this category, any text which promotes goal setting based on distances (code 48), describes the distance as easy (code 69), or instructs the reader on a particular distance goal (code 70).
3. Providing information → Advertised walk → Walk characteristics → Timing Information about the length it may take to complete the advertised route	Any text which provides information on the time it takes to complete the walk, or sections of the walk. This can be as simple as stating the time it will take in hours and minutes (1hr 40mins), or it can be more vague such as saying 'this is a short walk,' as long as it is clear, in this instance, that 'short' refers to the time it takes to complete the walk rather than the distance. If this is ambiguous, leave the text uncategorised. Do not include in this category, any text which promotes goal setting based on the time of the walk (code 49), describes the time the walk takes as easy (code 71) or instructs the reader on a particular timing-based goal (code 72).
4. Providing information → Advertised walk → Walk characteristics → Terrain Information about the terrain of the advertised route	Any text which provides information on the terrain of the advertised walk or walks. Include in this category, any description of any surface on the route such as steep, flat, smooth, as well as muddy, gravel, off-road etc. Do not include in this category any text which promotes strategies to overcome difficulties with the terrain (code 53), describes the terrain as easy to manage (code 78), or instructs the reader on ways to overcome difficulties with the terrain (code 79).
5. Providing information → Advertised walk → Walk characteristics → Presence of a map Presence of a map	Any picture or graphic of a map that is related to the advertised walk. The map can be detailed or simplistic, coloured or monochrome, and include the routes on it, or not. Do not include in this category the presence of a map key (code 50).
6. Providing information → Advertised walk → Walk characteristics → Route Information about	Any text which provides information on the advertised walk's overall route. This can include succinct descriptions of the shape of the route (circular, A to B), as well as longer descriptions of what places the route passes through (e.g. 'one of the walks in this leaflet follows a section of coast path from West Down Beacon back to the station at Exmouth'), or starts/ends at (e.g. 'starting and finishing at Lower Tamar Lake'). It can also include details about specific features of the route that do not refer

the overall course of the advertised route	to other codes (e.g. 'there are a number of Geocache boxes hidden along Dr'ke's Trail'). Do not include in this category, any text which promotes way of overcoming difficulties with, or features of, the route (codes 53-57). Also do not include any text which says that overcoming route difficulties is easy (codes 78, 80, 82, 85 or 86) or instructs the reader on how to overcome aspects of the route that may be challenging (codes 79, 81, 83, 85, or 87). Also do not include in this category any text which refers to signage or waymarkers (codes 51, 73, or 74).
7. Providing information → Advertised walk → Walk characteristics → Map/OS information Information about maps related to the advertised route	Any text which provides information about map materials or Ordinance Survey maps that are related to the advertised walk. The text can simply name a related map or describe a related map and its contents. For example 'OS Map: 115 Explorer' would be an instance of this category, but extended details e.g. 'Ordinance Survey map 115 (Explorer) also covers this route as well as surrounding foot and cycle paths' would also be an instance. Do not include in this category any text which describes other brochures that have walking routes advertised as this is maintenance information (codes 52, 75 or 76). Also do not include in this category, instances of text that promote reading the maps in the brochure as a mean of managing the route (code 55), or tell the reader that reading maps is easy to do (code 82), or instructs the reader on how to read maps (code 83).
8. Providing information → Advertised walk → Amenities → Public Transport Information about public transport options related to the advertised route	Any text which provides information on how the advertised walk can be combined with public transport links. Include in this category instances of where public transport can be used to access the start of the walk, can be supplemented in for part of the walk, or can be used at the end of a walk in order to return to your start point. For example, 'buses leave Budleigh Salterton from the Public Hall/ Library bus-stop'. Also include text referring to fares/timetables/contact information regarding public transport. Also **include** in this category any text which encourages or guides the reader to take public transport. These **would not** be categorised under enhancing self-efficacy categories as it does not build confidence specifically for the walk/walking. Do not include in this category text where public transport is part of a map key (code 50).
9. Providing information → Advertised walk → Amenities → Parking Information about parking provision related to the advertised route	Any text which provides information on parking in relation to the advertised walk. Include in this category instances of where the text provides information on the presence of parking facilities at the start of the walk or at other points in the walk where the reader may want to start instead. For example, 'a car park is available in Topsham on Holman Way that is a short walk from the quay'. Also **include** in this category any text which encourages or guides the reader to use parking facilities. These **would not** be categorised under enhancing self-efficacy categories as they do not build confidence specifically for the walk/walking. Do not include in this category text where parking facilities are part of a map key (code 50).
10. Providing information → Advertised walk → Amenities → Toilets Information about the provision of toilets on the advertised route	Any text which provides information on the presence of toilets, at any point on the advertised walk. For example, 'public toilets are beside the route at the top of Phear Park'. Do not include in this category text where toilets are part of a map key (code 50).
11. Providing information →	Any text which provides information on café's, eateries, restaurants and refreshments available on the route or at the destination. For example,

Advertised walk → Amenities → Refreshments Information about refreshments on, or at the end of, the advertised route	'the Turf Locks Hotel is a family run pub serving great food, local ales and wines'. The text can be directed at the reader (**you** can choose from a wide variety of restaurants) or not (there is a large selection of restaurants); both examples would be instances of this category. Encouraging or guiding the reader to utilise the eateries would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any enhancing self-efficacy categories. Listed information can also be included here – text such as "Amenities: Café's, toilets and parking." The word 'café's' would be an instance of this category (toilets and parking would be instances of the two previous categories). Do not include in this category text where refreshments are part of a map key (code 50).

HIGHLIGHTING CONSEQUENCES

Instances of highlighting consequences in this coding scheme generally refer to benefits one can acquire from doing physical activity, undertaking walking in general, or undertaking the advertised walk. For physical activity/walking in general, any text which describes a financial (saving money), environmental (less emissions), health (physiological, mental), or social (activity for families/children) benefit should be categorised as an instance of highlighting consequences. As most walking literature refers to outdoor and natural environments, for 'the advertised walk' we used categories based on the cultural ecosystems services classifications outlined in the UK National Ecosystem Assessment (UKNEA, 2011). So for the advertised walk, any benefit alluding to monuments/statues, historical/heritage sites, wildlife, views/scenery or botany can be counted as instances of highlighting consequences as well as anything alluding to the benefits families, friends or children can receive, and recreational/leisure facilities at the destination or on the route. **Do not** include as instances of highlighting consequences where the text says **other people** experience similar benefits – these will be counted under **social influence** categories. Below is a list and descriptions of all the subordinate categories for highlighting consequences.

LEVEL 4 CATEGORIES	**DESCRIPTION**
12. Highlighting consequences → Recommended physical activity/walking in general → Financial → Cost Financial consequences of walking	Any text which conveys the idea that money saved by choosing physical activity/walking over other modes of transport is a beneficial outcome of walking. The text can either be directed at the reader (walking can save **you** money) or not (walking **saves** money); both examples would be counted as instances of this category. For example, in reference to walking; 'it's FREE! No fares, no parking fees, no machine to buy and maintain'. **Do not** include in this category any text which provides normative information about the financial benefits of physical activity/walking e.g. 'other people who walk more often, save more money' (code 29).
13. Highlighting consequences → Recommended physical activity/walking in general → Environmental → Sustainable / Green Environmental consequences of walking	Any text which conveys the idea that physical activity/walking is an 'environmentally friendly' option compared to other modes of transport. The text can either be directed at the reader (**you** can help reduce your carbon footprint by choosing to walk over using the car) or not (walking is a better option for the planet); both examples would be counted as instances of this category. For example, 'Walking is the greenest way to go, with no carbon emissions and no special equipment needed'. **Do not** include in this category any text which provides normative information about the environmental benefits of physical activity/walking over other modes of transport for example 'most pedestrians tend to have lower carbon footprints than motorists' (code 30).
14. Highlighting	Any text which conveys the idea that physical activity/walking is good for

consequences → Recommended physical activity/walking in general → Health → Physical Physical health consequences of walking	one's physical health. This can include references to the reduction in risk of certain conditions, improvements in physiological indicators etc. The text can either be directed at the reader (by walking more often **you** can reduce the risk of contracting type 2 diabetes) or not (walking more often results in less chance of contracting type 2 diabetes); both examples would be counted as instances of this category. For example 'Walking can help prevent gaining weight and helps you to lose weight'. **Do not** include in this category any text which provides normative information about the physical health benefits of walking over other modes of transport for example 'people who walk more tend to have less chance of contracting type 2 diabetes' (code 31).
15. Highlighting consequences → Recommended physical activity/walking in general → Health → Mental Mental health consequences of walking	Any text which conveys the idea that walking is good for one's mental health. This can include references to the reduction in risk of certain mental health conditions, improvements in mood, stress levels etc. The text can be directed at the reader (increasing **your** walking could make you feel more relaxed) or not (walking can be relaxing); both examples would be counted as instances of this category. For example, 'walking is invigorating and improves your mood'. **Do not** include in this category any text which provides normative information about the mental health benefits of walking over other modes of transport for example 'people who walk more tend to deal with stress better than those who walk less' (code 32).
16. Highlighting consequences → Recommended physical activity/walking in general → Social → Family / friend / general sociability benefits. Social benefits of walking	Any text which conveys the idea that walking can act as an opportunity to strengthen social bonds with family or friends. This can include references to how the reader may feel better walking in the company of others. The text can be directed at the reader (walking is something **you** may enjoy more if you go with family) or not (walking is more enjoyable with family); both examples would be counted as instances of this category. For example 'walking can be a very sociable activity'. **Do not** include in this category any text which provides normative information about the social benefits of walking/being physically active with family or friends such as 'most people enjoy exercising with their family' or 'lots of people tend to go walking with their family at the weekend' (code 33). Also do not include in this category any text which refers to the advertised walk as being suitable for 'family walks' or for 'your children' etc (code 40).
17. Highlighting consequences → Recommended physical activity/walking in general → Social → Children benefits Benefits to children of walking	Any text which conveys the idea that walking can act as a fun activity for children. This can include references to how the reader's children may enjoy walking. The text can be directed at the reader; 'walking is something **your** children may enjoy;' or not; 'walking can be an enjoyable activity for children too;' both examples would be counted as instances of this category. **Do not** include in this category any text which provides normative information about the social benefits of walking/being physically active with children such as 'most people like to go for a walk with their children' or 'other people enjoy exercise by playing sports and games with their children' (code 34). Also do not include in this category any text which refers to experiences that children can have on the advertised walk (code 41).
18. Highlighting consequences → Advertised walk → Heritage → Monument Viewing a monument as a consequence of walking the	Any text which implies that the sight or experience of a monument/statue etc is an outcome of undertaking the walk advertised. The text can either be directed at the reader (and the end of the path **you** can see a war memorial) or not (at the end of the path there is a war memorial); both examples would be counted as instances of this category. Encouraging or guiding the reader to attend to the monument would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories.

advertised route	**Do not** include in this category any text which provides normative information about seeing a monument or statue on the advertised walk such as 'most people tend to pay attention to this monument' (code 35).
19. Highlighting consequences → Advertised walk → Heritage → Historical site Viewing historical points of interest as consequences of walking the advertised route	Any text which implies that historical points of interest are outcomes of undertaking the walk advertised. The text can either be directed at the reader (in the distance **you** can view Powderham castle) or not (in the distance is Powderham castle); both examples would be counted as instances of this category. Encouraging or guiding the reader to attend to the historical site would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the Heritage benefits of seeing a historical site on the advertised walk such as 'most people tend to have a walk around the castle grounds' (code 36).
20. Highlighting consequences → Advertised walk → Aesthetic → Wildlife Viewing wildlife as a consequence of walking the advertised route	Any text which implies that the sight or experience of wildlife is an outcome of undertaking the walk advertised. The text can either be directed at the reader (**you** can view salmon leaping over this bridge) or not (salmon leap over this bridge in Summer); both examples would be counted as instances of this category. Encouraging or guiding the reader to view the wildlife would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the aesthetic benefits of seeing wildlife on the advertised walk such as 'a lot of people like to watch the salmon leap' (code 37).
21. Highlighting consequences → Advertised walk → Aesthetic → View/scenery Viewing scenery as a consequence of walking the advertised route	Any text which implies that a pleasant view or scene is an outcome of undertaking the walk advertised. The text can either be directed at the reader (and the end of the path **you** can see out over Torbay) or not (at the end of the path there is a great view of Torbay); both examples would be counted as instances of this category. Encouraging or guiding the reader to attend to the scene would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the aesthetic benefits of viewing scenery on the advertised walk such as 'a lot of people like to take a rest here and gaze out over the peninsula' (code 38).
22. Highlighting consequences → Advertised walk → Aesthetic → Botany Botanical points of interest as consequences of walking the advertised route	Any text which implies that a botanical point of interest is an outcome of undertaking the walk advertised. The text can either be directed at the reader (and the end of the path **you** can see a 500 year old tree) or not (at the end of the path there is a 500 year old tree); both examples would be counted as instances of this category. Encouraging or guiding the reader to attend to the scene would also be counted as instances of this category as these are not confidence building for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the aesthetic benefits of botanical points of interest on the advertised walk such as 'a lot of people like to view these trees in Autumn' (code 39).
23. Highlighting consequences → Advertised walk → Social → Family or friend benefits Social consequences of	Any text which implies that the opportunity to strengthen social bonds with family or friends is an outcome of undertaking the walk advertised. The text may for example state that the particular route is best enjoyed as a family, or the destination may be described as a great place to go with friends (implying the reader should undertake the walk with friends). Encouraging or guiding the reader to undertake the walk with friends or family because of the opportunity for heightened enjoyment would also be counted as instances of this category as these are not building

walking the advertised route	confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the social benefits of walking with family or friends on the advertised walk such as 'most people tend to walk this route with their family' (code 40).
24. Highlighting consequences → Advertised walk → Social → Children benefits Benefits to children of walking the advertised route	Any text which implies that children will experience enjoyment from partaking in the advertised walk. The text may for example state that particular sections of the walk are perfect for children to run around, or the destination may be described as a great place for children to have fun (implying the reader should take their children with them). Encouraging or guiding the reader to undertake the walk with children because of the opportunities the children would have for heightened enjoyment would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the social benefits for children on the advertised walk such as 'most people take their children on this walk due to the mass of play equipment on the route' (code 41).
25. Highlighting consequences → Advertised walk → Recreational → Accommodation Accommodation at the destination as a consequence of walking the advertised route	Any text which implies that accommodation at the destination (if it is a long walking route) is a desirable outcome of undertaking the advertised walk. The text may for example state that there is a range of hotels at the destination. The text can be directed at the reader (**you** can choose from a wide variety of hotels) or not (there is a large selection of hotels); both examples would be instances of this category. For example, 'you will discover some wonderful and luxurious self-catering accommodation'. Encouraging or guiding the reader to utilise the accommodation would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the recreational benefits of utilising accommodation at the end of the advertised walk such as 'most people choose a guesthouse for an overnight stay' (code 42).
26. Highlighting consequences → Advertised walk → Recreational → Leisure Leisure opportunities as consequences of walking the advertised route	Any text which implies that other leisure opportunities along the route or at the destination are a desirable outcome of undertaking the advertised walk. The text may for example state that there are shops, cinemas, arcades etc at the destination or that there are play parks along the route. The text can be directed at the reader (**you** could visit one of the many arcades) or not (there are many arcades); both examples would be instances of this category. For example, 'there are several clubs and training centres available to help you make the most of the Exe'. Encouraging or guiding the reader to utilise leisure opportunities would also be counted as instances of this category as these are not building confidence for walking per se and therefore would not be categorised under any self efficacy categories. **Do not** include in this category any text which provides normative information about the recreational benefits of utilising leisure facilities on/at the end of the advertised walk such as 'most people relax at the end of the walk by visiting the cinema or going round the shops' (code 43).

<u>ESTABLISHING NORMATIVE BELIEFS</u>

Instances of establishing normative beliefs include any text where **people other than the reader** are mentioned in a way that is designed to motivate the reader to undertake physical activity/walking or to undertake the advertised walk. In this sense, almost all the social influence categories are related to, but distinct from, the outcome expectancy categories. For physical activity/walking, instances of establishing normative beliefs can include normative information about government guidelines for physical activity, expert opinion on physical activity, or normative information about financial gains from walking (pedestrians save money), environmental benefits of walking (non-motorists help the planet), or physical or mental health benefits of walking (people who walk more are more healthy/less stressed). For the advertised walk, instances of establishing normative beliefs can include normative information about how others enjoy the same cultural, aesthetic, social and recreational benefits that were detailed in the outcome expectancy categories (e.g. other people enjoy watching the salmon leap; most people take a walk around the castle grounds). A list and descriptions of all subordinate social influence categories is presented below.

LEVEL 4 CATEGORIES	**DESCRIPTION**
27. Establishing normative beliefs → Recommended physical activity/walking → Governmental recommendations → Normative information Normative information about recommended physical activity guidelines or walking	Any text which describes other people's behaviour, attitudes etc in relation to governmental recommendations for physical activity or for walking in general. Text could include statements such as 'Most people try to do 30 minutes of physical activity per day' or 'most people walk daily' or 'a lot of people wish to walk more often' or 'some people don't walk at all.' Virtually any description of other people's physical activity or walking behaviours can be included in this category. Do not include in this category information about governmental recommendations for physical activity or information about walking in general that makes no reference to others behaviour such as 'getting 30 minutes of physical activity per day is ideal' (code 1). Also do not include in this category text such as 'the government recommends that everyone achieve 30 minutes of moderate intensity exercise per day' or 'experts recommend walking on a daily basis.' These mention an authority figure and therefore would be categorised under code 28.
28. Establishing normative beliefs → Recommended physical activity/walking → Governmental recommendations → Expert recommendation Expert recommendations about physical activity or walking	Any text which describes an experts', or any other authority figures', recommendations about physical activity or about walking in general. Text could include statements such as 'the UK government suggests that you do 30 minutes of moderate intensity physical activity at least 5 times a week' or 'doctors recommend walking as a healthy activity' or 'the NHS fully supports walking initiatives.' Also include in this category, text such as quotes that are attributed to an authority for example '"walking is good for you" – Chief Medical Officer.' Do not include in this category any text which only refers to 'most' people or 'some' people. When the subject of the sentence is not an authority, the text should be categorised under code 27. Information about recommendations that does not mention an expert or authority (code 1).
29. Establishing normative beliefs → Recommended physical activity/walking → Financial→ Normative information Normative information about the financial consequences of walking	Any text which describes the financial benefits others experience by choosing to walk/be physically active over other modes of transport. Text could include statements such as 'almost all pedestrians save money by walking rather than taking a car' or 'people who save money by walking spend it on things they enjoy.' Note that these statements would **not** be instances of code 12, because although they convey a benefit, semantically, they provide normative information. An example of code 12 could be 'walking can save you money'.
30. Establishing normative beliefs →	Any text which describes the environmental benefits others get by choosing to walk/be physically active over other modes of transport.

Recommended physical activity/walking → Environmental → Normative information Normative information about the environmental consequences of walking	Text could include statements such as ‘people who walk more often have a lower carbon footprint’ or ‘people who walk or cycle put less pressure on the planet.’ Note that these statements would **not** be coded under code 13, because although they convey a benefit, semantically, they provide normative information. An example of code 13 could be ‘walking is better than driving for the planet’.
31. Establishing normative beliefs → Recommended physical activity/walking → Health → Normative information – physical Normative information about the physical health consequences of walking	Any text which describes the physical health benefits others get by choosing to walk/be physically active over other modes of transport. Text could include statements such as ‘people who exercise more are healthier’ or ‘people who walk every day are at less risk of getting heart problems.’ Note that these statements would **not** be coded under code 14, because although they convey a benefit, semantically, they provide normative information. An example of code 14 could be ‘walking is good for your heart’.
32. Establishing normative beliefs → Recommended physical activity/walking → Health → Normative information – mental Normative information about the mental health consequences of walking	Any text which describes the mental health benefits others get by choosing to walk/be physically active over other modes of transport. Text could include statements such as ‘others who exercise regularly are generally more relaxed’ or ‘most people who walk every day are less stressed.’ Note that these statements would **not** be coded under code 14, because although they convey a benefit, semantically, they provide normative information. An example of code 15 could be ‘walking can help you relax’.
33. Establishing normative beliefs → Recommended physical activity/walking → Social → Normative informati–n - family or friend benefits Normative information about the social consequences of walking	Any text which describes the enjoyment others get from undertaking physical activity/walking with family or friends. Text could include statements such as ‘most people enjoy walking with friends’ or ‘a lot of people choose to undertake exercise with their family.’ Note that these statements would **not** be coded under code 16, because although they convey a benefit, semantically, they provide normative information. An example of code 16 could be ‘walking can be very sociable’.
34. Establishing normative beliefs → Recommended physical activity/walking → Social → Normative informati–n - children benefits Normative information about the	Any text which describes the enjoyment other may get from undertaking physical activity/walking with children. Text could include statements such as ‘a lot of people get their daily exercise through playing sports or games with their children’ or ‘most people enjoy walking with their children.’ Note that these statements would **not** be coded under code 17, because although they convey a benefit, semantically, they provide normative information. An example of code 17 could be ‘walking can be fun for your children’.

benefits to children of walking	
35. Establishing normative beliefs → The advertised walk → Heritage→ NI monument Normative information about viewing a monument on the advertised route	Any text which describes a monument/statue etc as being a benefit of the advertised walk that other people enjoy. Text could include statements such as 'most people like to take a minute to look at this monument.' Note that this sort of statement would **not** be coded under code 18, because although they convey a benefit, semantically, they provide normative information. An example of code 18 could be 'there is a war memorial at the end of the path'.
36. Establishing normative beliefs → The advertised walk → Heritage→ NI historical site Normative information about viewing historical points of interest on the advertised route	Any text which describes a historical site as being a benefit of the advertised walk that other people enjoy. Text could include statements such as 'a lot of people tend to take time out from the main route to walk around the castle grounds.' Note that this would **not** be coded under code 19, because although they convey a benefit, semantically, they provide normative information. An example of code 19 could be 'the castle was built in 1800'.
37. Establishing normative beliefs → The advertised walk → Aesthetic→ NI wildlife Normative information about viewing wildlife on the advertised route	Any text which describes wildlife as being a benefit of the advertised walk that other people enjoy. Text could include statements such as 'people like to stop in summer and try and catch a glimpse of the salmon leaping.' Note that this would **not** be coded under code 20, because although they convey a benefit, semantically, they provide normative information. An example of code 20 could be 'you can see salmon leaping here'.
38. Establishing normative beliefs → The advertised walk → Aesthetic→ NI view/scenery Normative information about viewing scenery on the advertised route	Any text which describes views or scenery as being a benefit of the advertised walk that other people enjoy. Text could include statements such as 'people like to take a breather and look out across the peninsular here' or 'often people will sit at the top of the cliff and look out to sea.' Note that this would **not** be coded under code 21, because although they convey a benefit, semantically, they provide normative information. An example of code 21 could be 'there are great views over the Exe here'.
39. Establishing normative beliefs → The advertised walk → Aesthetic→ NI botany Normative information about viewing botanical points of interest on the advertised route	Any text which describes seeing botanical points of interest as being a benefit of the advertised walk that others enjoy. Text could include statements such as 'some people like to gaze at the tree which is over 1000 years old.' Note that this would **not** be coded under code 22, because although they convey a benefit, semantically, they provide normative information. An example of code 22 could be 'behind is an attractive landscape of salt marshes, now managed as a nature reserve'.
40. Establishing normative beliefs → The advertised walk → Social → NI family or friend benefits Normative information about the	Any text which describes the opportunity to strengthen social bonds with friends or family as a benefit of the advertised walk that other people enjoy. Text could include statements such as 'most people tend to walk this route with their family' or 'lots of people enjoy this walk with friends.' Note that these would **not** be coded under code 23, because although they convey a benefit, semantically, they provide normative information.

social consequences of walking the advertised route	An example of code 23 could be ‘this walk is for all the family to enjoy’.
41. Establishing normative beliefs → The advertised walk → Social → NI children benefits Normative information about the benefits to children of walking the advertised route	Any text which describes the idea that children enjoy the walk as a benefit of the advertised walk that other people enjoy. Text could include statements such as ‘most people love to see their children running across the fields’ or ‘other families get a real kick out of the freedom their children have to explore the natural environment around them.’ Note that these would **not** be coded under code 24, because although they convey a benefit, semantically, they provide normative information. An example of code 24 could be ‘for children there are quizzes and puzzles to solve along the way’.
42. Establishing normative beliefs → The advertised walk → Recreational → NI accommodation Normative information about accommodation at the destination of the advertised route	Any text which describes accommodation at the destination (if it is a long walking route) as a benefit of undertaking the advertised walk that others enjoy. Text could include statements such as ‘most guests tend to stay in a B&B’ or ‘a lot of people choose one of the smaller hotels.’ Note that these would **not** be coded under code 25, because although they convey a benefit, semantically, they provide normative information. An example of code 25 could be ‘delightful hotels on the coast or in the country, cosy country pubs, idyllic guesthouses and farms, ideal for family holidays’.
43. Establishing normative beliefs → The advertised walk → Recreational → NI leisure Normative information about leisure opportunities on, or at the end of, the advertised route	Any text which describes leisure facilities on route or at the destination as a benefit of the advertised walk that other people enjoy. Text could include statements such as ‘a lot of people make the most of the destination by going to the cinema or doing some shopping’ or ‘at the end of the walk, most people like to visit the swimming pool or arcade.’ Note that these would **not** be coded under code 26, because although they convey a benefit, semantically, they provide normative information. An example of code 26 could be ‘sandy beaches and water based recreation are some of the attractions to be found on the Exe Estuary’.

PROMOTING INTENTIONS AND PLANNING

Instances of promoting intentions and planning categories can be any text which aims to promote a behavioural strategy for undertaking physical activity, walking in general, or for completing the advertised walk **without encouraging** (saying that the technique will make the intended behaviour easier) **or guiding** (telling the reader how to utilise the technique or what, for example, goals, should be set) the reader about these strategies. For example, text which advises the reader to try and set distance (or amount of steps) goals, or set aside time for walking/physical activity or asks them to ‘try walking regularly’ would be instances of promoting intentions for physical activity or walking in general. Text which asks the reader to ‘think about breaking the advertised walk up,’ or ‘consider how long they will walk before resting,’ or advises them to ‘follow waymarkers’ or ‘access other walk information’ would also be instances of promoting intentions as they do not provide information on *how* to do these things. In the case of the advertised walk, it can also include strategies about how to overcome difficulties with the walk such as inviting the reader to take waterproofs, look out for muddy patches, think about map reading, or tells them to consider following the printed directions. Promotion of general barrier reduction e.g. ‘don’t worry about the weather’ (where weather is common barrier) is also included in promoting intentions and planning. Pictorially, the presence of a map key can also be counted as an instance of promoting intentions and planning. A list and descriptions of all subordinate categories for promoting intentions and planning is displayed below.

LEVEL 4	DESCRIPTION

CATEGORIES	
44. Promoting intentions and planning → Recommended physical activity/walking → Walk management → Distance or route based goals Prompting walking goals based on distance	Any text which tells the reader to set distance or route based goals for physical activity or walking in general **without** guiding them on how to do that **or** telling them that this will make achieving those aims easier. For example, 'decide how far you will walk' or 'plan a walk that is suitable for your level of fitness'. In the latter, this would be as long as the text is referring to distance rather than time. It could even be more general such as 'try walking further' or 'go on longer-distance walks;' again these refer to distance goals without telling the reader how to achieve them. Do not include in this category any text which suggests that setting goals for walking/physical activity makes achieving those things easier such as 'it is easy to walk long distances' or 'sticking to a walking aim is easy' (code 60). Also do not include in this category any text which guides the reader on how to set goals or what goals to set such as 'write on your calendar how far you will walk on a particular day, then stick to it' or 'attempt to walk around where you live every day' (code 61). Also do not include in this category text which promotes distance goals for the advertised walk (code 48).
45. Promoting intentions and planning → Recommended physical activity/walking → Walk management → Time based goals Prompting walking goals based on time	Any text which tells the reader to manage their time for physical activity or walking in general **without** telling them precisely how to do that **or** telling them that this strategy will make achieving those aims easier. Text could include statements such as 'set aside some time for exercise' or 'consider freeing up some time for walking' or 'why not try walking on a weekly basis?' It could be even more general such as 'walk regularly' or 'walk more often;' these still refer to time based goals without telling the reader how to achieve them. Do not include in this category any text which suggests that time based goals are easy or makes physical activity/walking aims easier to achieve such as 'finding an hour a day to walk is easy' or 'setting aside an evening is an easy way of knowing when you will exercise' (code 62). Also do not include text which guides the reader on what time based goals to set such as 'set aside an hour in your evening and use it to walk around where you live' or 'make sure that at the weekend you have a whole afternoon free so that you can go out to your local environments and get some exercise' (code 63). Also do not include in this category text which promotes time based goals for the advertised walk (code 49).
46. Promoting intentions and planning → Recommended physical activity/walking → Walk management → Barrier reduction Prompting barrier reduction for walking	Any text which invites the reader to reduce general barriers to completing recommended physical activity or walking in general **without** telling them how to overcome these barriers **or** saying that overcoming these barriers is easy. Text can include statements such as 'you can even walk in the rain' or 'walking need not require special equipment.' These address common barriers (weather, provision of correct equipment) but do not tell the reader how to, for example, walk in the rain, or if there are circumstances where equipment is required. Do not include in this category any text which says that overcoming general barriers to achieving recommended physical activity/walking in general is easy such as 'walking in bad weather is rather simple' or 'getting yourself motivated to do exercise isn't difficult' (code 64). Also do not include in this category any text which guides the reader upon how to overcome barriers such as 'have a healthy meal beforehand' or 'you can start slowly and build up gradually' (code 65). Also do not include in this category text which promotes overcoming barriers related to the advertised walk (code 57).
47. Promoting intentions and planning → Recommended physical activity/walking → Reinforcement →	Any text which tells the reader to keep walking or keep practicing physical activity **without** telling the reader how to do this **or** saying that this is easy. Text could include statements such as 'make sure you walk every day' or 'once you've started walking, keep it up' or 'why not go walking every day?' Do not include in this category any text which suggests that continuing

Maintenance Prompting repeated walking	walking or physical activity behaviours is easy such as 'it is easy to keep up walking' or 'exercising often need not be difficult' (code 66). Also do not include in this category text which guides the reader on how to continue walking/physical activity behaviours such as 'keep exercising regularly by planning what you will do and when' (code 67). Also do not include in this category text which promotes continued walking or exercising that is related to the advertised walk, such as the promotion of other brochures, walking routes etc (code 52).
48. Promoting intentions and planning → The advertised walk → Walk management → Distance or route based goals Prompting distance goals for the advertised route	Any text which tells the reader to set distance or route based goals for the advertised walk **without** saying that setting goals for the advertised walk is easy **or** guiding the reader on how to set goals/what goals to set for the advertised walk. For example, 'as well as circular routes around the Exe, there are also several long distance routes which can be met on the estuary' or 'perhaps try a slightly longer walk of some 21 (4 km) which passes more of the Tamar Lakes.' Do not include in this category any text that suggests that setting goals for the advertised walk is easy such as 'it is easy to divide the walk into more manageable stretches' or 'the route is a lot easier if done in stages' (code 69). Also do not include in this category text which guides the reader on how to set distance goals for the advertised walk or what goals to set such as 'you can shorten the walk by 1.9 kilometres (1.2 miles) by following the East Devon Way' (code 70).
49. Promoting intentions and planning → The advertised walk → Walk management → Time based goals Prompting time goals for the advertised route	Any text which tells the reader to set time based goals for the advertised walk **without** saying that time based goals for the advertised walk are easy **or** guiding the reader on how to manage their time for the advertised walk. For example 'many of the trails link up to form a network of walks, providing opportunities to do a shorter day or half day walk.' Do not include in this category any text that suggests that setting time based goals for the advertised walk is easy such as 'the walk only takes an hour so you can fit it in your day with ease' (code 71). Also do not include in this category text which guides the reader on how to set time goals for the advertised walk or what time goals to set such as 'the Exe Valley Way can be divided up into a series of 10 stages, most of which can be walked comfortably by most walkers in half a day' (code 72).
50. Promoting intentions and planning → The advertised walk → Walk management → Map key Presence of a map key	Any picture/diagram that is a key to a map. Do not code if it is not obvious to which map the key refers.
51. Promoting intentions and planning → The advertised walk → Reinforcement → Stimulus control Prompting attention to signage on the advertised route	Any text which tells the reader to attend or 'look out for' discriminative stimuli on the advertised walk **without** saying that this would make the walk easier **or** precisely guiding how they should use the stimuli. Discriminative stimuli in this instance would mean signage or waymarkers that reinforce further or continued walking. Text could include statements such as 'use the waymarkers' or 'follow the coastal footpath signs.' Do not include in this category text which suggests that using signage/waymarkers makes the walk easier such as 'it is easy to follow the signs' or 'it is easy to keep track of how far you've walked by looking at the waymarkers' (code 73). Also do not include in this category text which guides the reader on how to use the waymarkers/signage such as 'look at each waymarker to see how far you have walked and how far you have to go' or 'as you pass each waymarker, look closely to make sure you are following the right path' (code 74).
52. Promoting intentions and planning → The	Any text which promotes a way in which the reader can continue to walk routes similar to the advertised walk. This could mean accessing anything related to the advertised walk that promotes continued walking in

advertised walk → Reinforcement → Maintenance Prompting repeated recreational walking similar to the advertised route	a similar fashion such as looking up other related leaflets. Text could include statements such as 'look up our other walks' or 'download more brochures in this series' or 'a small book is available, containing information and suggested routes, price £2.99.' Do not include in this category any text which suggests that accessing related walk information is easy such as 'it is simple to download the other brochures in this series' or that it is easy to continue doing similar walks 'there are so many walks in Devon, it is easy to choose one to do every week' (code 75). Also do not include in this category text which guides the reader on how to access related walk information such as 'this is one of the many walks that can be found at www.southwestcoastpath.com' (code 76).
53. Promoting intentions and planning → The advertised walk → Route difficulties → Terrain management Prompting ways to overcome difficulties with the terrain on the advertised route	Any text which tells the reader to be wary/alert to the terrain of the advertised walk **without** saying that it is easy to cope with the terrain **or** guiding on ways to overcome difficulties with the terrain. For example 'be aware of the dangers from rising tides, soft mud, cliff edges and strong currents.' Do not include in this category any text which states that it is easy to cope with difficulties in the terrain such as 'although muddy, the walk is generally easy' (code 78). Also do not include in this category any text which guides on how to overcome difficulties with the terrain such as 'do not attempt the walk via the beach for two hours either side of high tide' or 'this route is closed during the shooting season from 1st October to 1st February, and walkers should follow the alternative route along the quiet road instead at that time' (code 79).
54. Promoting intentions and planning → The advertised walk → Route difficulties → Appropriate equipment Prompting equipment needed for walking the advertised route	Any text which tells the reader to consider appropriate equipment **without** telling them that it will make the walk easier **or** guiding them to directly take appropriate equipment. Text could include statements such as 'consider layering up your clothes.' Do not include in this category any text which states that the walk is easier with appropriate equipment/clothing such as 'having walking boots will make for an easier trek' (code 80). Also do not include in this category any text which guides the reader directly to take appropriate equipment or wear certain clothing such as 'dress according to the conditions, and take water with you even on a cloudy day' or 'but don't rely on them (cafés) for your refreshments – always take more than you think you will need' (code 81).
55. Promoting intentions and planning → The advertised walk → Route difficulties → Map reading Prompting map reading for the advertised route	Any text which tells the reader to read the accompanying map **without** saying that this will make the walk easier **or** guiding them on how to read the map efficiently. For example 'the route should be followed with the help of the sketch maps inside this booklet.' Do not include in this category any text which states that the walk would be made easier by reading the map such as 'the map is clearly labelled so you can follow the route with ease' (code 82). Also do not include in this category text which tells the reader how to use the map such as 'the map can be used to create your own trails depending on where you would like to visit, your means of transport, and how long you would like to take' (code 83).
56. Promoting intentions and planning → The advertised walk → Route difficulties → Direction taking Prompting direction taking for the advertised route	Any text which tells the reader to follow directions **without** telling them that this will make the walk easier **or** specifically outlining directions. Text could include statement such as 'follow the directions' or 'consider the steps outlined in this leaflet.' Text could also refer to the direction of the route more generally such as 'follow the coastline.' Do not include in this category text which tells the reader that the walk will be easier if they follow directions such as 'following the steps in this booklet will make navigating the route a lot easier' or text that says the walk is easy due to its overall direction such as 'the circularity of this walk makes it easy to follow' (code 84). Also do not include in this category

	text which outlines directions for the reader such as 'leaving Polsloe Bridge station, cross the main Pinhoe Road and go under the railway bridge' (code 85).
57. Promoting intentions and planning → The advertised walk → Route difficulties → Barrier reduction Prompting barrier reduction on the advertised route	Any text which tells the reader to undertake the walk in spite of potential barriers, but **does not** tell them how to overcome such barriers **or** that adjusting to such barriers is easy. Text could include statements such as 'it is also suitable for use by cyclists, wheelchair users or as a pushchair walk' as this reduces disability/children related barriers. Another example could be 'the walks are not competitive – so it doesn't matter if you are not as fast as anyone else' as this reduces speed/pace related barriers. However, in neither case does the text say that, for example, the path is **easy** for wheelchairs/pushchairs/at a slow pace, nor does the text instruct on how to best manage the walk with a wheelchair/pushchair/slower pace. Do not include in this category text which states that barriers to the advertised walk are easy to overcome such as 'even in wet weather, this route is easy to do' (code 86). Also do not include in this category text which guides the reader on how to overcome general barriers to the advertised walk such as 'buses on A376 Exmouth Road or trains from Lympstone can be used to shorten the walk if required' (code 87). This would be categorised under code 87 as it refers to a general barrier (access via public transport) rather than one of the other stated barriers in this coding scheme (e.g. terrain, equipment, map reading, direction taking).

ENHANCING SELF-EFFICACY

Instances of enhancing self-efficacy categories can be any text which **builds confidence** in the reader for doing physical activity, walking in general, or builds confidence for undertaking the advertised walk. It can be text which **encourages** the reader to utilise a behavioural strategy for doing physical activity/walking in general by saying it is easy to set distance or time goals or to continue doing physical activity. It can also include general encouragement for completing government recommended levels of physical activity (e.g. it is easy to do 30 minutes per day). Self-efficacy text can also guide on these strategies for example by saying what goals the reader should set and/or how to set them (e.g. reserve an hour every weekday evening to walk around some fields; write on your calendar when you will do your 30 minutes of exercise). For the advertised walk, text can similarly encourage the reader that setting distance or time goals, continuing similar walks, or following waymarkers (discriminative stimuli that reinforce walking) is easy to do as well as say that managing the terrain, reading maps, following directions, or reducing general barriers (access weather) to doing the advertised walk is simple. Again, self-efficacy text can also guide on these things, for example how the reader can upkeep walking by telling them how to access related walk information (e.g. go to *website* and download the electronic versions of the other walks in this series and keep them in a folder on your computer so you can access them at any time). Importantly, self-efficacy text can guide on direction taking (e.g. turn left at the end of Bonhay Road, then cross the river) which builds confidence in the reader that they can follow the correct route. Instances of this (guidance for direction taking) are perhaps the most commonly used strategy in walking leaflets. Pictorially, modelling walking behaviours (generally, or for the advertised walk) would also be instances of enhancing self-efficacy categories. A list and descriptions of all the subordinate self-efficacy categories is listed below.

LEVEL 4 CATEGORIES	DESCRIPTION
58. Enhancing self-efficacy → Recommended physical	Any text which conveys the sense that achieving recommended levels of walking is **easy** for the reader to do. This can include text that states for example 'getting 30 minutes 5 days a week is easy.'

activity/walking → Governmental recommendations → Encouraging recommended physical activity/walking Encouraging recommended levels of physical activity	Do not include in this category text which guides the reader on means by which they can achieve recommended levels of walking – any instance of this should be categorised beneath one of the guidance categories below. Also do not include any text which states that managing time for walking, or setting goals for walking, is easy. These should be categorised under the relevant encouragement categories below.
59. Enhancing self-efficacy → Recommended physical activity/walking → Governmental recommendations → Guidance for recommended physical activity/walking Guidance on how to achieve recommended levels of physical activity	Any text which guides the reader on how to achieve recommended levels of physical activity, or how to undertake walking in general, without reference to distance or time based goals, general barrier reduction strategy, or maintenance strategies. For example 'Doing 10,000 steps per day will contribute to the recommendation of moderate-intensity physical activity for at least 30 minutes on 5 or more days per week.' This statement does not refer to distance or times goals, maintenance strategies or barriers (e.g. weather) but provides guidance on other ways (in this case, step counts) of achieving physical activity. Do not include in this category text which merely states that it is easy to achieve recommended amounts of physical activity or walking in general (code 58).
60. Enhancing self-efficacy → Recommended physical activity/walking → Walk management → Encouraging distance or route based goals Encouraging walking goals based on distances	Any text which conveys the sense that distance or route based goals for recommended levels of physical activity/walking in general are **easy** for the reader to do **without** guiding the reader on how to do it. This can include text for example that states 'it is **easy** to walk 2 miles every day.' Do not include in this category text which guides the reader on how to set a distance goal e.g. 'mark on your calendar how far you'll walk each day'; or what distance goals to set 'walk 2 miles around your village every day' (code 61).
61. Enhancing self-efficacy → Recommended physical activity/walking → Walk management → Guidance for distance or route based goals Guidance on walking goals based on distances	Any text which guides the reader on how to set distance/route goals, or more commonly, on how to achieve distance/route goals, for recommended levels of physical activity/walking in general. For example, 'walk around your local area for 2 miles every day; you could do this by walking your children to school and back.' Do not include in this category text which states the ease with which one can achieve a distance/route goal (code 60). Also do not include text which merely promotes distance goals such as 'try walking longer distances around your village' (code 44).
62. Enhancing self-efficacy → Recommended physical activity/walking → Walk management → Encouraging time based goals Encouraging walking	Any text which conveys the sense that setting time based goals for recommended levels of physical activity/walking in general is **easy** for the reader to do **without** guiding the reader on how to do it. This can include text for example that states 'it is easy to fit daily walking into your everyday routine' or 'finding time in your day to do some walking is not difficult.' Do not include in this category text which guides the reader on how to set time based goals or what time based goals to set e.g. 'by walking to work instead of driving, you will dramatically increase the time you

goals based on time	spend walking each day' (code 63).
63. Enhancing self-efficacy → Recommended physical activity/walking → Walk management → Guidance for time based goals Guidance on walking goals based on time	Any text which guides the reader on how to set time based goals, or more commonly, tells the reader to manage their time in a particular way for the purposes of achieving recommended levels of physical activity/walking in general. For example, 'replace an hour of TV in the evening with an hour of physical activity such as going for a walk.' Do not include in this category text which states the ease with which one can set time based goals (code 62). Also do not include in this category text which merely promotes time based goals e.g. 'free up some time exercise' (code 45).
64. Enhancing self-efficacy → Recommended physical activity/walking → Walk management → Encouraging barrier reduction Encouraging the reduction of barriers to walking	Any text that says that overcoming general barriers to physical activity or walking in general is easy. Text could include statements such as 'getting motivated for walking is easy' or 'you shouldn't worry about the bad weather, even walking in the rain is pretty simple'. These are all examples of ways of encouraging physical activity or walking through reducing traditional barriers but don't refer to distance/time based goals or maintenance. Do not include in this category text which guides the reader on how to overcome traditional barriers to physical activity/walking in general, such as 'have an energy filled snack like a banana an hour before exercising' (code 65).
65. Enhancing self-efficacy → Recommended physical activity/walking → Walk management → Guidance for barrier reduction Guidance on the reduction of barriers to walking	Any text that guides the reader on how to overcome general barriers to physical activity or walking in general. Text could include statements such as 'prepare yourself for walking by having a quick energy boosting snack' or 'if you do not have the time or energy to walk all the way to your destination, walking combined with buses or trains is a good way to get there.' This is an example of guiding the reader on ways to do physical activity without reference to distance /time based goals or maintenance strategies, but through reducing general barriers (motivation/amount of energy). Do not include in this category and text which states that general reduction of barriers to physical activity/walking in general is easy (code 64). Also do not include in this category text that merely tells the reader to reduce barriers e.g. 'you can even walk in the rain' or 'get yourself motivated before exercise' (code 46).
66. Enhancing self-efficacy → Recommended physical activity/walking → Reinforcement → Encouraging maintenance Encouraging repeated walking	Any text which conveys the sense that continuing practicing physical activity/walking in general is **easy** for the reader to do **without** guiding the reader on how to do it. For example, 'it is easy to keep up a walking routine." Do not include in this category text which guides the reader upon how to continue physical activity/walking in general such as 'making sure all short leisure trips are taken by foot is a good way of continuing to walk more' (code 67).
67. Enhancing self-efficacy → Recommended physical activity/walking → Reinforcement → Guidance for maintenance Guidance on ways to continue walking	Any text which guides the reader on ways to continue walking or practicing physical activity in general. For example, 'committing with a friend to going for a short run every week is a good way of keeping up a physical activity routine.' Do not include in this category text which states the ease with which one can continue walking/practicing physical activity (code 66). Also do not include in this category any text which merely promotes maintenance behaviours such as 'try walking every day' or 'think about exercising regularly' (code 47).
68. Enhancing self-efficacy →	Any picture of people walking which **is not** related to the advertised walk. For example somebody walking down a nondescript street.

Recommended physical activity/walking → Reinforcement → Modelling Modelling physical activity pictorially	Do not include in this category a picture of someone walking a part of the advertised walk (code 77).
69. Enhancing self-efficacy → The advertised walk →Walk management → Encouraging distance or route based goals Encouraging distance walking goals for the advertised route	Any text which conveys the sense that setting distance or route based goals for the advertised walk is **easy**. This can include anything which says the walk is 'easy to break up' or 'easy to divide into stages' for example, **without** guiding the reader on specific ways on how to do so. Do not include in this category text which provides distance or route based goals for the advertised walk such as 'this can be shortened to 9km/5.5 miles by missing Lee Bay and Lee Village and to 7km/4.5 miles by missing Morte Point' (code 70).
70. Enhancing self-efficacy → The advertised walk → Walk management → Guidance for distance or route based goals Guidance on distance walking goals for the advertised route	Any text which guides the reader on how to set distance or route based goals for the advertised walk or, more usually, provides the reader with options on how to 'break up' the walk into more manageable sections or stages such as 'you can shorten the walk by 1.9 kilometres (1.2 miles) by following the East Devon Way.' Do not include in this category text which only says that distance goals for the advertised walk are easy to set (code 69). Also do not include in this category text which merely promotes distance goals for the advertise walk such as 'try breaking up the walk into stages' (code 48).
71. Enhancing self-efficacy → The advertised walk → Walk management → Encouraging time based goals Encouraging timed walking goals for the advertised route	Any text which conveys the sense that setting time based goals for the advertised walk is an **easy** thing to do **without** guiding the reader on how to set time based goals such as 'all the walks in this leaflet can easily be incorporated into your daily routine.' Do not include in this category any text which tells the reader which guides the reader on what time based goals to set, such as 'the Exe Valley Way can be divided up into a series of 10 stages, most of which can be walked comfortably by most walkers in half a day' (code 72).
72. Enhancing self-efficacy → The advertised walk → Walk management→ Guidance for time based goals Guidance on timed walking goals for the advertised route	Any text which guides the reader on how to set time based goals or what time based goals to set such as 'though an active rambler may be able to complete the walk in a few days, the majority will need longer, even a full fortnight' or 'the route can be divided up in to a series of 10 stages, most of which can be walked in half a day.' Do not include in this category text which only tells the reader that it is easy to manage timing of the walks (code 71). Also do not include in this category text which merely promotes time based goals for the advertised walk (without guidance on what goals to set) such as 'there are opportunities to do a shorter day or half day walk' (code 49).
73. Enhancing self-efficacy → The advertised walk → Reinforcement → Encouraging stimulus control Encouraging attention to signage on the advertised	Any text which conveys the sense that using discriminative stimuli is **easy** or any text that suggests that discriminative stimuli make walking easier **without** guiding the reader to directly use or attend to discriminative stimuli. Discriminative stimuli in this instance tend to mean anything along the route that encourages further walking – most commonly waymarkers or other signage. This could include text which states that it is easy to 'stay on track as there are waymarkers throughout' or text that says 'it is easy to follow the signs.' Do not include in this category text which guides the reader on how to

route	use signage/waymarkers such as 'keep track of how far you've walked using the waymarkers' (code 74).
74. Enhancing self-efficacy → The advertised walk → Reinforcement → Guidance for stimulus control Guidance on attending to signage on the advertised route	Any text which guides the reader on how to attend to discriminative stimuli on the route. An example of this could be 'use the waymarkers to tell how far you've travelled and how far you have to go' or 'pay attention to the distance markings on the signs so you can keep track of how far you've walked.' Do not include in this category text which only states that discriminative stimuli (signage) make the walk easier or any text that only states it is easy to use the signage (code 73). Also do not include in this category text which merely promotes the use of waymarkers or signage e.g. 'keep an eye open for the mauve arrows marking the East Devon Way' (code 51).
75. Enhancing self-efficacy → The advertised walk → Reinforcement → Encouraging maintenance Encouraging repeated recreational walks similar to the advertised route	Any text which conveys the **ease** with which one can continue to walk routes related to the advertised walk **without** guiding the reader on how to access other similar walks such as 'accessing the other walks in this series couldn't be easier.' Do not include in this category any text which guides the reader on how to access further information related to similar walks such as 'Leaflets are available from TIC, our website: www.exe-estuary.org,or by contacting us via email: exeestua@devon.gov.uk' (code 76).
76. Enhancing self-efficacy → The advertised walk → Reinforcement → Guidance for maintenance Guidance on repeated recreational walks similar to the advertised route	Any text which guides the reader on how to access other walks or tells the reader to walk certain other routes such as 'detailed Guides for these routes are available from Tourist Information Centres and from www.exe-estuary.org.' Do not include in this category text which only states it is easy to continue doing similar walks (code 75). Also do not include in this category text which merely promotes further similar walks e.g. 'other similar leaflets are available' (code 52).
77. Enhancing self-efficacy → The advertised walk → Reinforcement → Modelling Modelling walking on the advertised route pictorially	Any picture which depicts people walking part of the advertised route. Do not include in this category pictures of walking/exercising where it is not clear whether it is related to the advertised walk (code 68).
78. Enhancing self-efficacy → The advertised walk → Route difficulties → Encouraging terrain management Encouraging ways to overcome difficulties with the terrain on the advertised route	Any text which conveys the **ease** with which one can overcome difficulties with the terrain on the advertised walk **without** guiding the reader on how to overcome them such as 'the hills should not be a problem.' Do not include in this category text which guides the reader on how to overcome difficulties with the terrain such as 'walk well away from the edge of the cliff as they are prone to landslides' (code 79).
79. Enhancing self-efficacy → The advertised walk → Route difficulties → Guidance for terrain management	Any text which guides the reader on how to overcome difficulties with the terrain on the advertised walk such as 'this is a tidal crossing which cannot be passed within 2 hours either side of high tide, and you should consult the tide times website (see the back page of this leaflet) before crossing onto the Bere Peninsula.' Do not include in this category text which only states that it is easy to

Guidance on ways to overcome difficulties with the terrain on the advertised route	overcome difficulties with the terrain (code 78). Also do not include in this category text which merely promotes overcoming terrain difficulties such as 'take care as there are no pavements' (code 53).
80. Enhancing self-efficacy → The advertised walk → Route difficulties → Encouraging appropriate equipment Encouraging equipment necessary for the advertised route	Any text which conveys how appropriate equipment is easy to access for the purposes of the advertised walk 'getting some stout footwear should be easy enough.' Do not include in this category text which guides the reader on appropriate equipment to take such as 'you must take water with you even on a cloudy day' or 'a robust pair of walking boots should be taken in order to manage the hills' (code 81).
81. Enhancing self-efficacy → The advertised walk → Route difficulties → Guidance for appropriate equipment Guidance on equipment necessary for the advertised route	Any text which guides the reader on how to overcome difficulties on the advertised walk by using appropriate equipment or clothing such as 'you must wear good quality walking boots to reduce the risk of falling.' Do not include in this category text which only states how appropriate equipment will make the walk easier such as 'wearing more layers will make this walk easier on a wintery day' (code 80). Also do not include in this category text which merely promotes appropriate equipment such as 'consider wearing good shoes' (code 54).
82. Enhancing self-efficacy → The advertised walk → Route difficulties → Encouraging map reading Encouraging map reading	Any text which conveys how map reading is **easy without** guiding the reader to read the map such as 'following the direction on the map should not be difficult.' Do not include in this category, text that guides the reader on how to read the maps in the leaflet such as 'follow the route marked red to make sure you stay on track' (code 83).
83. Enhancing self-efficacy → The advertised walk → Route difficulties → Guidance for map reading Guidance on map reading	Any text which guides the reader to use or read the map in a certain way such as 'check the map every now and again to make sure you are on the right path' or more imperative statements such as 'follow the red marked route on the map to make sure you stay on track.' Do not include in this category text which only states that reading the maps will make the walk easier such as 'following the map directions is easy' (code 82). Also do not include in this category text which merely promotes map reading such as 'use the maps within' (code 55).
84. Enhancing self-efficacy → The advertised walk → Route difficulties → Encouraging direction taking Encouraging direction taking for the advertised route	Any text which conveys to the reader that following the directions in the leaflet/booklet is easy such as 'this booklet makes the route easy to follow.' Do not include in this category text which guides the reader on directions to take such as 'after passing the old wall of St. Katherine's Priory on the right, cross Prince Charles Road and walk up St. Katherine's Road' (code 85).
85. Enhancing self-efficacy → The advertised walk → Route difficulties → Guidance for direction taking	Any text which either guides the reader to follow directions or outlines or guides specific directions to take. In the case of the former, text could include statements such as 'make sure you follow each step carefully to ensure you follow the route correctly' or 'read each direction before you set off.' In the case of the latter, text can include guidance such as 'start at junction of Pennsylvania Rd' or 'turn left at end of public footpath and go straight ahead along Velwell Rd.' These sorts of

Guidance for direction taking on the advertised route	direction taking guidance are frequent in walking leaflets and booklets. Do not include in this category text which only states that following directions is easy such as 'with the help of this leaflet, it should be easy to follow the route' (code 84). Also do not include in this category text which merely promotes following directions such as 'you can consider the directions which are described in this booklet' (code 56).
86. Enhancing self-efficacy → The advertised walk → Route difficulties → Encouraging barrier reduction Encouraging ways to reduce barriers to walking the advertised route	Any text that says that general barriers for completing the advertised walk are easy to overcome, without telling the reader **how** to overcome them. These barriers would **not** include references to terrain, appropriate equipment, map reading or direction taking. Text could include statements such as 'it is easy to do the walk even in bad weather' or 'with a little bit of arranging public transport it is easy to get to the start of the walk.' Both statements target barrier reduction (weather, access) without guiding on how to overcome the barriers. Do not include in this category any text which guides the reader on how to overcome general barriers such as 'buses on A376 Exmouth Road or trains from Lympstone can be used to shorten the walk if required' (code 87).
87. Enhancing self-efficacy → The advertised walk → Route difficulties → Guidance for barrier reduction Guidance on ways to reduce barriers to walking the advertised route	Any text that guides the reader on how to overcome general barriers to completing the advertised walk. Text could include statements such as 'take extra care to walk on drier sections of the path when the weather is bad' or 'free guided tours are offered.' These provide guidance on barriers not mentioned elsewhere in the coding scheme (weather/cost). Do not include in this category any text which merely says that adapting to barriers for the advertised walk is easy to do (code 86). Also do not include in this category text which merely promotes the reduction of general barriers to doing the advertised walk such as 'the walk is suitable for wheelchair users and pushchairs' (code 57) as this only addresses the existence of barriers for the disabled/those with pushchairs; it does not build confidence for doing the route in a wheelchair/with a pushchair.

0. Uncoded Text Uncoded text	Any textual statements not captured in the above coding scheme. This can include (but is not limited to) publishing credits, feedback forms, details about the locations that are not captured in the coding scheme (e.g. this beach was used in a film), other website information (if it is not used to promote maintenance), and information on environmental behaviours (e.g. take litter home, buy locally produced goods etc).

Appendix M

Reliability statistics for the coding taxonomy in Chapter 5 (before consensus on unreliable categories was sought).

Category no.	Category Name	*n* (rater 1)	*n* (rater 2)	*n* (agreed)	AC1	*p*	LB	UB
1	Information about recommended physical activity guidelines	0	0	0	n/a	n/a	n/a	n/a
2	Information about the distance of the advertised route	18	20	17	0.89	<.001	0.47	1.00
3	Information about the time it may take to complete the advertised route	0	1	0	-0.01	1.000	-0.01	-0.01
4	Information about the terrain of the advertised route	47	47	42	0.89	<.001	0.63	1.00
5	Presence of a map	11	11	11	1.00	<.001	0.41	1.00
6	Information about the overall course of the advertised route	38	13	8	0.31	0.003	0.09	0.52
7	Information about maps related to the advertised route	3	4	3	0.86	0.043	-0.12	1.00
8	Information about public transport options related to the advertised route	20	21	15	0.73	<.001	0.36	1.00
9	Information about parking provision related to the advertised route	3	3	3	1.00	0.043	-0.14	1.00
10	Information about the provision of toilets on the advertised route	3	3	3	1.00	0.043	-0.14	1.00
11	Information about refreshments on, or at the end of, the advertised route	6	7	6	0.92	0.007	0.18	1.00
12	Financial consequences of walking	2	2	2	1.00	0.081	-0.32	1.00
13	Environmental consequences of walking	3	2	2	0.80	0.081	-0.32	1.00
14	Physical health consequences of walking	3	3	3	1.00	0.043	-0.14	1.00
15	Mental health consequences of walking	4	4	4	1.00	0.024	0.01	1.00
16	Social benefits of walking	1	1	1	1.00	0.161	-0.98	1.00
17	Benefits to children of walking	0	0	0	n/a	n/a	n/a	n/a
18	Viewing a monument as a consequence of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a

19	Viewing historical points of interest as consequences of walking the advertised route	57	42	40	0.81	<.001	0.56	1.00
20	Viewing wildlife as a consequence of walking the advertised route	5	5	5	1.00	0.013	0.12	1.00
21	Viewing scenery as a consequence of walking the advertised route	13	23	11	0.61	<.001	0.25	0.97
22	Botanical points of interest as consequences of walking the advertised route	2	2	2	1.00	0.081	-0.40	1.00
23	Social consequences of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
24	Benefits to children of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
25	Accommodation at the destination as a consequence of walking the advertised route	3	4	3	0.86	0.043	-0.12	1.00
26	Leisure opportunities as consequences of walking the advertised route	16	9	8	0.64	0.003	0.19	1.00
27	Normative information about recommended physical activity guidelines or walking	0	0	0	n/a	n/a	n/a	n/a
28	Expert recommendations about physical activity or walking	0	0	0	n/a	n/a	n/a	n/a
29	Normative information about the financial consequences of walking	0	0	0	n/a	n/a	n/a	n/a
30	Normative information about the environmental consequences of walking	1	1	1	1.00	0.161	-0.98	1.00
31	Normative information about the physical health consequences of walking	0	0	0	n/a	n/a	n/a	n/a
32	Normative information about the mental health consequences of walking	0	0	0	n/a	n/a	n/a	n/a
33	Normative information about the social consequences of walking	0	0	0	n/a	n/a	n/a	n/a
34	Normative information about the benefits to children of walking	1	1	1	1.00	0.161	-0.98	1.00
35	Normative information about viewing a monument on the advertised route	0	0	0	n/a	n/a	n/a	n/a
36	Normative information about viewing historical points of interest on the advertised route	0	0	0	n/a	n/a	n/a	n/a
37	Normative information about viewing wildlife on the advertised route	0	0	0	n/a	n/a	n/a	n/a
38	Normative information about viewing scenery on the advertised route	0	0	0	n/a	n/a	n/a	n/a
39	Normative information about viewing botanical points of interest on the advertised route	0	0	0	n/a	n/a	n/a	n/a
40	Normative information about the social consequences of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
41	Normative information about the benefits to children of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
42	Normative information about accommodation at the destination of the advertised route	0	0	0	n/a	n/a	n/a	n/a

43	Normative information about leisure opportunities on, or at the end of, the advertised route	0	0	0	n/a	n/a	n/a	n/a
44	Prompting walking goals based on distance	0	0	0	n/a	n/a	n/a	n/a
45	Prompting walking goals based on time	0	0	0	n/a	n/a	n/a	n/a
46	Prompting barrier reduction for walking	2	1	1	0.66	0.162	-0.66	1.00
47	Prompting repeated walking	0	1	0	-0.01	1.000	-0.01	-0.01
48	Prompting distance goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
49	Prompting time goals for the advertised route	1	0	0	-0.01	1.000	-0.01	-0.01
50	Presence of a map key	3	2	2	0.80	0.081	-0.32	1.00
51	Prompting attention to signage on the advertised route	0	0	0	n/a	n/a	n/a	n/a
52	Prompting repeated recreational walking similar to the advertised route	5	6	2	0.36	0.084	-0.15	0.87
53	Prompting ways to overcome difficulties with the terrain on the advertised route	4	0	0	-0.01	1.000	-0.01	-0.01
54	Prompting equipment needed for walking the advertised route	2	1	1	0.66	0.162	-0.66	1.00
55	Prompting map reading for the advertised route	0	1	0	-0.01	1.000	-0.01	-0.01
56	Prompting direction taking for the advertised route	2	5	2	0.57	0.082	-0.02	1.00
57	Prompting barrier reduction on the advertised route	4	1	1	0.39	0.165	-0.40	1.00
58	Encouraging recommended levels of physical activity	0	1	0	-0.01	1.000	-0.01	-0.01
59	Guidance on how to achieve recommended levels of physical activity	1	1	0	-0.01	1.000	-0.01	-0.01
60	Encouraging walking goals based on distances	0	1	0	-0.01	1.000	-0.01	-0.01
61	Guidance on walking goals based on distances	1	0	0	-0.01	1.000	-0.01	-0.01
62	Encouraging walking goals based on time	0	0	0	n/a	n/a	n/a	n/a
63	Guidance on walking goals based on time	1	0	0	-0.01	1.000	-0.01	-0.01
64	Encouraging the reduction of barriers to walking	0	2	0	-0.01	1.000	-0.01	-0.01
65	Guidance on the reduction of barriers to walking	3	2	2	0.80	0.081	-0.32	1.00
66	Encouraging repeated walking	0	0	0	n/a	n/a	n/a	n/a
67	Guidance on ways to continue walking	0	0	0	n/a	n/a	n/a	n/a
68	Modelling walking pictorially	6	3	3	0.66	0.044	-0.10	1.00
69	Encouraging distance walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a

70	Guidance on distance walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
71	Encouraging timed walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
72	Guidance on timed walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
73	Encouraging attention to signage on the advertised route	1	2	0	-0.01	1.000	-0.01	0.01
74	Guidance on attending to signage on the advertised route	1	0	0	-0.01	1.000	-0.01	-0.01
75	Encouraging repeated recreational walks similar to the advertised route	0	0	0	n/a	n/a	n/a	n/a
76	Guidance on repeated recreational walks similar to the advertised route	13	8	7	0.66	0.004	0.17	1.00
77	Modelling walking on the advertised route pictorially	0	0	0	n/a	n/a	n/a	n/a
78	Encouraging ways to overcome difficulties with the terrain on the advertised route	1	1	0	-0.01	1.000	-0.01	-0.01
79	Guidance on ways to overcome difficulties with the terrain on the advertised route	4	5	1	0.21	0.170	-0.23	0.65
80	Encouraging equipment necessary for the advertised route	0	0	0	n/a	n/a	n/a	n/a
81	Guidance on equipment necessary for the advertised route	0	0	0	n/a	n/a	n/a	n/a
82	Encouraging map reading	0	0	0	n/a	n/a	n/a	n/a
83	Guidance on map reading	1	1	1	1.00	0.161	-0.98	1.00
84	Encouraging direction taking for the advertised route	1	1	0	-0.01	1.000	-0.01	-0.01
85	Guidance for direction taking on the advertised route	148	153	143	0.95	<.001	0.82	1.00
86	Encouraging ways to reduce barriers to walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
87	Guidance on ways to reduce barriers to walking the advertised route	3	1	0	-0.01	1.000	-0.01	-0.01
88	Uncoded or missed text	8	47	6	0.21	0.009	0.03	0.39
Overall agreement at superordinate level = 80.67%		476	476	384	0.77	<.001	0.73	0.82
Overall agreement at general physical activity / advertised route level = 80.67%		476	476	384	0.79	<.001	0.75	0.83
Overall agreement at thematic grouping level =78.78%		476	476	375	0.78	<.001	0.74	0.82
Overall agreement at individual category level = 76.26%		476	476	363	0.76	<.001	0.72	0.80

Appendix N

Reliability statistics for the coding taxonomy in Chapter 5 (after consensus on unreliable categories was sought).

Category no.	Category Name	*n* (rater 1)	*n* (rater 2)	*n* (agreed)	AC1	*p*	LB	UB
1	Information about recommended physical activity guidelines	0	0	0	n/a	n/a	n/a	n/a
2	Information about the distance of the advertised route	18	18	18	1.00	<.001	0.54	1.00
3	Information about the time it may take to complete the advertised route	0	1	0	-0.01	1.000	-0.01	-0.01
4	Information about the terrain of the advertised route	46	46	45	0.98	<.001	0.70	1.00
5	Presence of a map	11	11	11	1.00	<.001	0.41	1.00
6	Information about the overall course of the advertised route	26	26	26	1.00	<.001	0.62	1.00
7	Information about maps related to the advertised route	3	3	3	1.00	0.043	-0.14	1.00
8	Information about public transport options related to the advertised route	20	22	18	0.86	<.001	0.46	1.00
9	Information about parking provision related to the advertised route	3	3	3	1.00	0.043	-0.14	1.00
10	Information about the provision of toilets on the advertised route	3	3	3	1.00	0.043	-0.14	1.00
11	Information about refreshments on, or at the end of, the advertised route	6	7	6	0.92	0.007	0.18	1.00
12	Financial consequences of walking	2	2	2	1.00	0.081	-0.40	1.00
13	Environmental consequences of walking	3	3	3	1.00	0.043	-0.14	1.00
14	Physical health consequences of walking	3	3	3	1.00	0.043	-0.14	1.00
15	Mental health consequences of walking	4	4	4	1.00	0.024	0.01	1.00
16	Social benefits of walking	1	1	1	1.00	0.161	-0.98	1.00
17	Benefits to children of walking	0	0	0	n/a	n/a	n/a	n/a
18	Viewing a monument as a consequence of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a

19	Viewing historical points of interest as consequences of walking the advertised route	54	51	50	0.95	<.001	0.70	1.00
20	Viewing wildlife as a consequence of walking the advertised route	5	5	5	1.00	0.013	0.12	1.00
21	Viewing scenery as a consequence of walking the advertised route	16	18	15	0.88	<.001	0.44	1.00
22	Botanical points of interest as consequences of walking the advertised route	2	2	2	1.00	0.081	-0.40	1.00
23	Social consequences of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
24	Benefits to children of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
25	Accommodation at the destination as a consequence of walking the advertised route	4	4	4	1.00	0.024	0.01	1.00
26	Leisure opportunities as consequences of walking the advertised route	16	10	9	0.69	0.001	0.24	1.00
27	Normative information about recommended physical activity guidelines or walking	0	0	0	n/a	n/a	n/a	n/a
28	Expert recommendations about physical activity or walking	0	0	0	n/a	n/a	n/a	n/a
29	Normative information about the financial consequences of walking	0	0	0	n/a	n/a	n/a	n/a
30	Normative information about the environmental consequences of walking	1	1	1	1.00	0.161	-0.98	1.00
31	Normative information about the physical health consequences of walking	0	0	0	n/a	n/a	n/a	n/a
32	Normative information about the mental health consequences of walking	0	0	0	n/a	n/a	n/a	n/a
33	Normative information about the social consequences of walking	0	0	0	n/a	n/a	n/a	n/a
34	Normative information about the benefits to children of walking	1	1	1	1.00	0.161	-0.98	1.00
35	Normative information about viewing a monument on the advertised route	0	0	0	n/a	n/a	n/a	n/a
36	Normative information about viewing historical points of interest on the advertised route	0	0	0	n/a	n/a	n/a	n/a
37	Normative information about viewing wildlife on the advertised route	0	0	0	n/a	n/a	n/a	n/a
38	Normative information about viewing scenery on the advertised route	0	0	0	n/a	n/a	n/a	n/a
39	Normative information about viewing botanical points of interest on the advertised route	0	0	0	n/a	n/a	n/a	n/a
40	Normative information about the social consequences of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
41	Normative information about the benefits to children of walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
42	Normative information about accommodation at the destination of the advertised route	0	0	0	n/a	n/a	n/a	n/a

43	Normative information about leisure opportunities on, or at the end of, the advertised route	0	0	0	n/a	n/a	n/a	n/a
44	Prompting walking goals based on distance	0	0	0	n/a	n/a	n/a	n/a
45	Prompting walking goals based on time	0	0	0	n/a	n/a	n/a	n/a
46	Prompting barrier reduction for walking	2	1	1	0.66	0.162	-0.66	1.00
47	Prompting repeated walking	0	1	0	-0.01	1.000	-0.01	-0.01
48	Prompting distance goals for the advertised route	1	1	1	1.00	0.161	-0.98	1.00
49	Prompting time goals for the advertised route	1	0	0	-0.01	1.000	-0.01	-0.01
50	Presence of a map key	3	3	3	1.00	0.043	-0.14	1.00
51	Prompting attention to signage on the advertised route	3	3	3	1.00	0.043	-0.14	1.00
52	Prompting repeated recreational walking similar to the advertised route	4	4	4	1.00	0.024	0.01	1.00
53	Prompting ways to overcome difficulties with the terrain on the advertised route	4	1	1	0.39	0.165	-0.40	1.00
54	Prompting equipment needed for walking the advertised route	2	2	2	1.00	0.081	-0.40	1.00
55	Prompting map reading for the advertised route	0	1	0	-0.01	1.000	-0.01	-0.01
56	Prompting direction taking for the advertised route	2	2	2	1.00	0.081	-0.40	1.00
57	Prompting barrier reduction on the advertised route	3	3	3	1.00	0.043	-0.14	1.00
58	Encouraging recommended levels of physical activity	0	1	0	-0.01	1.000	-0.01	-0.01
59	Guidance on how to achieve recommended levels of physical activity	1	1	0	-0.01	1.000	-0.01	-0.01
60	Encouraging walking goals based on distances	0	1	0	-0.01	1.000	-0.01	-0.01
61	Guidance on walking goals based on distances	1	0	0	-0.01	1.000	-0.01	-0.01
62	Encouraging walking goals based on time	0	0	0	n/a	n/a	n/a	n/a
63	Guidance on walking goals based on time	1	0	0	-0.01	1.000	-0.01	-0.01
64	Encouraging the reduction of barriers to walking	0	1	0	-0.01	1.000	-0.01	-0.01
65	Guidance on the reduction of barriers to walking	3	2	2	0.80	0.081	-0.32	1.00
66	Encouraging repeated walking	0	0	0	n/a	n/a	n/a	n/a
67	Guidance on ways to continue walking	0	0	0	n/a	n/a	n/a	n/a
68	Modelling walking pictorially	6	6	6	1.00	0.007	0.20	1.00
69	Encouraging distance walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a

70	Guidance on distance walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
71	Encouraging timed walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
72	Guidance on timed walking goals for the advertised route	0	0	0	n/a	n/a	n/a	n/a
73	Encouraging attention to signage on the advertised route	2	2	1	0.49	0.164	-0.49	1.00
74	Guidance on attending to signage on the advertised route	1	1	1	1.00	0.161	-0.98	1.00
75	Encouraging repeated recreational walks similar to the advertised route	0	0	0	n/a	n/a	n/a	n/a
76	Guidance on repeated recreational walks similar to the advertised route	15	15	14	0.93	<.001	0.45	1.00
77	Modelling walking on the advertised route pictorially	0	0	0	n/a	n/a	n/a	n/a
78	Encouraging ways to overcome difficulties with the terrain on the advertised route	2	3	2	0.80	0.081	-0.32	1.00
79	Guidance on ways to overcome difficulties with the terrain on the advertised route	2	2	2	1.00	0.081	-0.40	1.00
80	Encouraging equipment necessary for the advertised route	0	0	0	n/a	n/a	n/a	n/a
81	Guidance on equipment necessary for the advertised route	0	0	0	n/a	n/a	n/a	n/a
82	Encouraging map reading	0	0	0	n/a	n/a	n/a	n/a
83	Guidance on map reading	1	1	1	1.00	0.161	-0.98	1.00
84	Encouraging direction taking for the advertised route	1	1	0	-0.01	1.000	-0.01	-0.01
85	Guidance for direction taking on the advertised route	148	153	148	0.98	<.001	0.85	1.00
86	Encouraging ways to reduce barriers to walking the advertised route	0	0	0	n/a	n/a	n/a	n/a
87	Guidance on ways to reduce barriers to walking the advertised route	1	1	0	-0.01	1.000	-0.01	-0.01
88	Uncoded or missed text	18	18	18	1.00	<.001	0.54	1.00
Overall agreement at the superordinate level = 96.22%		476	476	458	0.96	<.001	0.94	0.98
Overall agreement at the general physical activity / advertised route level = 96.22%		476	476	458	0.96	<.001	0.94	0.98
Overall agreement at the thematic grouping level = 94.54%		476	476	450	0.94	<.001	0.92	0.96
Overall agreement at the individual category level = 94.12%		476	476	448	0.94	<.001	0.92	0.96

Appendix O

Descriptive statistics for all categories in the taxonomy in Chapter 5.

	% brochures with ≥1 instance	*M* instances	*SD* instances	Max instances	% all content	% of superordinate
Providing information	100.0	57.12	72.83	299	29.1	-
1. Information on recommended physical activity guidelines	3.8	0.04	0.20	1	0.0	0.1
2. Information on the distance of the advertised route	92.3	8.50	10.75	44	4.3	14.9
3. Information on the length it may take to complete the advertised route	26.9	1.04	2.95	14	0.5	1.8
4. Information on the terrain of the advertised route	84.6	8.77	14.30	48	4.5	15.4
5. Presence of a map	84.6	4.08	3.91	12	2.1	7.1
6. Information on the overall course of the advertised route	88.5	15.12	20.97	91	7.7	26.5
7. Information on maps related to the advertised route	50.0	2.08	4.28	19	1.1	3.6
8. Information on public transport options related to the advertised route	61.5	9.77	14.77	54	5.0	17.1
9. Information on parking provision related to the advertised route	38.5	1.62	2.98	9	0.8	2.8
10. Information about provision of toilets on the advertised route	46.2	1.81	4.04	18	0.9	3.2
11. Information on refreshments on, or at the end of, the advertised route	57.7	4.31	7.77	29	2.2	7.5
Highlighting consequences	100.0	50.73	72.73	361	25.9	-

12. Financial consequences of walking	7.7	0.12	0.43	2	0.1	0.2
13. Environmental consequences of walking	7.7	0.15	0.61	3	0.1	0.3
14. Physical health consequences of walking	7.7	0.23	0.82	3	0.1	0.5
15. Mental health consequences of walking	7.7	0.27	0.96	4	0.1	0.5
16. Social benefits of walking	3.8	0.04	0.20	1	0.0	0.1
17. Benefits to children of walking	3.8	0.04	0.20	1	0.0	0.1
18. Viewing a monument as a consequence of walking the advertised route	50.0	1.69	3.02	13	0.9	3.3
19. Viewing historical features as consequences of walking the advertised route	100.0	25.50	38.51	187	13.0	50.3
20. Viewing wildlife as a consequence of walking the advertised route	76.9	3.27	4.03	20	1.7	6.4
21. Viewing scenery as a consequence of walking the advertised route	92.3	11.54	19.92	98	5.9	22.7
22. Botanical points of interest as consequences of walking the advertised route	76.9	2.31	2.94	13	1.2	4.5
23. Social consequences of walking the advertised route	3.8	0.04	0.20	1	0.0	0.1
24. Benefits to children of walking the advertised route	11.5	0.12	0.33	1	0.1	0.2
25. Accommodation at the destination as a consequence of walking the advertised route	23.1	0.65	1.55	6	0.3	1.3
26. Leisure opportunities as consequences of walking the advertised route	42.3	4.77	8.42	30	2.4	9.4
Establishing normative beliefs	15.4	0.31	0.79	3	0.2	-
27. Normative information about recommended physical activity guidelines or walking	3.8	0.04	0.20	1	0.0	12.5
28. Expert recommendations on physical activity or walking	3.8	0.04	0.20	1	0.0	12.5

29. Normative information on the financial consequences of walking	0.0	0.00	0.00	0	0.0	0.0
30. Normative information on the environmental consequences of walking	3.8	0.04	0.20	1	0.0	12.5
31. Normative information on the physical health consequences of walking	3.8	0.04	0.20	1	0.0	12.5
32. Normative information on the mental health consequences of walking	0.0	0.00	0.00	0	0.0	0.0
33. Normative information on the social consequences of walking	0.0	0.00	0.00	0	0.0	0.0
34. Normative information on the benefits to children of walking	3.8	0.04	0.20	1	0.0	12.5
35. Normative information on viewing a monument on the advertised route	0.0	0.00	0.00	0	0.0	0.0
36. Normative information on viewing historical points of interest on the advertised route	3.8	0.04	0.20	1	0.0	12.5
37. Normative information on viewing wildlife on the advertised route	0.0	0.00	0.00	0	0.0	0.0
38. Normative information on viewing scenery on the advertised route	3.8	0.04	0.20	1	0.0	12.5
39. Normative information on viewing botanical points of interest on the advertised route	0.0	0.00	0.00	0	0.0	0.0
40. Normative information on the social consequences of walking the advertised route	0.0	0.00	0.00	0	0.0	0.0
41. Normative information on the benefits to children of walking the advertised route	0.0	0.00	0.00	0	0.0	0.0
42. Normative information about accommodation at the destination of the advertised route	0.0	0.00	0.00	0	0.0	0.0
43. Normative information about leisure opportunities on, or at the end of, the advertised route	3.8	0.04	0.20	1	0.0	12.5
Promoting Intentions and Planning	100.0	10.73	13.11	55	5.5	-
44. Prompting walking goals based on distance	7.7	0.19	0.69	3	0.1	1.8
45. Prompting walking goals based on time	0.0	0.00	0.00	0	0.0	0.0

46. Prompting barrier reduction for walking	7.7	0.12	0.43	2	0.1	1.1
47. Prompting repeated walking	0.0	0.00	0.00	0	0.0	0.0
48. Prompting distance goals for the advertised route	26.9	0.62	1.30	5	0.3	5.7
49. Prompting time goals for the advertised route	23.1	0.50	1.27	6	0.3	4.7
50. Map key	65.4	0.96	0.82	2	0.5	9.0
51. Prompting attention to signage on the advertised route	38.5	1.04	1.84	8	0.5	9.7
52. Prompting repeated recreational walking similar to the advertised route	73.1	4.04	5.23	17	2.1	37.6
53. Prompting ways to overcome difficulties with the terrain on the advertised route	34.6	1.42	2.79	12	0.7	13.3
54. Prompting equipment needed for walking the advertised route	11.5	0.12	0.33	1	0.1	1.1
55. Prompting map reading for the advertised route	19.2	0.27	0.67	3	0.1	2.5
56. Prompting direction taking for the advertised route	19.2	0.27	0.60	2	0.1	2.5
57. Prompting barrier reduction on the advertised route	34.6	1.19	2.77	13	0.6	11.1
Enhancing self-efficacy	100.0	69.31	107.36	403	35.3	-
58. Encouraging recommended levels of physical activity	0.0	0.00	0.00	0	0.0	0.0
59. Guidance on how to achieve recommended levels of physical activity	3.8	0.04	0.20	1	0.0	0.1
60. Encouraging walking goals based on distances	0.0	0.00	0.00	0	0.0	0.0
61. Guidance on walking goals based on distances	7.7	0.08	0.27	1	0.0	0.1
62. Encouraging walking goals based on time	0.0	0.00	0.00	0	0.0	0.0

63. Guidance on walking goals based on time	3.8	0.04	0.20	1	0.0	0.1
64. Encouraging the reduction of barriers to walking	0.0	0.00	0.00	0	0.0	0.0
65. Guidance on the reduction of barriers to walking	3.8	0.12	0.59	3	0.1	0.2
66. Encouraging repeated walking	0.0	0.00	0.00	0	0.0	0.0
67. Guidance on ways to continue walking	0.0	0.00	0.00	0	0.0	0.0
68. Modelling physical activity pictorially	3.8	0.04	0.20	1	0.0	0.1
69. Encouraging distance walking goals for the advertised route	3.8	0.04	0.20	1	0.0	0.1
70. Guidance on distance walking goals for the advertised route	26.9	0.42	0.86	3	0.2	0.6
71. Encouraging timed walking goals for the advertised route	3.8	0.04	0.20	1	0.0	0.1
72. Guidance on timed walking goals for the advertised route	7.7	0.92	4.51	23	0.5	1.3
73. Encouraging attention to signage on the advertised route	3.8	0.08	0.39	2	0.0	0.1
74. Guidance on attending to signage on the advertised route	19.2	0.19	0.40	1	0.1	0.3
75. Encouraging repeated recreational walks similar to the advertised route	0.0	0.00	0.00	0	0.0	0.0
76. Guidance on repeated recreational walks similar to the advertised route	46.2	2.50	4.58	20	1.3	3.6
77. Modelling walking on the advertised route pictorially	30.8	1.35	2.86	12	0.7	1.9
78. Encouraging ways to overcome difficulties with the terrain on the advertised route	3.8	0.04	0.20	1	0.0	0.1
79. Guidance on ways to overcome difficulties with the terrain on the advertised route	53.8	1.92	2.45	8	1.0	2.8
80. Encouraging equipment necessary for the advertised route	0.0	0.00	0.00	0	0.0	0.0

81. Guidance on equipment necessary for the advertised route	15.4	0.23	0.65	3	0.1	0.3
82. Encouraging map reading	0.0	0.00	0.00	0	0.0	0.0
83. Guidance on map reading	7.7	0.12	0.43	2	0.1	0.2
84. Encouraging direction taking for the advertised route	11.5	0.15	0.46	2	0.1	0.2
85. Guidance for direction taking on the advertised walk	88.5	60.88	99.31	362	31.0	87.8
86. Encouraging ways to reduce barriers to walking the advertised route	0.0	0.00	0.00	0	0.0	0.0
87. Guidance on ways to reduce barriers to walking the advertised route	11.5	0.12	0.33	1	0.1	0.2
Text which was unable to be otherwise categorised	88.5	7.92	8.33	28	4.0	-

"% leaflets with ≤1 instance" refers to the percentage of brochures in the sample with greater than or equal to one instance of the persuasive technique or superordinate.
"*M* instances" refers to the average number of instances of the persuasive technique or superordinate across the sample of brochures.
"*SD* instances" refers to the standard deviation of instances of the persuasive technique or superordinate across the sample of brochures.
"Max instances" refers to the maximum number of instances of the persuasive technique or superordinate in any one brochure in the sample.
"% all content" refers to the percentage of all content which is accounted for by the persuasive technique or superordinate.
"% of superordinate" refers to the percentage of superordinate content which is accounted for by the persuasive technique.

Appendix P

Annotated version of the enhanced brochure in Chapter 6.

Stage 1:

Forhampton to Wickbury

Distance: 5 miles (8 km)

Surfaces: Whatever your previous experience, this leaflet will help you tackle all the surfaces on this walk.
Gradients: There is one climb and descent. These are not too difficult especially if you shorten your stride and pace yourself – this will make it feel much easier.
Obstacles: Gates and foot bridges along the way can be used as markers of your progress along the route.

1 The walk begins at Forhampton centre. Start by passing through a gated courtyard by the museum and information centre. Follow a path to the right of the museum, through the car park onto Jacobs Pool, where you turn left. When closed, walk up George Street to the left of the White Hart Hotel. Follow George Street and turn right into Castle Road. Where the road bends across the West Forment river, continue straight on the path alongside the left bank of the river.

Many people like yourself love to walk this route. For some people though, walking five miles can be daunting. Using this leaflet will help you break up the route into a series of mini-walks and seem more manageable.

2 Pass through a gate into the nature reserve, bearing left to climb the middle path through the woods, keeping left at two path junctions. Turn right along a bridleway. Many people enjoy walking around this nature reserve and find it especially relaxing.

3 On reaching the golf course, take the path across the golf course, taking care as you proceed. After 200m, as the track turns sharply to the right, continue ahead along the path. Leave the golf course at a gate, and follow the right edge of the field ahead. Take a rest here if you feel tired, and catch your breath if you need to. If you've come this far, you've made excellent progress – well done!

4

Follow the 'path' signs through a gate and through a farmyard, to join a surfaced lane beyond the farm. When you reach the road turn left across the road bridge.

A **Walking** every day can have a variety of health benefits. Completing a walk like this will reduce your blood pressure and may help you stay more relaxed for the rest of the day. Experts say a 30 minute walk 5 days a week can sustain these benefits long-term. Lots of people walk on a daily basis and tend to feel healthier and happier.

B **Practice** can build up stamina if you don't walk a lot at present. Try doing short walks near your home that you think are easy to do. Then slowly build up the difficulty of your walks until you feel confident enough to undertake longer walks like this one.

4 Take the path to the rear of the parking area beside the road. Where a path goes to your right under the road, continue ahead on the path towards the river. Continue along the river, cross the footbridge and climb the hill on the path bearing left. Climbing hills can be difficult, but pace yourself and you'll find it much easier. Pass through a gate, turn right onto a track past Peldon Farm, and turn left when you reach the road.

Comment [EL4]: Again maintaining directions.

Comment [EL1]:
•Enhance self-efficacy
•Through prompting reattribution of past failure.

Comment [EL2]: •Enhance self-efficacy
•Through prompting barrier identification and planning in relation to anticipated barriers.

Comment [EL3]: •Facilitating behaviour change by prompting environmental change.
•Teaching to use environmental prompts and cues (gates and bridges) – sort of teaching to cognitively reframe these.

Comment [EL6]: •Change beliefs about benefits of the behaviour.
•Provide health behaviour link info.
•Describe material consequences of behaviour.

Comment [EL5]: Kept directions but shortened them to add more info below. This would already be classed under self-efficacy – provide instruction.

Comment [EL7]: •Change normative beliefs.
•Information about others behaviour.

Comment [EL8]: •Change normative beliefs about other people's behaviour.
•By providing information on others behaviour.

Comment [EL9]: •Enhance self-efficacy.
•Set graded tasks.
ALSO
•Facilitate behaviour change by prompting environmental change.
•Teaching to use prompts (the steps in the leaflet).

Comment [EL15]: •Enhance self-efficacy.
•Set graded tasks/goals for achieving the walk.

Comment [EL10]: Again, maintained directions, but cut down to add content. Self-efficacy – provide instruction.

Comment [EL11]: •Change affective attitudes associated with the behaviour.
•By describing affective consequences of the walk.
Also normative beliefs – info about others behaviour.

Comment [EL16]: Maintaining direction instructions.

Comment [EL17]: •Enhance self-efficacy.
•Use argument to bolster efficacy (asserting that they can do the hill).

Comment [EL12]: Again, keeping instructions but shortening to add content.

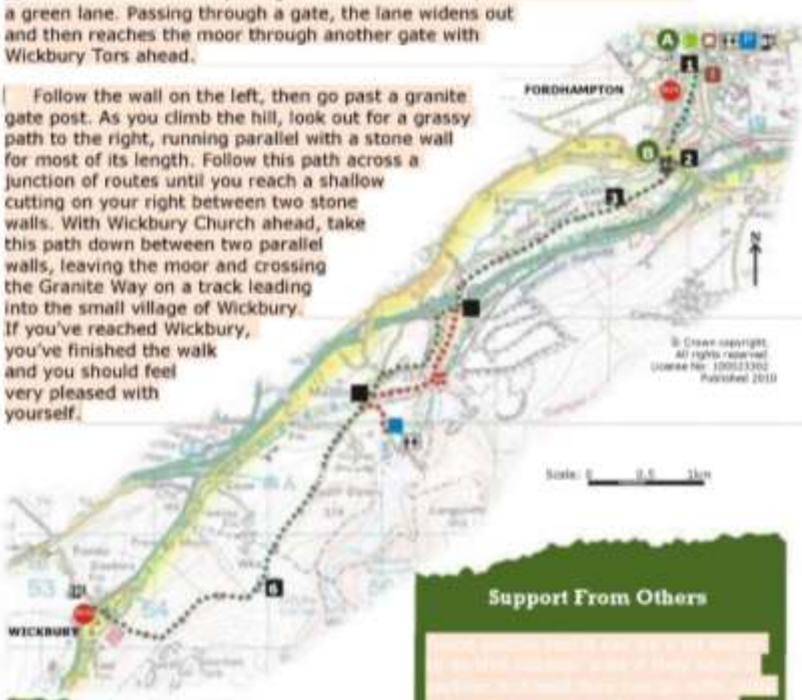
Comment [EL13]: •Enhance self-efficacy.
•Prompt barrier identification (getting tired) and how to overcome (take a rest).

Comment [EL18]: Maintaining directions.

Comment [EL14]: •Enhance self-efficacy.
•Providing feedback on performance with praise.

5 Pass under the railway bridge and continue ahead; the road soon becomes a green lane. Passing through a gate, the lane widens out and then reaches the moor through another gate with Wickbury Tors ahead.

6 Follow the wall on the left, then go past a granite gate post. As you climb the hill, look out for a grassy path to the right, running parallel with a stone wall for most of its length. Follow this path across a junction of routes until you reach a shallow cutting on your right between two stone walls. With Wickbury Church ahead, take this path down between two parallel walls, leaving the moor and crossing the Granite Way on a track leading into the small village of Wickbury. If you've reached Wickbury, you've finished the walk and you should feel very pleased with yourself.



Regular Walkers

They also provide good

Support From Others

Comment [EL19]: Shortened directions.

Comment [EL20]: Shortened directions.

Comment [EL21]: •Enhance self-efficacy.
•Providing feedback on performance with praise.

Comment [EL22]: •Facilitating behaviour change by promoting environmental change.
•By prompting organisation of social support.

Comment [EL25]: •Change beliefs about benefits.
•Material AND health consequences of walking (free/healthier).

Comment [EL26]: •Enhance self-efficacy
•Providing instruction (on equipment – preparatory behaviour).

Comment [EL27]: •Change normative beliefs.
•Provide info on others' walking.
•ALSO Enhancing self-efficacy
•By using an argument (i.e. against self doubt – fitness and age don't matter)

Comment [EL28]: •Fostering a positive behaviour related identity.
•By providing a positive group identity for those engaging in outdoor walking.

Comment [EL23]: •Facilitating behaviour change by promoting environmental change.
•By prompting organisation of social support (this time through walking groups).
•Also prompting barrier identification.

Comment [EL29]: •Fostering a positive behaviour related identity.
•By prompting the individual to identify as a potential role model.

Comment [EL24]: •Facilitating behaviour change by promoting environmental change.
•Organisation of social support.
•Also enhances efficacy.
•By providing instruction on how to find walking groups.

Appendix Q

Summary of responses to the item asking “If you feel that reading the leaflet somehow changed your motivation to go on outdoor recreational walks, please explain why here” included in the study presented in Chapter 6.

Responses from non-walkers reading the standard brochure:

Although there were a bit too much too read in the leaflet, I feel as though the descriptive writing has encouraged me to get up and mak [sic] a move and get more involved in such expedition-like leisure activities
Clear and precise information regarding the route in the leaflet would encourage me to take the route as often, walking routes are not obvious when attempted without such knowledge.
D’dn't change how I feel about it
Easy to understand
Explained how to complete the route, made it seem achievable
Gave information as to what you were seeing and may have missed otherwise
I cannot undertake walks like this due to disability
I enjoy scenery and by the description it sounded really nice, i also like country houses etc.
I feel as though this guide gives a good solid walking route and offers potential extras such as the scenic detour to the Peldon reservoir
I feel that i would prefer more interesting buildings or sies [sic] of historical value.it would be too much countryside for me.as an inexperienced walker i would also find the whole route too long.
I have just read a very interesting and informative article; it certainly has grabbed my interest enough to find out about walks around my area. I particularly was impressed with the amount of detail, and the choice of routes described with land marks along the way.
I like the idea of seeing museums and golf courses etc. Instead of just see landscape
I liked the historical detail explaining the thing’ I'd be seeing and passing
I liked the precise descriptions when to turn where. Makes it very easy to find the way
I really can’t remember any examples
I would love to do walks like these, but the leaflet d’dn't say if there were places where I could sit down and rest in between sections. If there were or if not if there was wheelchair access I would love to do it. Or you could put the ease of access or the state of fitness needed to complete the course.
I would love to go on a walk like this. Sadly, as I indicated in one of your early questions, I have mobility/chronic pain issues that would preclude me from doing a walk like this Gradients, even small ones, and uneven surfaces are a no-no for me. Also, I cannot walk for long distances. I do think that, for someone who does not have my issues, a walk like this would be a delightful way to spend a day out.’
I'm afraid’it's not for me
Interesting history and combination of town and countryside
Intesting [sic] and pretty walks
It didn’t
It d’dn't
It d’dn't change my motivation.
It d’dn't make me want to walk
It gave a clear route and instructions which would be very helpful
It gave clear and explicit instructions of where to go. It also gave some nice insight and history into the place itself.
It has not
It hasn’t
It made me think about the possibility of walking more but did not inspire me to do one anytime soon
It made the route look interesting, it made the instructions simple, I like the idea of seeing the

reservoir [sic]
It made the walk sound more exciting more than just a walk
It seems fun and to do with friends
It shows what walks are out there
It sounds like a very tranquil walk with plenty around you to admire
'It's good to see a clear description of the level of difficulty of the walk, plus interesting descriptions of things to see along the way
Just made it more interesting
Like following instructions to doscover [sic] off the beaten track places. Few things to see along the way if you want to.
Lots of things to see whilst walking
Makes it seem easier
N/a
N/a
N/a
Na
Na
Nice way to relax and get fresh air.
No
No
No
No
No changes in motivatI...
No difference
Not sure
Nothing
Nothoing [sic]
Seems like a steady walk
Shows all what you can see while walking
Sounded exciting but I love walking anyway
Sounds a nice walk, history was included.
Sounds like'there's a lot to see along the way.
The description of the walk being uneven with steep hills, muddy patches, rocky surfaces etc.
The history of the area and scenic views
The instructions were very detailed and I am confident I would not get lost
The mention of scenic routes e.g. Peldon Reservior would convince to go on the walk and see different areas
There are many scenery to be observed simultaneously with recreational walking. Moreover, recreational walks as such bring peace of mind and relieve from daily stress because of the ambience of nature
This is the sort of walk which I would have enjoyed doing 10 years ago but I am not now physically able to do it.
To be more active
Unsure
Very detailed so you know what your [sic] getting in terms of the route

Responses from non-walkers reading the enhanced brochure:

A bit too patronising for me

A lot of reading to do before hand’and I'm not into walking. Maybe a clearer key to explain about dog waling or picninc [sic] areas available
Adventurous
At present I walk seven days a week, each walk lasting 4 miles at a brisk pace along a sea front. I do this in order to keep fit etc. The walk described in the leaflet appears a natural development for me and I would love to try a similar route in my area, giving me the chance to meet people of a similar nature.
Because it can make you happier and more relaxed for the rest of your day
Different types of scenery’
Don't feel like walking alon’
Don't kno’
Don't know
Dont [sic] know just would be gre387eso seee [sic] all this places
Good clear instructions and landmarks to look out for. Good advice for doing the difficult bits like hills.
Health benefits Scenery
Health reasons and being near nature appeals to me.
I am disabled
’ didn't feel the design was very engaging and was a bit old fashioned to really get my attention and excite me
’I don't think it changed my mind I am a keen Iker... Normally around north DevIcoasts... But I am always looking for new ideas and pIIs to walk...
I feel confident that the instructions are vivid enough that I would not get lost! I also feel that due to the gradient of each section being so well explained I would not have any shocks in the middle of the walk and experience difficulties either for myself or companions. It is a very positive leaflet that made me feel comfortable in taking it on despite having no experience. The descriptiveness of it made me feel almost as though the walker had shared their experience and tempted me to see the river, walkthrough the farm yard, and made me a chuckle as i imagined dodging golf balls on the course. For a moment it transported me.
I just imagined it to be fun. It would be exciting to go out and follow the map or the instructions, and I think I would be very pleased with myself if I completed it.
I like the clear instructionsI how to walk....in case you get lost.
I liked the fact that your leaflet broke the journey down into smaller parts and was very informative and easy to digest.
I liked the way the leaflet said places on the route where you could rest! Also it was honest about areas which might cause difficulty (like a hill). It also suggested going with other people would help and I know from ’y experience–that's very true - especially on a new route. Wish there were more leaflet387estorathis about possbile [sic] walking routes as I felt it very inspiring.
I really liked the leaflet, mostly because it was very encouraging and felt like it was addressing me as an individual and not just giving the route directions, which is the norm. So it had a very different feel ‘o most. Ie [sic] 'you should be ple’sed w‘th yourself' ’nd 'pace yourself' when going up the hill etc. made it feel fun and personal. It made me want to start to walking again in fact, (I hav’ stopped as I don't drive and my partner is disabled). So whoever wrote this did a very good job!
I used to love going on walks and for that matter cross country runs but due to disability and very poor mobility this sort of walk would no longer be possible
I would like to ge’ out more but don't ever seem to have the time
I would prefer a circular route as if I had left transport at the start point I would need to get back there!
Interesting example of what to expect when taking th [sic] walk
’t didn’t
’t didn't
It didn't change my m’tivation
It didn't. I like w’lking; I just don't have the time for it. The route looked nice though
It emphasised the helth [sic] benefits of walking 30 minutes a day, that the route was not too difficult, one incline and one decline, taking rests along the way, general upbeat positive tone of

the leaflet
It explained the health benefits to walking and the social aspect.
It gave a positive attitude towards the walk, making it seem more ’njoyable
It hasn't changed anything but it does inspire.
It made me realise what is on my doorstep that i am missing out on
It reinforced & confirmed what I thought
It reminded me about how good a walk can be, but I did feel somewhat “atronised by t”e "walking advice". Is this a real route? If so, perhaps a more picturesque one could have been chosen, and points of interest, views, etc been picked out to increase interest. Perhaps also some hi’toric notes (what's the history of the pub, the railway, did the river play a part in the Industrial Revolution, etc, etc?).
It reminded me of the joy of walking in fresh air and doing things with other people. It made me feel sad and frustrated as well as motivated.
It reminds me of the days when i used to walk everwhere [sic] getting trapped in boggy fields the smell of farm animals most of which i have forgotten over the ages and am now in the twilight of my youth longing to regain [sic] this feeling again
It sounds lovely, very picturesque and healthy
It was very patronising
It’s good for your health, blood pressure and stamina.
Know wee well
Looks good and will keep me healthy
Made it seem more sociable
More likely to
N/a
Na
No
No
No already happy to undertake walks, just walked the tour de mont blanc
No change
No change in my motivation
No I have no need to do a walk
No, i am feeling the sam’ way
No, it didn't
None
Not change but intrigued [sic]
Not exactly, it seems like a lovely walk and well advertised, however I find that in daily life I am too busy to go for walks and therefore the leaflet has had no effect upon me.
Not much
Not really, but definitely another option
Nothing
Ok
Poor health
Put images into my head
Reminded me of how many routes there are out there
Safe
Says it relaxes you and improves health
Seemed a good idea and the health benefits would make it worthwhile.
Stay healthy
That you have someone to walk with

The description was exciting and seemed peaceful and relaxing.
The encouragement given in the sheet was good Simple short instructions Pointing out the interesting features is helpful The O.S. Map feature is a good idea, encouraging user to become more adventurous
The guide seemed very clear
The info boxes detailing health benefits, the detailed info on the walk and what to notice, the suggestion boxes eg askIiends to go too...all helped to motivate me-giving me confidence too in the professional approach taken by the creators.
The information was detailed enough with clear instructions.
The leaflet does its job in motivating me/people and helps by breaking it down in bit size chunks. My problem is my mobility having M.E makes it very difficult to undertake exercises like this although I really want to. I would love to know if you do different gradients of walks, for example a one mile flat walk, then maybe a three mile bramble. Walks that lead on to the bigger challenges like this one.
The leaflet gave a good description of the walk and would motivate me to complete it if I was fit enough to do so.
The route sounds interesting
The r–ute was planned out - very detailed and this is what I would need for myself and friend.
The world
Though I cycle, I will like to try walking on a regular basis as well
Very informative and lots of information
Walking help us stay more relaxed for the rest of the day.
Worth giving a go might enjoy it
Would love to do this but having a 4 year to look after hampers my efforts at the moment!

Responses from walkers reading the standard brochure:

Already do a lot of hill walking
Although on one route, you can notice (and the leaflet gives) alternative suggestions in the same area.
Am already motivated but reading the leaflet and learning about the town , reservoir etc. made me feel that I would like to walk routes further away from my usual ones just for th [sic] information and experience
Am unsure when walking on muddy surfaces
An exciting walk with varied terrain
And another time have been of such transitions and the experience is unique.
Better health
Cannot remember
Can’t remember
Chance to see new scenery as well as learn some history of the area
Detailed instructio–s as to where to go - alternative routes were given to vary the walk- historical referen389estora made in the’leaaflet [sic]
Didn't change my motivation, but would be very nice to b able to go walk around so beautiful and interesting places like in th’ leflet [sic].
Didn't really as I love outdoor walks but think it would encourage people to do it
Explanation
Good
Good
Good walks
Great descriptions of varied sights, plus historical significance is co’l
Great walks
Hasn't changed my motivation but has improved on my willingness to set aside time to complete walks such as this

Healthy good about myself
Historical aspect
I already go on these kinds of walks frequently
I alrea’y go outdoors
I can't remember
I enjoy a challenge
I enjoy countryside walks but also on the environs of a town, ti enjoy the history, plus here is a lovely lake or reservoir to lunch beside
I just enjoy walking and exploring new route
I like that you have plenty of places to visit and alot [sic] of history
I liked the examples of sites to look out for. Points of interest etc.
I love that the leaflet incuded [sic] a little bit about the history of the place that’s quite inspiring
I love to go for walks but often go to the same places as I am unsure of permissive paths or where to go. Guided leaflets have in the past given me the confidence to try out new routes. The leaflet in this example made me feel like trying out a route such as this, because it inspires me by the information it gives and the thought that I might see wonderful views and scenery.
I often look at walking routes
I only prefer to walk by waterways especially rivers wich [sic] are now a lot cleaner than they used to be.
I was always passionate about recreational walks, and if there would be something ar’und where I live; it'd make everything more interesting!
I was very inspired when I read a healthy living plan on a website which gave me the confidence to run more
I wish I could, but in a wheelchair
I would go on a walk like this if I lived nearby
I would like the views on display.
Interesting walk through countryside with history thrown in
Intresti“g [sic] sights like "pass thorugh [sic]”an iron kissing gate"
It describes the surrounding scenery and whet you would expect to see and experience during then walk
It did not change my opinion or motivation as I already do this k’nd of rout’
It didn't
It didn't change my’motivation.
It didn't change my views about competing such walks because I have used lots of similar guides to do walks in the past ad [sic] present, but new history and such information does encourage me to do new walks to experience new places and new learning.
It gave areas of interest and points of note
It gives interesting information about what can be seen, such as the grounds of Torhampton Castle and Peldon Viaduct.
It gives you an overall pictures
It has good information and makes it more interesting
It has increased my motivation to go on outdoor recreational walks because you get to experience different scenery.
It hasn’t change my motivation for walking but a preplanned route can make it easier in a part of the country that you are unfamiliar with. It is also easi’r for those that don't want to complete the walk to know where they can meet you in the car
It hasn’t, I intend to start walking more anyway
It included points of interest and a variety of landscapes/geography rather than just long pathways that hold little interest.
It looks like beautiful scenery which makes the walk worthwhile
It made me contact my friends and family to join me in this
It made me feel amazing
It made me more aware of things to go look at whilst walking.

It made me realise how pretty some places are
It made me think more about these walks and get excited to'try them when I hadn't thought of some of them before
It made me want to go on more in depth walks, mainly going further in to the country side.
It made seem quite fun and exciting
It reminded me of the experience and joys I can get out of this type of walking
It seemed to much effort
It suggests a decent worthwhile with what appear to be a nice diversion to the reservoir.
It was 5 miles long which is about the right distance for me and my partner, there were several bridges on the route, there was a mixture of rural and village waking which make it more interesting [sic]
Just seemed complicated route
Just the simple reminder of country walks has motivated me to go on one as soon as possible
Looks well planned with plenty to see long the way, toilet stops and a reasonable length
Made me feel more motivated
Made me less likely to want to do it as it seemed very organised and walking acros' a golf course doesn't seem particularly scenic
Makes it seem more adventurous
My motivation is losing weight, though having a route set out would be great
N/a
N/a
Na
Na
Nice information about the surrounding area
No
No change.
No comment
No it encouraged me
No opinion
None
None
None
Noon [sic]
Not changed my motivation.
Not really
Not really. It is a we–l presented leaflet - easy to read & understand, informative and interesting with a good variety of presentation methods. I could use this to teach my children how to present a leaflet.
Nothinbg [sic]
Only that I reminded me of some of the reasons that walking is a pleasant activity, walking through different scenery and passing interesting sights
The instructions are clear, and I liked that there was lots of mentions of things to see along the way.
The leaflet was broken down into points which is always easier to digest than one long written piece. The historical interest points are good and make you want to go on the walk.
The scenery and history
The suggestions of scenic routes etc. were a great idea, and something I could potentially do in my own town
The variety of sight on the way under bridges and alongside a golf course
The variety on route
The walk sounds interesting, but I have a terrible sense of direction so would have to constantly

refer to the guide and may get lost. All part of the fun though, for folk like me, the map could be updated to includ– the route points 1 - 6, that would ’ake it easier. Doesn't sound too taxing and looks to be an interesting walk.
The wide variety of views and discovering new and pleasant areas. This will also be healthy and fun as well as pleasant.
This is a low level route therefore fairly easy terrain, unlike the Pennine Hills where I live which are more difficult
Very informative and I enjoyed reading the historical detail and descriptions of the environment.
Very motivated, love the outdoors
Walking is extremely fun and I live in a nice location with great routes to walk in
Walkways differ4 [sic]

Responses from walkers reading the enhanced brochure:

Actually a leaflet showing a walking root does not affect my opinion/motivation about achieving something like that.
All the health benefits are very appealing
As a couple, we do walk for recreation in out [sic] own area & elsewhere, & often look for new routes. As the leaflet showed, discovering new places is one of the joys of walking.
As it outlines the exact walk and gives advice on resting points it makes the walk seem more manageable.
As this leaflet has helped to manage the walk and to split it in smaller walks
Basically it did the experience to light. I now wish to walk this route. Starting in the courtyard. Very nice combination of scenery
Be healthy, adventurous, worthwhile.
Did not change my motivation, but the tone of the leaflet was quite condescending, made no mention of if the route is suitable for pushchairs/wheelchairs/dogs, and also no mention of how to get back to the start point.
Didn’t change my motivation
Don’t
Easy directions, motivational language.
Engaging
Found the leaflet patronising
Getting out in the country and feeling the fresh air seems very beneficial.
Good
Good
Good
I already enjoy walks, but reading the leaflet definitely got me in the mood to walk. It described the pleasantness of the scenery, and the sense of accomplishment ’hat you get once you've complet’d such a walk. I can't wait to get outside!
I am often slow to try new routes because–I fear getting lost - this leaflet gave really good descriptions of the routeId its way markings... I feel I would manage not to get lost using t’is.
I dint know
I don't normally walk as far as the leaflet recommended but I enjoy it and the fact that it reminds you how good it is for you and how pleasant it is to sightsee does make me feel more motivated
I enjoyed the way the route was described as being an adventure as opposed to just a simple walk down a path to another town. It made me curious to even visit this place.
I have had some concerns for a while regarding my blood pressure and depression. Although I do walk regularly I tend to walk shorter distances than this as I also have some problems with my knee. I would like to try to walk further distances and after reading the leaflet it has made me think twice about walking a bit further and taking breaks if I need to rest to ensure my knee does not pack up. This would also give me the opportunity to take in the scenery.
I have not walked as regularly as I used to walk, due to personal family circumstances. However, the ideas in the leaflet about pacing going up a hill, and taking a break to notice the Nature Reserve, to walk by a church is always a good place to take a break and look at the church and its grounds, which are normally tranquil places. The information about granite walls

sounding inspiring and historical. The thought of walking along a green path next to a granite walk felt as if I was actually there walking it taking in the country air. It made me realise how much I've missed walking and I must get back to it, as it does relax me and it is so social.
I like off the shelf routes that gives a bit more information regarding the route that I am walking. Explaining direction and what to see. This route motivates a person to get to point A and explains in clear English how to get to point B.
I liked the leaflet but I go out on walks like this near my home town and fully enjoy them
I love this sort of walks
I often walk around snipe dales, and enjoy the wildlife while completing the walk
I really like how you have explained to people the benefits of walking(paragraph A B),how to build up stamina, it is a motivating leaflet
I thought the leaflet wa' laid out well, it wasn't too much to read, it was kept short and informative
I want to get fkt [sic]
Inpirationall [sic]
It detailed the route well to help not to get lost.
It did not
It did not change my mind
It did not change my motivation, I am already motivated
It didn't
It didn't affect my motivation at any way
It didn't change anything it made want to get out in the country and walk for miles taking in all the l'vely fresh air
It didn't change my motivation as I am already very motivated to walk outdoors
It encouraged me to walk to further away places.
It gives good reasoning to why it's good for you and also its di'ferent scenery
It hasn't changed my motivation as I already do a393estoratwalking with my labrador. Leaflets like these will make the walks more enjoyable as it provides a good route and what the gradient will be when you visit new places
It looked accessible and easy to follow
It made it sound very pleasant and easy to do.
It shows it in a bit more exciting way and having a planned walk you will meet new people
It was interesting reading the leaflet but I am very motivated about walking routes like this anyway. I have ju't completed the Hadrian's wall Path this last month and am researching other paths to do
It was very descriptive, though probably too descriptive, i think it would take away from the enjoyment of the walk and prefer s'mething more visual
It's a bit patronsising [sic] in places, just having the route would be enough for me. The motivational stuff is off putting.
I''s good for fitness
It's nice to walk a planned route and no the exact distance you are covering
Like motivation
Looking over the benefits of exercising.
Looks funny
Makes walks easy
Meeting new people with same interests
My motivation remains the same.
N/a
No
No change
No change, I was willing to do walking routes when I stated the survey
No I don't it changed my motivation

No, I found it a bit patronising to be honest. It was trying to do two things but the encouragement/motivation would have been better grouped together and not interspersed with directions. Mentioning good views etc. or comments like having achieved the short steep section it is downhill all the way are fine but leave the motivational stuff to a separate section or it is annoying and patronising
None
None
None
Not really
Not really. It is like the walks i usually do
Not sure
Perhaps bolder colour to mark the route
Reading the leaflet made me want to go walking more often. I will make the time to fit walking into my life more.
Reminds one of how relaxing it is to take a walk with views and running water (river or sea)
Sadness
Seem4d [sic] plesant [sic]
Should get more fresh air
The amount of different features on the walk made it sound like an interesting & beautiful walk. The features could also act as good markers for rest points on to enable walkers to split the walk into smaller chunks if needed.
The description along the walk made it seem interesting and worth the effort
The fact that it makes you feel more relaxed in the day
The leaflet is very encouraging towards those who might not walk regularly, or have built up the stamina for such a walk, as it mentions wh‘re walkers can st’p to 'catch your breath' without being patronising.
The leaflet made it sound fun and interesting almost like a treasure hunt
The steps breakdown makes the walk seem more manageable suggesting places of interest along the route.
The walk from forhampton centre
There is so much to see without to [sic] much effort
There were lots of encouraging comments through the leaflet to drive t’e walker.
Though I don't know this locality it sounds like a pleasant outing.
To be honest this walk would be quite long for someone my age
Variety of features and scenery and easy distance of 5 miles passing a railway
Walk’ng long distances doesn't have to be difficult; these can be broken up into mini walks and set ’he pace so that you don't struggle when climbing inclines.
Walks are calm and relaxing especially long walks , and it’s good for our health

Appendix R

Unadjusted and adjusted regression coefficients for stated and revealed intentions (whole sample n=557).

	Stated Intentions			Revealed Intentions		
	b	LB	UB	e^b	LB	UB
Unadjusted						
Constant	4.97	4.74	5.20	0.78	-	-
Brochure (Standard brochure=ref)						
No brochure	0.38*	0.04	0.73	0.90	0.59	1.37
Enhanced brochure	0.33*	0.01	0.66	0.82	0.55	1.22
R^2	0.01			0.00 (Cox & Snell) 0.00 (Nagelkerke)		
Adjusted for demographics						
Constant	3.54	2.62	4.45	1.03	-	-
Brochure (Standard brochure=ref)						
No brochure	0.28	-0.06	0.62	0.92	0.60	1.42
Enhanced brochure	0.28†	-0.04	0.59	0.79	0.53	1.19
Gender (Males=ref)						
Females	-0.07	-0.34	0.21	1.30	0.91	1.85
Age (18-35 years old=ref)						
35-48 years old	0.00	-0.34	0.34	1.64*	1.06	2.54
49-65 years old	-0.21	-0.55	0.13	1.29	0.83	2.00
Ethnicity (BAME=ref)						
White British	-0.02	-0.40	0.35	0.61*	0.38	0.97

Disability status (Some disability=ref)						
No disability	0.79***	0.45	1.12	0.86	0.56	1.32
Income (less than £15,000=ref)						
£15,000-£25,000	0.29	-0.17	0.75	0.57†	0.31	1.03
£25,000-£35,000	0.27	-0.18	0.72	0.76	0.43	1.34
£35,000-£50,000	0.38	-0.10	0.86	0.68	0.37	1.25
£50,000 and over	0.64**	0.18	1.10	0.99	0.56	1.77
Don't know	-0.46	-1.07	0.16	0.85	0.39	1.83
R^2	0.10			0.03 (Cox & Snell) 0.04 (Nagelkerke)		
Additionally adjusted for propensity for visiting natural environments						
Constant	3.06	2.14	3.99	0.77	-	-
Brochure (Standard brochure=ref)						
No brochure	0.29†	-0.04	0.62	0.92	0.60	1.42
Enhanced brochure	0.27†	-0.04	0.58	0.79	0.52	1.18
Gender (Males=ref)						
Females	-0.05	-0.32	0.22	1.32	0.93	1.89
Age (18-35 years old=ref)						
35-48 years old	0.09	-0.25	0.42	1.74*	1.12	2.70
49-65 years old	-0.14	-0.48	0.19	1.35	0.87	2.09
Ethnicity (BAME=ref)						
White British	-0.06	-0.43	0.31	0.59*	0.37	0.96
Disability status (Some disability=ref)						
No disability	0.82***	0.49	1.15	0.88	0.57	1.36
Income (less than £15,000=ref)						

£15,000-£25,000		0.31	-0.15	0.76	0.57†	0.32	1.04
£25,000-£35,000		0.29	-0.16	0.74	0.75	0.42	1.34
£35,000-£50,000		0.41†	-0.07	0.87	0.69	0.37	1.26
£50,000 and over		0.63**	0.18	1.09	0.99	0.55	1.76
Don't know		-0.40	-1.00	0.21	0.87	0.40	1.89
Long-term visit propensity (Less frequent=ref)							
More frequent		0.46**	0.16	0.75	1.40†	0.95	2.06
Short-term visit propensity (Continuous variable)		0.03†	-0.00	0.06	1.01	0.97	1.05
R^2		0.13			0.04 (Cox & Snell) 0.05 (Nagelkerke)		
Additionally adjusted for recreational walking status	*n*						
Constant	-	1.83	0.90	2.76	0.45	-	-
Brochure (Standard brochure=ref)	205						
No brochure	155	0.30†	-0.01	0.62	0.93	0.60	1.44
Enhanced brochure	197	0.33*	0.03	0.62	0.81	0.53	1.21
Gender (Males=ref)	252						
Females	305	-0.05	-0.31	0.20	1.32	0.92	1.88
Age (18-35 years old=ref)	179						
35-48 years old	186	0.08	-0.24	0.39	1.74*	1.11	2.71
49-65 years old	192	-0.07	-0.39	0.24	1.39	0.89	2.18
Ethnicity (BAME=ref)	90						
White British	467	-0.06	-0.41	0.29	0.59*	0.36	0.95
Disability status (Some disability=ref)	122						
No disability	435	0.71***	0.39	1.02	0.84	0.54	1.30

Income (less than £15,000=ref)	89						
£15,000-£25,000	101	0.24	-0.19	0.67	0.55†	0.30	1.01
£25,000-£35,000	116	0.19	-0.23	0.62	0.72	0.40	1.29
£35,000-£50,000	97	0.31	-0.14	0.75	0.66	0.35	1.21
£50,000 and over	116	0.58**	0.15	1.01	0.96	0.54	1.73
Don't know	38	-0.36	-0.93	0.21	0.88	0.40	1.94
Long-term visit propensity (Less frequent=ref)	265						
More frequent	292	0.12	-0.17	0.41	1.21	0.81	1.82
Short-term visit propensity (Continuous variable)	557	0.02	-0.01	0.05	1.00	0.97	1.04
Recreational walking status (Non-walkers=ref)	257						
Walkers	300	1.08***	0.81	1.35	1.59*	1.09	2.31
R^2		0.22			0.05 (Cox & Snell) 0.07 (Nagelkerke)		

n.s not significant; † p<.1; * p<.05; ** p<.01; *** p<.001; N.B "LB" and "UB" refer to 95% confidence intervals; for revealed intentions, these are not symmetrical around the odds ratio because the confidence intervals are exponentiated from the confidence intervals around the log of the odds.

Appendix S

Unadjusted and adjusted regression coefficients for stated and revealed intentions (stratified by recreational walking status).

	Stated Intentions						Revealed Intentions					
	Non-walkers (n=257)			Walkers (n=300)			Non-walkers (n=257)			Walkers (n=300)		
	b	LB	UB	*b*	*LB*	*UB*	e^b	LB	UB	e^b	LB	UB
Unadjusted												
Constant	4.19	3.84	4.54	5.60	5.34	5.86	0.30	-	-	1.53	-	-
Brochure (Standard brochure=ref)												
No brochure	0.49†	-0.05	1.02	0.31	-0.09	0.70	2.42*	1.22	4.78	0.45**	0.25	0.79
Enhanced brochure	0.56*	0.07	1.04	0.25	-0.13	0.63	2.44**	1.30	4.59	0.37***	0.21	0.64
R^2	0.02			0.01			0.04 (Cox & Snell)			0.05 (Cox & Snell)		
							0.05 (Nagelkerke)			0.06 (Nagelkerke)		
Adjusted for demographics												
Constant	2.59	1.30	3.88	4.65	3.49	5.81	0.31	-	-	3.50	-	-
Brochure (Standard brochure=ref)												
No brochure	0.45†	-0.06	0.96	0.25	-0.15	0.65	2.52*	1.24	5.12	0.48*	0.26	0.86
Enhanced brochure	0.48*	0.02	0.95	0.26	-0.12	0.64	2.39**	1.24	4.62	0.36***	0.21	0.64
Gender (Males=ref)												
Females	-0.35†	-0.76	0.05	0.14	-0.19	0.48	1.04	0.60	1.82	1.40	0.86	2.30
Age (18-35 years old=ref)												
35-48 years old	0.36	-0.17	0.89	-0.20	-0.59	0.20	2.15*	1.03	4.51	1.43	0.80	2.58
49-65 years old	0.05	-0.45	0.56	-0.17	-0.58	0.20	1.94†	0.94	3.97	1.05	0.57	1.94

Ethnicity (BAME=ref)												
White British	-0.26	-0.81	0.29	0.14	-0.31	0.59	0.40*	0.19	0.83	0.77	0.40	1.51
Disability status (Some disability=ref)												
No disability	1.11***	0.63	1.58	0.35	-0.07	0.78	1.20	0.62	2.33	0.58†	0.31	1.10
Income (less than £15,000=ref)												
£15,000-£25,000	0.43	-0.22	1.08	0.11	-0.47	0.69	0.53	0.21	1.31	0.63	0.27	1.51
£25,000-£35,000	0.52	-0.13	1.18	-0.10	-0.65	0.45	0.95	0.39	2.30	0.65	0.28	1.49
£35,000-£50,000	0.45	-0.25	1.15	0.11	-0.47	0.70	0.79	0.31	2.02	0.60	0.25	1.45
£50,000 and over	0.57†	-0.09	1.23	0.52†	-0.05	1.09	0.98	0.41	2.35	0.93	0.40	2.16
Don’t know	-0.31	1.13	0.51	-0.51	-1.32	0.30	0.96	0.32	2.89	0.88	0.26	3.00
R^2	0.17			0.06			0.09 (Cox & Snell)			0.08 (Cox & Snell)		
							0.12 (Nagelkerke)			0.11 (Nagelkerke)		
Additionally adjusted for propensity for visiting natural environments												
Constant	2.29	0.99	3.58	4.61	3.38	5.83	0.24	-	-	3.26	-	-
Brochure (Standard brochure=ref)												
No brochure	0.37	-0.13	0.88	0.25	-0.15	0.65	2.42*	1.19	4.95	0.48*	0.26	0.86
Enhanced brochure	0.50*	0.04	0.96	0.25	-0.13	0.64	2.40**	1.24	4.66	0.36***	0.20	0.64
Gender (Males=ref)												
Females	-0.31	-0.71	0.10	0.15	-0.19	0.48	1.07	0.61	1.87	1.42	0.86	2.33
Age (18-35 years old=ref)												
35-48 years old	0.47†	-0.05	1.00	-0.19	-0.59	0.21	2.32*	1.09	4.93	1.45	0.80	2.62
49-65 years old	0.12	-0.38	0.62	-0.17	-0.58	0.24	2.05†	0.99	4.23	1.06	0.58	1.96
Ethnicity (BAME=ref)												

White British			-0.32	-0.87	0.22	0.14	-0.32	0.59	0.38^{*}	0.18	0.80	0.77	0.40	1.51
Disability status (Some disability=ref)														
No disability			1.09^{***}	0.62	1.57	0.36	-0.07	0.79	1.22	0.63	2.36	0.59	0.31	1.12
Income (less than £15,000=ref)														
£15,000-£25,000			0.46	-0.18	1.10	0.12	-0.47	0.70	0.53	0.21	1.33	0.64	0.27	1.52
£25,000-£35,000			$0.60^{\dagger}$	-0.05	1.26	-0.10	-0.66	0.46	0.96	0.39	2.37	0.65	0.28	1.48
£35,000-£50,000			0.47	-0.22	1.16	0.11	-0.47	0.70	0.79	0.30	2.03	0.92	0.25	1.45
£50,000 and over			0.51	-0.15	1.16	$0.52^{\dagger}$	-0.05	1.09	0.95	0.39	2.30	0.87	0.40	2.15
Don't know			-0.29	-1.09	0.52	-0.51	-1.33	0.31	0.97	0.32	2.94	1.10	0.26	2.97
Long-term visit propensity (Less frequent=ref)														
More frequent			0.02	-0.46	0.50	0.05	-0.32	0.42	1.25	0.65	2.42	1.10	0.64	1.91
Short-term visit propensity (Continuous variable)			0.07^{*}	0.02	0.13	-0.00	-0.03	0.03	1.03	0.95	1.11	0.99	0.95	1.04
R^2			0.20			0.06			0.10 (Cox & Snell)			0.08 (Cox & Snell)		
									0.13 (Nagelkerke)			0.11 (Nagelkerke)		
Additionally adjusted for mediators	*n* (non-walkers)	*n* (walkers)												
Constant	-	-	-0.30	-1.31	0.70	0.34	-0.86	1.53	-3.38	-	-	0.73	-	-
Brochure (Standard brochure=ref)	91	114												
No brochure	69	86	-0.03	-0.39	0.33	0.20	-0.13	0.53	$2.03^{\dagger}$	0.95	4.32	0.46^{*}	0.26	0.85
Enhanced brochure	97	100	0.12	-0.21	0.45	0.05	-0.26	0.36	$1.93^{\dagger}$	0.96	3.88	0.35^{***}	0.20	0.63

Gender (Males=ref)	113	139												
Females	144	161	-0.10	-0.40	0.19	-0.03	-0.31	0.24	1.26	0.68	2.32	1.34	0.81	2.22
Age (18-35 years old=ref)	73	106												
35-48 years old	83	103	0.08	-0.29	0.45	-0.22	-0.54	0.10	1.99†	0.89	4.46	1.48	0.82	2.70
49-65 years old	101	91	-0.06	-0.43	0.31	-0.32†	-0.66	0.01	2.07†	0.94	4.56	1.04	0.56	1.93
Ethnicity (BAME=ref)	41	49												
White British	216	251	-0.21	-0.60	0.17	0.23	-0.14	0.59	0.38*	0.17	0.85	0.78	0.40	1.54
Disability status (Some disability=ref)	66	56												
No disability	191	244	0.03	-0.35	0.41	0.27	-0.08	0.63	0.56	0.25	1.26	0.61	0.32	1.17
Income (less than £15,000=ref)	48	41												
£15,000-£25,000	47	54	0.03	-0.43	0.48	-0.10	-0.58	0.37	0.34*	0.13	0.92	0.61	0.25	1.47
£25,000-£35,000	48	68	0.11	-0.35	0.58	-0.31	-0.76	0.14	0.59	0.23	1.56	0.63	0.38	2.10
£35,000-£50,000	40	57	-0.17	-0.66	0.32	0.01	-0.47	0.49	0.44	0.16	1.24	0.61	0.25	2.89
£50,000 and over	52	64	0.10	-0.37	0.56	0.14	-0.33	0.60	0.63	0.24	1.67	0.89	0.65	1.96
Don't know	22	16	-0.44	-1.00	0.13	-0.31	-0.97	0.36	0.86	0.27	2.74	0.84	0.25	2.89
Long-term visit propensity (Less frequent=ref)	168	97												
More frequent	89	203	-0.01	-0.34	0.33	0.00	-0.30	0.30	1.24	0.61	2.53	1.13	0.65	1.96
Short-term visit propensity (continuous variable)	257	300	0.03	-0.01	0.07	-0.01	-0.03	0.03	1.00	0.92	1.09	0.99	0.95	1.04
Mediators (Continuous variables)														
Attitudes	257	300	0.38***	0.23	0.53	0.52***	0.35	0.69	1.34†	0.96	1.86	1.18$^{n.s}$	0.86	1.62
Descriptive norms	257	300	0.15*	0.02	0.27	0.13*	0.00	0.25	1.06$^{n.s}$	0.81	1.38	1.01$^{n.s}$	0.80	1.26

Self-efficacy	257	300	0.50^{***}	0.39	0.61	0.24^{***}	0.11	0.38	1.49^{**}	1.16	1.90	$0.91^{n.s}$	0.71	1.17
R^2			0.61			0.40			0.19 (Cox & Snell)			0.09 (Cox & Snell)		
									0.26 (Nagelkerke)			0.12 (Nagelkerke)		

$^{n.s}$ not significant; † *p*<.1; * *p*<.05; ***p*<.01; *** *p*<.001; $^{N.B}$ "LB" and "UB" refer to 95% confidence intervals; for revealed intentions, these are not symmetrical around the odds ratio because the confidence intervals are exponentiated from the confidence intervals around the log of the odds.

References

Abraham, C. (2012). Mapping change mechanisms onto behaviour change techniques: a systematic approach to promoting behaviour change through text. In C. Abraham & M. Kools (eds.) *Writing health communication. An evidence-based guide* (pp. 99-116). London, UK: Sage.

Abraham, C. (2015). Mapping modifiable mechanisms in health promotion research: a commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review, 9*(2), 160-164.

Abraham, C., Kelly, M. P., West, R., & Michie, S. (2009). The UK National Institute for Health and Clinical Excellence public health guidance on behaviour change: a brief introduction. *Psychology, Health & Medicine, 14*(1), 1-8.

Abraham, C., & Kools, M. (2012). *Writing health communication. An evidence-based guide.* London, UK: Sage.

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology, 27*(3), 379-387.

Abraham, C., Krahé, B., Dominic, R., & Fritsche, I. (2002). Do health promotion messages target cognitive and behavioural correlates of condom use? A content analysis of safer sex promotion leaflets in two countries. *British Journal of Health Psychology, 7*(2), 227-246.

Abraham, C., Southby, L., Quandte, S., Krahé, B., & Sluijs, W. V. D. (2007). What's in a leaflet? Identifying research-based persuasive messages in European alcohol-education leaflets. *Psychology & Health, 22*(1), 31-60.

Adamowicz, W., Swait, J., Boxall, P., Louviere, J., & Williams, M. (1997). Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. *Journal of Environmental Economics and Management, 32*(1), 65-84.

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett Jr, D. R., Tudor-Locke, C., ... & Leon, A. S. (2011). 2011 Compendium of Physical Activities: a second update of codes and MET values. *Medicine & Science in Sports & Exercise, 43*(8), 1575-1581.

Ainsworth, B. E., Haskell, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., ... & Jacobs, D. R. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Medicine & Science in Sports & Exercise, 32*(9; Supp. 1), S498-S504.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Ajzen, I (2015). Constructing a theory of planned behaviour questionnaire. Retrieved from: http://people.umass.edu/aizen/pdf/tpb.measurement.pdf

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior.* New Jersey, USA: Prentice-Hall.

Albarracín, D., Gillette, J. C., Earl, A. N., Glasman, L. R., Durantini, M. R., & Ho, M. H. (2005). A test of major assumptions about behavior change: a comprehensive look at the effects of passive and active HIV-prevention interventions since the beginning of the epidemic. *Psychological Bulletin, 131*(6), 856-897.

Alcock, I., White, M. P., Wheeler, B. W., Fleming, L. E., & Depledge, M. H. (2014). Longitudinal effects on mental health of moving to greener and less green urban areas. *Environmental Science & Technology, 48*(2), 1247-1255.

Almanza, E., Jerrett, M., Dunton, G., Seto, E., & Pentz, M. A. (2012). A study of community design, greenness, and physical activity in children using satellite, GPS and accelerometer data. *Health & Place, 18*(1), 46-54.

American College of Sports Medicine (2013). *ACSM's guidelines for exercise testing and prescription.* China: Lippincott, Williams & Wilkins.

Asakawa, K. (2004). Flow experience and autotelic personality in Japanese college students: How do they experience challenges in daily life? *Journal of Happiness Studies, 5*(2), 123-154.

Ashbullby, K. J., Pahl, S., Webley, P., & White, M. P. (2013). The beach as a setting for families' health promotion: A qualitative study with parents and children living in coastal regions in Southwest England. *Health & Place, 23,* 138-147.

Badland, H. M., Christian, H., Giles-Corti, B., & Knuiman, M. (2011). Seasonality in physical activity: should this be a concern in all settings? *Health & Place, 17*(5), 1084-1089.

Ball, K. (2015). Traversing myths and mountains: addressing socioeconomic inequities in the promotion of nutrition and physical activity behaviours. *International Journal of Behavioral Nutrition and Physical Activity, 12*(142), 1-7.

Ball, K., Carver, A., Downing, K., Jackson, M., & O'Rourke, K. (2015). Addressing the social determinants of inequities in physical activity and sedentary behaviours. *Health Promotion International, 30*(Supp. 2), 8-19.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84,* 191–215.

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

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* New Jersey, USA: Prentice-Hall.

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

Barton, J., & Pretty, J. (2010). What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environmental Science & Technology, 44*(10), 3947-3955.

Becker, M. H., Haefner, D. P., Kasl, S. V., Kirscht, J. P., Maiman, L. A., & Rosenstock, I. M. (1977). Selected psychosocial models and correlates of individual health-related behaviors. *Medical Care, 15*(5), 27-46.

Bedimo-Rung, A. L., Mowen, A. J., & Cohen, D. A. (2005). The significance of parks to physical activity and public health: a conceptual model. *American Journal of Preventive Medicine, 28*(2), 159-168.

Beenackers, M. A., Kamphuis, C. B., Giskes, K., Brug, J., Kunst, A. E., Burdorf, A., ... & Bentley, R. (2012). Socioeconomic inequalities in occupational, leisure-time, and transport related physical activity among European adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9*(116), 1-23.

Behnken, D. W., & Draper, N. R. (1972). Residuals and their variance patterns. *Technometrics, 14*(1), 101-111.

Bélanger, M., Townsend, N., & Foster, C. (2011). Age-related differences in physical activity profiles of English adults. *Preventive Medicine, 52*(3), 247-249.

Bell, S. L., Phoenix, C., Lovell, R., & Wheeler, B. W. (2015a). Seeking everyday wellbeing: the coast as a therapeutic landscape. *Social Science & Medicine, 142,* 56-67.

Bell, S. L., Phoenix, C., Lovell, R., & Wheeler, B. W. (2015b). Using GPS and geo-narratives: a methodological approach for understanding and situating everyday green space encounters. *Area, 47*(1), 88-96.

Ben-Akiva, M., Bradley, M., Morikawa, T., Benjamin, J., Novak, T., Oppewal, H., & Rao, V. (1994). Combining revealed and stated preferences data. *Marketing Letters, 5*(4), 335-349.

Berry, M. S., Repke, M. A., Nickerson, N. P., Conway III, L. G., Odum, A. L., & Jordan, K. E. (2015). Making time for nature: visual exposure to natural environments lengthens subjective time perception and reduces impulsivity. *PloS one, 10*(11), 1-16.

Berry, T. R., & Latimer-Cheung, A. E. (2013). Overcoming challenges to build strong physical activity promotion messages. *American Journal of Lifestyle Medicine, 7*(6), 371-378.

Berryman, J. W. (2012). Motion and rest: Galen on exercise and health. *The Lancet, 380*(9838), 210-211.

Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal of Environmental Psychology, 25*(3), 249-259.

Berto, R., Massaccesi, S., & Pasini, M. (2008). Do eye movements measured across high and low fascination photographs differ? Addressing Kaplan's fascination hypothesis. *Journal of Environmental Psychology, 28*(2), 185-191.

Bishop, A. J., Marteau, T. M., Hall, S., Kitchener, H., & Hajek, P. (2005). Increasing women's intentions to stop smoking following an abnormal cervical smear test result. *Preventive Medicine, 41*(1), 179-185.

Bize, R., Johnson, J. A., & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in the general adult population: a systematic review. *Preventive Medicine, 45*(6), 401-415.

Blair, S. N., Haskell, W. L., Ho, P., Paffenbarger, R. S., Vranizan, K. M., Farquhar, J. W., & Wood, P. D. (1985). Assessment of habitual physical activity by a sevenday recall in a community survey and controlled experiments. *American Journal of Epidemiology, 122*(5), 794-804.

Borg, G. A. (1982). Psychophysical bases of perceived exertion. *Medicine & Science in Sports & Exercise, 14*(5), 377-381.

Borst, H. C., Miedema, H. M., de Vries, S. I., Graham, J. M., & van Dongen, J. E. (2008). Relationships between street characteristics and perceived attractiveness for walking reported by elderly people. *Journal of Environmental Psychology, 28*(4), 353-361.

Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health, 10*(456), 1-10.

Brawley, L. R., & Latimer, A. E. (2007). Physical activity guides for Canadians: messaging strategies, realistic expectations for change, and evaluation. *Applied Physiology, Nutrition, and Metabolism, 32*(Supp. 2E), S170-S184.

Brito, P. Q., & Pratas, J. (2015). Tourism brochures: Linking message strategies, tactics and brand destination attributes. *Tourism Management, 48,* 123-138.

Brockman, R., & Fox, K. R. (2011). Physical activity by stealth? The potential health benefits of a workplace transport plan. *Public Health, 125*(4), 210-216.

Brown, B. B., Werner, C. M., Amburgey, J. W., & Szalay, C. (2007). Walkable route perceptions and physical features converging evidence for en route walking experiences. *Environment and Behavior, 39*(1), 34-61.

Bull, F. C., Holt, C. L., Kreuter, M. W., Clark, E. M., & Scharff, D. (2001). Understanding the effects of printed health education materials: which features lead to which outcomes? *Journal of Health Communication, 6*(3), 265-280.

Buswell, G. T. (1935). *How people look at photographs: A study of the psychology of perception in art.* Chicago, USA: University of Chicago Press.

Cain, K. L., Millstein, R. A., Sallis, J. F., Conway, T. L., Gavand, K. A., Frank, L. D., ... & Glanz, K. (2014). Contribution of streetscape audits to explanation of physical activity in four age groups based on the Microscale Audit of Pedestrian Streetscapes (MAPS). *Social Science & Medicine, 116,* 82-92.

Calitri, R., Lowe, R., Eves, F. F., & Bennett, P. (2009). Associations between visual attention, implicit and explicit attitude and behaviour for physical activity. *Psychology & Health, 24*(9), 1105-1123.

Calogiuri, G., & Chroni, S. (2014). The impact of the natural environment on the promotion of active living: an integrative systematic review. *BMC Public Health, 14*(873), 1-27.

Carpenter, M. (2013). From ‘healthful exercise’ to ‘nature on prescription’: the politics of urban green spaces and walking for health. *Landscape and Urban Planning, 118,* 120-127.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126-131.

Chaix, B., Meline, J., Duncan, S., Merrien, C., Karusisi, N., Perchoux, C., ... & Kestens, Y. (2013). GPS tracking in neighborhood and health studies: a step forward for environmental exposure assessment, a step backward for causal inference? *Health & Place, 21,* 46-51.

Church, A., Burgess, J., & Ravenscroft, N. (2011). Cultural services. In UK National Ecosystem Assessment (Ed.) *The UK national ecosystem assessment technical report.* Cambridge, UK: The United Nations Environment Programme's World Conservation Monitoring Centre. Retrieved from: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=QLgsfedO70I%3d&tabid=82

Church, A., Fish, R., Haines-Young, R., Mourato, S., Tratalos, J., Stapleton, L., … & Kenter, J. (2014). UK national ecosystem assessment follow-on. Work package report 5: cultural ecosystem services and indicators. Cambridge, UK: The United Nations Environment Programme's World Conservation Monitoring Centre. Retrieved from: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=l0%2fZhq%2bgwtc%3d&tabid=82

Cohen, D. A., Golinelli, D., Williamson, S., Sehgal, A., Marsh, T., & McKenzie, T. L. (2009). Effects of park improvements on park use and physical activity: policy and programming implications. *American Journal of Preventive Medicine, 37*(6), 475-480.

Cohen, D. A., Han, B., Derose, K. P., Williamson, S., Marsh, T., & McKenzie, T. L. (2013). Physical activity in parks: a randomized controlled trial using community engagement. *American Journal of Preventive Medicine, 45*(5), 590-597.

Cohen, D. A., McKenzie, T. L., Sehgal, A., Williamson, S., Golinelli, D., & Lurie, N. (2007). Contribution of public parks to physical activity. *American Journal of Public Health, 97*(3), 509-514.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychosocial Measurement, 20,* 37-46.

Cohen-Cline, H., Turkheimer, E., & Duncan, G. E. (2015). Access to green space, physical activity and mental health: a twin study. *Journal of Epidemiology and Community Health, 69*(6), 523-529.

Coley, R. L., Sullivan, W. C., & Kuo, F. E. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior, 29*(4), 468-494.

Cook, T. M., Russell, J. M., & Barker, M. E. (2014). Dietary advice for muscularity, leanness and weight control in Men's Health magazine: a content analysis. *BMC Public Health, 14*(1062), 1-12.

Coombes, E., Jones, A. P., & Hillsdon, M. (2010). The relationship of physical activity and overweight to objectively measured green space accessibility and use. *Social Science & Medicine, 70*(6), 816-822.

Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., ... & Mead, G. E. (2013). Exercise for depression. *Cochrane Database of Systematic Reviews, 9*. Art. No.: CD004366.

Cowan, L. T., Van Wagenen, S. A., Brown, B. A., Hedin, R. J., Seino-Stephan, Y., Hall, P. C., & West, J. H. (2012). Apps of steel: are exercise apps providing consumers with realistic expectations? A content analysis of exercise apps for presence of behavior change theory. *Health Education & Behavior, 40*(2), 133-139.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York, USA: Harper & Row.

Cutt, H., Giles-Corti, B., Knuiman, M., & Burke, V. (2007). Dog ownership, health and physical activity: A critical review of the literature. *Health & Place, 13*(1), 261-272.

Dallimer, M., Davies, Z. G., Irvine, K. N., Maltby, L., Warren, P. H., Gaston, K. J., & Armsworth, P. R. (2014). What personal and environmental factors determine frequency of urban greenspace use? *International Journal of Environmental Research and Public Health, 11*(8), 7977-7992.

Darker, C. D., French, D. P., Eves, F. F., & Sniehotta, F. F. (2010). An intervention to promote walking amongst the general population based on an 'extended'theory of planned behaviour: a waiting list randomised controlled trial. *Psychology & Health, 25*(1), 71-88.

Davies, B., & Mutton, B. (1975). The effect of errors in the independent variables in linear regression. *Biometrika, 62*(2), 383-391.

Davies, N. J., Lumsdon, L. M., & Weston, R. (2012). Developing recreational trails: motivations for recreational walking. *Tourism Planning & Development, 9*(1), 77-88.

De Groot, R. S., Wilson, M. A., & Boumans, R. M. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics, 41*(3), 393-408.

Deluca, T. H., Patterson Iv, W. A., Freimund, W. A., & Cole, D. N. (1998). Influence of llamas, horses, and hikers on soil erosion from established recreation trails in western Montana, USA. *Environmental Management, 22*(2), 255-262.

Department of Health and Human Services (2008). 2008 Physical activity guidelines for Americans. Washington DC, USA: US Department of Health and Human Services.

Dolan, P., & Galizzi, M. M. (2015). Like ripples on a pond: behavioral spillovers and their implications for research and policy. *Journal of Economic Psychology, 47,* 1-16.

Dolan, P., & White, M. P. (2007). How can measures of subjective well-being be used to inform public policy? *Perspectives on Psychological Science, 2*(1), 71-85.

Downward, P., & Dawson, P. (2015). Is it pleasure or health from leisure that we benefit from most? An analysis of well-being alternatives and implications for policy. *Social Indicators Research, 126*(1), 443-465.

Dunton, G. F., Liao, Y., Almanza, E., Jerrett, M., Spruijt-Metz, D., & Pentz, M. A. (2013). Locations of joint physical activity in parent–child pairs based on accelerometer and GPS monitoring. *Annals of Behavioral Medicine, 45*(1), 162-172.

Eaton, S. B., & Eaton, S. B. (2003). An evolutionary perspective on human physical activity: implications for health. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 136*(1), 153-159.

Ekkekakis, P. (2013). *The measurement of affect, mood, and emotion: a guide for health-behavioral research*. Cambridge, UK: Cambridge University Press.

Ekkekakis, P. (2015). Honey, I shrunk the pooled SMD! Guide to critical appraisal of systematic reviews and meta-analyses using the Cochrane review on exercise for depression as example. *Mental Health and Physical Activity, 8*(1), 21-36.

Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005). Variation and homogeneity in affective responses to physical activity of varying intensities: an alternative perspective on dose–response based on evolutionary considerations. *Journal of Sports Sciences, 23*(5), 477-500.

Ekkekakis, P., Hall, E. E., VanLanduyt, L. M., & Petruzzello, S. J. (2000). Walking in (affective) circles: can short walks enhance affect? *Journal of Behavioral Medicine, 23*(3), 245-275.

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities. *Sports Medicine, 41*(8), 641-671.

Ekkekakis, P., & Petruzzello, S. J. (2000). Analysis of the affect measurement conundrum in exercise psychology: I. Fundamental issues. *Psychology of Sport and Exercise, 1*(2), 71-88.

Ekkekakis, P., & Petruzzello, S. J. (2001a). Analysis of the affect measurement conundrum in exercise psychology: II. A conceptual and methodological critique of the Exercise-induced Feeling Inventory. *Psychology of Sport and Exercise, 2*(1), 1-26.

Ekkekakis, P., & Petruzzello, S. J. (2001b). Analysis of the affect measurement conundrum in exercise psychology. III. A conceptual and methodological critique of the Subjective Exercise Experiences Scale. *Psychology of Sport and Exercise, 2*(4), 205-232.

Ekkekakis, P., & Petruzzello, S. J. (2002). Analysis of the affect measurement conundrum in exercise psychology: IV. A conceptual case for the affect circumplex. *Psychology of Sport and Exercise, 3*(1), 35-63.

Elliott, L. R., White, M. P., Taylor, A. H., & Abraham, C. (under revision). How do brochures promote walking in natural environments? *Health Promotion International.*

Elliott, L. R., White, M. P., Taylor, A. H., & Herbert, S. (2015). Energy expenditure on recreational visits to different natural environments. *Social Science & Medicine, 139,* 53-60.

Evenson, K. R., Wen, F., Hillier, A., & Cohen, D. A. (2013). Assessing the contribution of parks to physical activity using GPS and accelerometry. *Medicine & Science in Sports & Exercise, 45*(10), 1981.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191.

Faulkner, G., Finlay, S., & Roy, S. C. (2007). Get the news on physical activity research: a content analysis of physical activity research in the Canadian print media. *Journal of Physical Activity & Health, 4*(2), 180-192.

Faulkner, J., Parfitt, G., & Eston, R. (2007). Prediction of maximal oxygen uptake from the ratings of perceived exertion and heart rate during a perceptually-regulated sub-maximal exercise test in active and sedentary participants. *European Journal of Applied Physiology, 101*(3), 397-407.

Fiddler, H. (2001). Eastbourne's 'Pathway to Health' walk project: the impact of the signs on walking behaviour. Phase two study: a questionnaire survey. Retrieved from http://eprints.brighton.ac.uk/1714/1/Pathway_to_Health_Document_(complete).doc

Fishbein. M., & Ajzen. I. (1975). *Belief, attitude, intention & behaviour.* Reading, UK: Addison-Wesley.

Fisher, J. D., & Fisher, W. A. (1992). Changing AIDS-risk behavior. *Psychological Bulletin, 111*(3), 455-474.

Focht, B. C. (2009). Brief walks in outdoor and laboratory environments: effects on affective responses, enjoyment, and intentions to walk for exercise. *Research Quarterly for Exercise and Sport, 80*(3), 611-620.

Fong, G. T., Hammond, D., & Hitchman, S. C. (2009). The impact of pictures on the effectiveness of tobacco warnings. *Bulletin of the World Health Organization, 87*(8), 640-643.

France, C. R., Montalva, R., France, J. L., & Trost, Z. (2008). Enhancing attitudes and intentions in prospective blood donors: evaluation of a new donor recruitment brochure. *Transfusion, 48*(3), 526-530.

Franconeri, S. L., & Simons, D. J. (2003). Moving and looming stimuli capture attention. *Perception & Psychophysics, 65*(7), 999-1010.

Freedland, K. E., Mohr, D. C., Davidson, K. W., & Schwartz, J. E. (2011). Usual and unusual care: existing practice control groups in randomized controlled trials of behavioral interventions. *Psychosomatic Medicine, 73*(4), 323-335.

Frijda, N.H. (2009). Mood. In D. Sander & KR Scherer (Eds.), *The Oxford companion to emotion and the affective sciences*. New York: Oxford University Press.

Gainforth, H. L., Barg, C. J., Latimer, A. E., Schmid, K. L., O'Malley, D., & Salovey, P. (2011). An investigation of the theoretical content of physical activity brochures. *Psychology of Sport and Exercise, 12*(6), 615-620.

Galloway, S. D., & Maughan, R. J. (1997). Effects of ambient temperature on the capacity to perform prolonged cycle exercise in man. *Medicine & Science in Sports & Exercise, 29*(9), 1240-1249.

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forns, J., Plasència, A., & Nieuwenhuijsen, M. J. (2015). Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. *International Journal of Environmental Research and Public Health, 12*(4), 4354-4379.

Gibson, E. J. (2000). Where is the information for affordances? *Ecological Psychology, 12*(1), 53-56.

Gibson, J. J. (1950). *The perception of the visual world.* Massachussetts, USA: Houghton Mifflin.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Massachusetts, USA: Houghton Mifflin.

Gidlow, C. J., Jones, M. V., Hurst, G., Masterson, D., Clark-Carter, D., Tarvainen, M. P., ... & Nieuwenhuijsen, M. (2016). Where to put your best foot forward: Psycho-physiological responses to walking in natural and urban environments. *Journal of Environmental Psychology, 45,* 22-29.

Giles-Corti, B., Broomhall, M. H., Knuiman, M., Collins, C., Douglas, K., Ng, K., ... & Donovan, R. J. (2005). Increasing walking: how important is distance to, attractiveness, and size of public open space? *American Journal of Preventive Medicine, 28*(2), 169-176.

Giles-Corti, B., Bull, F., Knuiman, M., McCormack, G., Van Niel, K., Timperio, A., ... & Boruff, B. (2013). The influence of urban design on neighbourhood walking following residential relocation: longitudinal results from the RESIDE study. *Social Science & Medicine, 77,* 20-30.

Giles-Corti, B., & Donovan, R. J. (2002). The relative influence of individual, social and physical environment determinants of physical activity. *Social Science & Medicine, 54*(12), 1793-1812.

Gladwell, V. F., Brown, D. K., Wood, C., Sandercock, G. R., & Barton, J. L. (2013). The great outdoors: how a green exercise environment can benefit all. *Extreme Physiology & Medicine, 2*(3), 1-7.

Goodale, M. A., Milner, A. D., Jakobson, L. S., & Carey, D. P. (1991). A neurological dissociation between perceiving objects and grasping them. *Nature, 349*(6305), 154-156.

Government Office for Science (2007). Tackling obesities: future choices – obesity systems atlas. Retrieved from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295153/07-1177-obesity-system-atlas.pdf

Grinde, B., & Patil, G. G. (2009). Biophilia: does visual contact with nature impact on health and well-being? *International Journal of Environmental Research and Public Health, 6*(9), 2332-2343.

Gwet, K. (2002). Kappa statistic is not satisfactory for assessing the extent of agreement between raters. *Statistical Methods for Inter-rater Reliability Assessment, 1*(6), 1-6.

Haasova, M., Warren, F. C., Ussher, M., Janse Van Rensburg, K., Faulkner, G., Cropley, M., ... & Taylor, A. H. (2013). The acute effects of physical activity on cigarette cravings: systematic review and meta-analysis with individual participant data. *Addiction, 108*(1), 26-37.

Hagger, M. S., Chatzisarantis, N. L., & Biddle, S. J. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport & Exercise Psychology, 24*(1), 3-32.

Hamer, M., & Chida, Y. (2009). Physical activity and risk of neurodegenerative disease: a systematic review of prospective evidence. *Psychological Medicine, 39*(1), 3-11.

Hamer, M., Taylor, A., & Steptoe, A. (2006). The effect of acute aerobic exercise on stress related blood pressure responses: a systematic review and meta-analysis. *Biological Psychology, 71*(2), 183-190.

Hardy, C. J., & Rejeski, W. J. (1989). Not what, but how one feels: The measurement of affect during exercise. *Journal of Sport & Exercise Psychology, 11*(3), 304-317.

Harriss, D. J., Atkinson, G., Batterham, A., George, K., Tim Cable, N., Reilly, T., ... & Renehan, A. G. (2009). Lifestyle factors and colorectal cancer risk (2): a systematic review and meta-analysis of associations with leisure-time physical activity. *Colorectal Disease, 11*(7), 689-701.

Hartig, T., Evans, G. W., Jamner, L. D., Davis, D. S., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*(2), 109-123.

Hartig, T., Korpela, K., Evans, G. W., & Gärling, T. (1997). A measure of restorative quality in environments. *Scandinavian Housing and Planning Research, 14*(4), 175-194.

Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health, 35,* 207-228.

Hayes, D., & MacLeod, N. (2007). Packaging places: Designing heritage trails using an experience economy perspective to maximize visitor engagement. *Journal of Vacation Marketing, 13*(1), 45-58.

Hayhoe, M., & Ballard, D. (2005). Eye movements in natural behavior. *Trends in Cognitive Sciences, 9*(4), 188-194.

Heft, H. (1999). Affordances of children's environments: a functional approach to environmental description. In J. J. Nassar and W. F. E. Preiser (Eds.) *Directions in Person-Environment Research and Practice.* Aldershot, UK: Ashgate.

Heft, H. (2003). Affordances, dynamic experience, and the challenge of reification. *Ecological Psychology, 15*(2), 149-180.

Heft, H. (2010). Affordance and the perception of landscape: An environmental perception and aesthetics. In C. Ward Thompson, P. Aspinall, & S. Bell (Eds.), *Innovative approaches to researching landscape and health: Open space: People Space 2* (pp. 9-32). Abingdon, UK: Routledge.

Hillsdon, M., Panter, J., Foster, C., & Jones, A. (2006). The relationship between access and quality of urban green space with population physical activity. *Public Health, 120*(12), 1127-1132.

Holley, J., Crone, D., Tyson, P., & Lovell, G. (2011). The effects of physical activity on psychological well-being for those with schizophrenia: a systematic review. *British Journal of Clinical Psychology, 50*(1), 84-105.

Houthakker, H. S. (1950). Revealed preference and the utility function. *Economica, 17*(66), 159-174.

Hug, S. M., Hartig, T., Hansmann, R., Seeland, K., & Hornung, R. (2009). Restorative qualities of indoor and outdoor exercise settings as predictors of exercise frequency. *Health & Place, 15*(4), 971-980.

Humpel, N., Owen, N., & Leslie, E. (2002). Environmental factors associated with adults' participation in physical activity: a review. *American Journal of Preventive Medicine, 22*(3), 188-199.

Hunter, R. F., Christian, H., Veitch, J., Astell-Burt, T., Hipp, J. A., & Schipperijn, J. (2015). The impact of interventions to promote physical activity in urban green space: a systematic review and recommendations for future research. *Social Science & Medicine, 124,* 246-256.

International Sport and Culture Association (2015). The economic cost of physical activity in Europe. London, UK: Centre for Economics and Business Research.

Irvine, K. N., Warber, S. L., Devine-Wright, P., & Gaston, K. J. (2013). Understanding urban green space as a health resource: A qualitative comparison of visit motivation and derived effects among park users in Sheffield, UK. *International Journal of Environmental Research and Public Health, 10*(1), 417-442.

Izawa, K. P., Watanabe, S., Omiya, K., Hirano, Y., Oka, K., Osada, N., & Iijima, S. (2005). Effect of the self-monitoring approach on exercise maintenance during cardiac rehabilitation: a randomized, controlled trial. *American Journal of Physical Medicine & Rehabilitation, 84*(5), 313-321.

Jackson, S. A., & Eklund, R. C. (2002). Assessing flow in physical activity: The Flow State Scale-2 and Dispositional Flow Scale-2. *Journal of Sport & Exercise Psychology, 24*(2), 133-150.

Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport & Exercise Psychology, 18,* 17-35.

James, P., Banay, R. F., Hart, J. E., & Laden, F. (2015). A review of the health benefits of greenness. *Current Epidemiology Reports, 2*(2), 131-142.

James, W. (1892). *Psychology: The briefer course.* New York: Holt.

Jeon, C. Y., Lokken, R. P., Hu, F. B., & Van Dam, R. M. (2007). Physical activity of moderate intensity and risk of type 2 diabetes: a systematic review. *Diabetes Care, 30*(3), 744-752.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15*(3), 169-182.

Karacan, H. U., Cagiltay, K., & Tekman, H. G. (2010). Change detection in desktop virtual environments: An eye-tracking study. *Computers in Human Behavior, 26*(6), 1305-1313.

Katzmarzyk, P. T., Church, T. S., Craig, C. L., & Bouchard, C. (2009). Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Medicine & Science in Sports & Exercise, 41*(5), 998-1005.

Kawabata, M., & Mallett, C. J. (2011). Flow experience in physical activity: Examination of the internal structure of flow from a process-related perspective. *Motivation and Emotion, 35*(4), 393-402.

Keep Britain Tidy (2013). How clean is England? The local environmental quality survey of England 2012/2013. Retrieved from http://www.keepbritaintidy.org/Documents/Files/Surveys/KBT_LEQSE_report_2013_webFINAL.pdf

Kellert, S. R., & Wilson, E. O. (1993). *The biophilia hypothesis.* Washington DC, USA: Island Press.

Kelly, C. E., Tight, M. R., Hodgson, F. C., & Page, M. W. (2011). A comparison of three methods for assessing the walkability of the pedestrian environment. *Journal of Transport Geography, 19*(6), 1500-1508.

King, A. C., Stokols, D., Talen, E., Brassington, G. S., & Killingsworth, R. (2002). Theoretical approaches to the promotion of physical activity: forging a transdisciplinary paradigm. *American Journal of Preventive Medicine, 23*(2), 15-25.

Kline, A. S. (2002) Virgil: the Aeneid. Retrieved from http://www.poetryintranslation.com/PITBR/Latin/Virgilhome.htm

Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., ... & Lancet Physical Activity Series Working Group. (2012). The pandemic of physical inactivity: global action for public health. *The Lancet, 380*(9838), 294-305.

Kools, M., Ruiter, R. A., van de Wiel, M. W., & Kok, G. (2007). Testing the usability of access structures in a health education brochure. *British Journal of Health Psychology, 12*(4), 525-541.

Kools, M., Ruiter, R. A., van de Wiel, M. W., & Kok, G. (2008). The effects of headings in information mapping on search speed and evaluation of a brief health education text. *Journal of Information Science, 34*(6), 833-844.

Kools, M., van de Wiel, M. W., Ruiter, R. A., & Kok, G. (2006). Pictures and text in instructions for medical devices: effects on recall and actual performance. *Patient Education and Counseling, 64*(1), 104-111.

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychology Review.* DOI: 10.1080/17437199.2016.1151372.

Kweon, B. S., Sullivan, W. C., & Wiley, A. R. (1998). Green common spaces and the social integration of inner-city older adults. *Environment and Behavior, 30*(6), 832-858.

Lachowycz, K., & Jones, A. P. (2014). Does walking explain associations between access to greenspace and lower mortality? *Social Science & Medicine, 107,* 9-17.

Land, M., Mennie, N., & Rusted, J. (1999). The roles of vision and eye movements in the control of activities of daily living. *Perception, 28*(11), 1311-1328.

Lappe, M., Bremmer, F., & Van den Berg, A. V. (1999). Perception of self-motion from visual flow. *Trends in cognitive sciences, 3*(9), 329-336.

Lee, A. C. K., Jordan, H. C., & Horsley, J. (2015). Value of urban green spaces in promoting healthy living and wellbeing: prospects for planning. *Risk Management and Healthcare Policy, 8,* 131-137.

Lee, A. C. K., & Maheswaran, R. (2010). The health benefits of urban green spaces: a review of the evidence. *Journal of Public Health, 33*(2), 212-222.

Lee, D. N., & Kalmus, H. (1980). The optic flow field: The foundation of vision [and discussion]. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 290*(1038), 169-179.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet, 380*(9838), 219-229.

Lejeune, T. M., Willems, P. A., & Heglund, N. C. (1998). Mechanics and energetics of human locomotion on sand. *Journal of Experimental Biology, 201*(13), 2071-2080.

Li, J., & Siegrist, J. (2012). Physical activity and risk of cardiovascular disease—a meta-analysis of prospective cohort studies. *International Journal of Environmental Research and Public Health, 9*(2), 391-407.

Lovell, R., Husk, K., Cooper, C., Stahl-Timmins, W., & Garside, R. (2014). Environmental conservation activities for health: building on systematic review methods to consider a disparate, dispersed, and limited evidence base. *The Lancet, 384*(Supp. 2) S46.

Lynn, N. A., & Brown, R. D. (2003). Effects of recreational use impacts on hiking experiences in natural areas. *Landscape and Urban Planning, 64*(1), 77-87.

Maas, J., Verheij, R. A., Groenewegen, P. P., De Vries, S., & Spreeuwenberg, P. (2006). Green space, urbanity, and health: how strong is the relation? *Journal of Epidemiology and Community Health, 60*(7), 587-592.

Maas, J., Verheij, R. A., Spreeuwenberg, P., & Groenewegen, P. P. (2008). Physical activity as a possible mechanism behind the relationship between green space and health: a multilevel analysis. *BMC Public Health, 8*(1), 1-13.

Macintyre, S. (2007). Deprivation amplification revisited; or, is it always true that poorer places have poorer access to resources for healthy diets and physical activity? *International Journal of Behavioral Nutrition and Physical Activity, 4*(1), 1-7.

Macintyre, S., Macdonald, L., & Ellaway, A. (2008). Do poorer people have poorer access to local resources and facilities? The distribution of local resources by area deprivation in Glasgow, Scotland. *Social Science & Medicine, 67*(6), 900-914.

Mackworth, N. H., & Morandi, A. J. (1967). The gaze selects informative details within pictures. *Perception & Psychophysics, 2*(11), 547-552.

Malhotra, N. (2008). Completion time and response order effects in web surveys. *Public Opinion Quarterly, 72*(5), 914-934.

Mammen, G., & Faulkner, G. (2013). Physical activity and the prevention of depression: a systematic review of prospective studies. *American Journal of Preventive Medicine, 45*(5), 649-657.

Mantler, A., & Logan, A. C. (2015). Natural environments and mental health. *Advances in Integrative Medicine, 2*(1), 5-12.

Marine and Coastal Access Act (2009). Part 9 Coastal Access: The coastal access duty. Retrieved from: http://www.legislation.gov.uk/ukpga/2009/23/part/9

Marine Conservation Society (2014). Great British beach clean 2014 report. Retrieved from http://www.mcsuk.org/downloads/pollution/beachwatch/latest2015/MCS_GBBC_2014_Report.pdf

Marsh, H. W., & Jackson, S. A. (1999). Flow experience in sport: construct validation of multidimensional, hierarchical state and trait responses. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(4), 343-371.

Martens, D., Gutscher, H., & Bauer, N. (2011). Walking in “wild” and “tended” urban forests: The impact on psychological well-being. *Journal of Environmental Psychology, 31*(1), 36-44.

Mason, H., Jones-Lee, M., & Donaldson, C. (2009). Modelling the monetary value of a QALY: a new approach based on UK data. *Health Economics, 18*(8), 933-950.

McAuley, E., Mihalko, S. L., & Bane, S. M. (1997). Exercise and self-esteem in middle-aged adults: multidimensional relationships and physical fitness and self-efficacy influences. *Journal of Behavioral Medicine, 20*(1), 67-83.

McCormack, G. R., Rock, M., Toohey, A. M., & Hignell, D. (2010). Characteristics of urban parks associated with park use and physical activity: a review of qualitative research. *Health & Place, 16*(4), 712-726.

McCormack, G. R., & Shiell, A. (2011). In search of causality: a systematic review of the relationship between the built environment and physical activity among adults. *International Journal of Behavioral Nutrition and Physical Activity, 8*(125), 1-11.

McKercher, B. (2008). The implicit effect of distance on tourist behavior: A comparison of short and long haul pleasure tourists to Hong Kong. *Journal of Travel & Tourism Marketing, 25*(3-4), 367-381.

McKinlay, J. B. (1975). Who is really ignorant--physician or patient? *Journal of Health and Social Behavior, 16*(1), 3-11.

McMahan, E. A., & Estes, D. (2015). The effect of contact with natural environments on positive and negative affect: a meta-analysis. *The Journal of Positive Psychology, 10*(6), 507-519.

McSweeney, J., Rainham, D., Johnson, S. A., Sherry, S. B., & Singleton, J. (2014). Indoor nature exposure (INE): a health-promotion framework. *Health Promotion International, 30*(1), 126-139.

Merom, D., Bauman, A., Vita, P., & Close, G. (2003). An environmental intervention to promote walking and cycling—the impact of a newly constructed Rail Trail in Western Sydney. *Preventive Medicine, 36*(2), 235-242.

Merritt, A. C., Effron, D. A., & Monin, B. (2010). Moral self-licensing: When being good frees us to be bad. *Social and Personality Psychology Compass, 4*(5), 344-357.

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: a meta-regression. *Health Psychology, 28*(6), 690.

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. *Psychology & Health, 26*(11), 1479-1498.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., ... & Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine, 46*(1), 81-95.

Milcu, A. I., Hanspach, J., Abson, D., & Fischer, J. (2013). Cultural ecosystem services: a literature review and prospects for future research. *Ecology and Society, 18*(3), 44.

Millennium Ecosystem Assessment (2003). Ecosystems and human well-being: a framework or assessment. Retrieved from: http://millenniumassessment.org/en/Framework.html

Millenium Ecosystem Asessment (2005). Current states and trends: Volume 1. Retrieved from: http://millenniumassessment.org/en/Condition.html

Mitchell, R. (2013). Is physical activity in natural environments better for mental health than physical activity in other environments? *Social Science & Medicine, 91,* 130-134.

Mitchell, R., & Popham, F. (2007). Greenspace, urbanity and health: relationships in England. *Journal of Epidemiology and Community Health, 61*(8), 681-683.

Moayyeri, A. (2008). The association between physical activity and osteoporotic fractures: a review of the evidence and implications for future research. *Annals of Epidemiology, 18*(11), 827-835.

Molina, A., & Esteban, A. (2006). Tourism brochures: Usefulness and image. *Annals of Tourism Research, 33*(4), 1036-1056.

Monninkhof, E. M., Elias, S. G., Vlems, F. A., van der Tweel, I., Schuit, A. J., Voskuil, D. W., & van Leeuwen, F. E. (2007). Physical activity and breast cancer: a systematic review. *Epidemiology, 18*(1), 137-157.

Montoya, A. K., & Hayes, A. F. (under review). Two condition within-participant statistical mediation analysis: a path-analytic framework. *Manuscript submitted for publication.*

Montoye, H. J., Kemper, H. C. G., Saris, W. H. M., & Washnburn, R. A. (1996). *Measuring physical activity and energy expenditure.* Illinois, USA: Human Kinetics.

Morris, J. N., & Hardman, A. E. (1997). Walking to health. *Sports Medicine, 23*(5), 306-332.

Mourato, S., Atkinson, G., Collins, M., Gibbons, S., MacKerron, G., & Resende, G. (2010). Economic analysis of cultural services. Retrieved from: https://www.cbd.int/financial/values/unitedkingdom-culturalvalues.pdf

Murtagh, E. M., Boreham, C. A., & Murphy, M. H. (2002). Speed and exercise intensity of recreational walkers. *Preventive Medicine, 35*(4), 397-400.

Murtagh, E. M., Nichols, L., Mohammed, M. A., Holder, R., Nevill, A. M., & Murphy, M. H. (2015). The effect of walking on risk factors for cardiovascular disease: an updated systematic review and meta-analysis of randomised control trials. *Preventive Medicine, 72,* 34-43.

National Institute of Health and Care Excellence (2012). Physical activity: walking and cycling. Retrieved from http://www.nice.org.uk/guidance/ph41/resources/physical-activity-walking-and-cycling-1996352901061

Natural England (2015). Monitor of engagement with the natural environment technical report: March 2014 to February 2015. Retrieved from; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/481138/mene-technical-report-2014-15.pdf

Natural Resources Wales (2015). Wales Outdoor Recreation Survey 2014 Technical Report. Retrieved from: https://naturalresources.wales/media/4753/wales-outdoor-recreation-survey-2014-technical-report.pdf

Nocon, M., Hiemann, T., Müller-Riemenschneider, F., Thalau, F., Roll, S., & Willich, S. N. (2008). Association of physical activity with all-cause and cardiovascular mortality: a systematic review and meta-analysis. *European Journal of Cardiovascular Prevention & Rehabilitation, 15*(3), 239-246.

Nordh, H., Hagerhall, C. M., & Holmqvist, K. (2013). Tracking Restorative Components: Patterns in Eye Movements as a Consequence of a Restorative Rating Task. *Landscape Research, 38*(1), 101-116.

Nurse, J., Basher, D., Bone, A., & Bird, W. (2010). An ecological approach to promoting population mental health and well-being—a response to the challenge of climate change. *Perspectives in Public Health, 130*(1), 27-33.

Obbard, R. W., Sadri, S., Wong, Y. Q., Khitun, A. A., Baker, I., & Thompson, R. C. (2014). Global warming releases microplastic legacy frozen in Arctic Sea ice. *Earth's Future, 2*(6), 315-320.

Oettingen, G. (2012). Future thought and behaviour change. *European Review of Social Psychology, 23*(1), 1-63.

Oettingen, G., Pak, H. J., & Schnetter, K. (2001). Self-regulation of goal-setting: Turning free fantasies about the future into binding goals. *Journal of Personality and Social Psychology, 80*(5), 736-753.

Office for National Statistics (2013). Release: the effects of taxes and benefits on household income, 2011/2012. Retrieved from: http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-280824

Ogilvie, D., Foster, C. E., Rothnie, H., Cavill, N., Hamilton, V., Fitzsimons, C. F., & Mutrie, N. (2007). Interventions to promote walking: systematic review. *BMJ, 334*(7605), 1204-1207.

Owen, N., Humpel, N., Leslie, E., Bauman, A., & Sallis, J. F. (2004). Understanding environmental influences on walking: review and research agenda. *American Journal of Preventive Medicine, 27*(1), 67-76.

Panter, J. R., & Jones, A. P. (2008). Associations between physical activity, perceptions of the neighbourhood environment and access to facilities in an English city. *Social Science & Medicine, 67*(11), 1917-1923.

Park, J. J., O'Brien, L., Roe, J., Thompson, C. W., & Mitchell, R. (2011). The natural outdoors and health: assessing the value and potential contribution of secondary public data sets in the UK to current and future knowledge. *Health & Place, 17*(1), 269-279.

Pate, R. R., O'Neill, J. R., & Lobelo, F. (2008). The evolving definition of" sedentary". *Exercise and Sport Sciences Reviews, 36*(4), 173-178.

Pearce, J. R., Richardson, E. A., Mitchell, R. J., & Shortt, N. K. (2010). Environmental justice and health: the implications of the socio-spatial distribution of multiple environmental deprivation for health inequalities in the United Kingdom. *Transactions of the Institute of British Geographers, 35*(4), 522-539.

Pearsall, R., Smith, D. J., Pelosi, A., & Geddes, J. (2014). Exercise therapy in adults with serious mental illness: a systematic review and meta-analysis. *BMC Psychiatry, 14*(1), 1-17.

Peels, D. A., De Vries, H., Bolman, C., Golsteijn, R. H. J., Van Stralen, M. M., Mudde, A. N., & Lechner, L. (2013). Differences in the use and appreciation of a web-based or printed computer-tailored physical activity intervention for people aged over 50 years. *Health Education Research, 28*(4), 715-731.

Peels, D. A., van Stralen, M. M., Bolman, C., Golsteijn, R. H. J., de Vries, H., Mudde, A. N., & Lechner, L. (2014). The differentiated effectiveness of a printed versus a web-based tailored physical activity intervention among adults aged over 50. *Health Education Research, 29*(5), 870-882.

Pheasant, R. J., Fisher, M. N., Watts, G. R., Whitaker, D. J., & Horoshenkov, K. V. (2010). The importance of auditory-visual interaction in the construction of ‘tranquil space’. *Journal of Environmental Psychology, 30*(4), 501-509.

Pleguezuelos, E., Pérez, M. E., Guirao, L., Samitier, B., Ortega, P., Vila, X., ... & Miravitlles, M. (2013). Improving physical activity in patients with COPD with urban walking circuits. *Respiratory Medicine, 107*(12), 1948-1956.

Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research, 15*(5), 319-337.

Proschaska, J. & DiClemente, C., (1984). *The transtheoretical approach: crossing the traditional boundaries of therapy.* Illinois, USA: Dow Jones-Irwin.

Rayner, G., & Lang, T. (2012). *Ecological public health: reshaping the conditions for good health.* Oxford, UK: Routledge.

Renaud, P., & Blondin, J. P. (1997). The stress of Stroop performance: Physiological and emotional responses to color–word interference, task pacing, and pacing speed. *International Journal of Psychophysiology, 27*(2), 87-97.

Reyers, B., Roux, D. J., & O'Farrell, P. J. (2010). Can ecosystem services lead ecology on a transdisciplinary pathway? *Environmental Conservation, 37*(4), 501-511.

Reynolds, R., McKenzie, S., Allender, S., Brown, K., & Foulkes, C. (2014). Systematic review of incidental physical activity community interventions. *Preventive Medicine, 67,* 46-64.

Rhodes, R. E., Brown, S. G., & McIntyre, C. A. (2006). Integrating the perceived neighborhood environment and the theory of planned behavior when predicting walking in a Canadian adult sample. *American Journal of Health Promotion, 21*(2), 110-118.

Rhodes, R. E., & Kates, A. (2015). Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. *Annals of Behavioral Medicine, 49*(5), 715-731.

Rind, E., & Jones, A. P. (2011). The geography of recreational physical activity in England. *Health & Place, 17*(1), 157-165.

Rogatko, T. P. (2009). The influence of flow on positive affect in college students. *Journal of Happiness Studies, 10*(2), 133-148.

Robertson, R., Robertson, A., Jepson, R., & Maxwell, M. (2012). Walking for depression or depressive symptoms: a systematic review and meta-analysis. *Mental Health and Physical Activity, 5*(1), 66-75.

Rosenberg, M., Schooler, C., Schoenbach, C., & Rosenberg, F. (1995). Global self-esteem and specific self-esteem: different concepts, different outcomes. *American Sociological Review, 60*(1) 141-156.

Ross, R., & McGuire, K. A. (2011). Incidental physical activity is positively associated with cardiorespiratory fitness. *Medicine & Science in Sports & Exercise, 43*(11), 2189-2194.

Rothman, A. J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology, 19*(1; Supp.), 64-69.

Rowe, D. A., Kang, M., Sutherland, R., Holbrook, E. A., & Barreira, T. V. (2013). Evaluation of inactive adults' ability to maintain a moderate-intensity walking pace. *Journal of Science and Medicine in Sport, 16*(3), 217-221.

Ruby, M. B., Dunn, E. W., Perrino, A., Gillis, R., & Viel, S. (2011). The invisible benefits of exercise. *Health Psychology, 30*(1), 67-74.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39,* 1161-1178.

Said, I., & Bakar, M. S. A. (2005). Landscape for children to play and learn: a conceptual comparison between natural stream and playground. *Jurnal Teknologi, 42*(B), 1-10.

Sallis, J., Bauman, A., & Pratt, M. (1998). Environmental and policy interventions to promote physical activity. *American Journal of Preventive Medicine, 15*(4), 379-397.

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health, 27,* 297-322.

Samuelson, P. A. (1948). Consumption theory in terms of revealed preference. *Economica, 15*(60), 243-253.

Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: opportunities to enhance health and biodiversity conservation. *Ecosystem Services, 12,* 1-15.

Scarborough, P., Bhatnagar, P., Wickramasinghe, K. K., Allender, S., Foster, C., & Rayner, M. (2011). The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006–07 NHS costs. *Journal of Public Health, 33*(4), 527-535.

Seery, M. D. (2011). Challenge or threat? Cardiovascular indexes of resilience and vulnerability to potential stress in humans. *Neuroscience & Biobehavioral Reviews, 35*(7), 1603-1610.

Sellers, C. E., Grant, P. M., Ryan, C. G., O'Kane, C., Raw, K., & Conn, D. (2012). Take a walk in the park? A cross-over pilot trial comparing brisk walking in two different environments: park and urban. *Preventive Medicine, 55*(5), 438-443.

Seresinhe, C. I., Preis, T., & Moat, H. S. (2015). Quantifying the impact of scenic environments on health. *Scientific Reports, 5*(16899), 1-9.

Siegle, G. J., Ichikawa, N., & Steinhauer, S. (2008). Blink before and after you think: blinks occur prior to and following cognitive load indexed by pupillary responses. *Psychophysiology, 45*(5), 679-687.

Smith, M. A., & Lynch, W. J. (2012). Exercise as a potential treatment for drug abuse: evidence from preclinical studies. *Frontiers in Psychiatry, 2*(82), 1-10.

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review, 8*(1), 1-7.

Solomon, E., Rees, T., Ukoumunne, O. C., Metcalf, B., & Hillsdon, M. (2013). Personal, social, and environmental correlates of physical activity in adults living in rural south-west England: a cross-sectional analysis. *International Journal of Behavioral Nutrition and Physical Activity, 10*(129), 1-15.

Spencer, L., Adams, T. B., Malone, S., Roy, L., & Yost, E. (2006). Applying the transtheoretical model to exercise: a systematic and comprehensive review of the literature. *Health Promotion Practice, 7*(4), 428-443.

Stanton, R., & Reaburn, P. (2014). Exercise and the treatment of depression: a review of the exercise program variables. *Journal of Science and Medicine in Sport, 17*(2), 177-182.

Sugiyama, T., Gunn, L. D., Christian, H., Francis, J., Foster, S., Hooper, P., ... & Giles-Corti, B. (2015). Quality of public open spaces and recreational walking. *American Journal of Public Health, 105*(12), 2490-2495.

Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: a multimethod validation of reversal theory constructs. *Journal of Personality and Social Psychology, 48*(1), 107-116.

Tanaka, H., Monahan, K. D., & Seals, D. R. (2001). Age-predicted maximal heart rate revisited. *Journal of the American College of Cardiology, 37*(1), 153-156.

Tardon, A., Lee, W. J., Delgado-Rodriguez, M., Dosemeci, M., Albanes, D., Hoover, R., & Blair, A. (2005). Leisure-time physical activity and lung cancer: a meta-analysis. *Cancer Causes & Control, 16*(4), 389-397.

Tatler, B. W. (2007). The central fixation bias in scene viewing: Selecting an optimal viewing position independently of motor biases and image feature distributions. *Journal of Vision, 7*(14):4, 1-17.

Taylor, A. H. (1994). Evaluating the efficacy of exercise promotion signs on Eastbourne sea front: observations and perceptions of over 35 year olds. *British Journal of Physical Education,* (Suppl. 14, Summer) 17-22.

Taylor, A. H., & Faulkner, G. (2014). Evidence and theory into practice in different health care contexts: A call for more translational science. *Mental Health and Physical Activity, 1*(7), 1-5.

Tester, J., & Baker, R. (2009). Making the playfields even: evaluating the impact of an environmental intervention on park use and physical activity. *Preventive Medicine, 48*(4), 316-320.

Teychenne, M., Ball, K., & Salmon, J. (2010). Sedentary behavior and depression among adults: a review. *International Journal of Behavioral Medicine, 17*(4), 246-254.

Theeuwes, J. (1991). Exogenous and endogenous control of attention: The effect of visual onsets and offsets. *Perception & Psychophysics, 49*(1), 83-90.

Theeuwes, J. (1994). Stimulus-driven capture and attentional set: selective search for color and visual abrupt onsets. *Journal of Experimental Psychology: Human Perception and Performance, 20*(4), 799-806.

Thompson, R. C., Moore, C. J., Vom Saal, F. S., & Swan, S. H. (2009). Plastics, the environment and human health: current consensus and future trends. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 364*(1526), 2153-2166.

Thompson Coon, J., Boddy, K., Stein, K., Whear, R., Barton, J., & Depledge, M. H. (2011). Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. *Environmental Science & Technology, 45*(5), 1761-1772.

Tonello, L., Reichert, F. F., Oliveira-Silva, I., Del Rosso, S., Leicht, A. S., & Boullosa, D. A. (2015). Correlates of heart rate measures with incidental physical activity and cardiorespiratory fitness in overweight female workers. *Frontiers in Physiology, 6*(405), 1-11.

Townsend, N., Bhatnagar, P., Wickramasinghe, K., Scarborough, P., & Foster, C. (2012). Physical activity statistics 2012. London, UK: British Heart Foundation.

Townsend, N., Wickramasinghe, K., Williams, J., Bhatnagar, P., & Rayner, M. (2015). Physical activity statistics 2015. London, UK: British Heart Foundation.

Troiano, R. P., Berrigan, D., Dodd, K. W., Mâsse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise, 40*(1), 181-188.

Trost, S. G., McIver, K. L., & Pate, R. R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine & Science in Sports & Exercise, 37*(11), S531-S543.

Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: review and update. *Medicine & Science in Sports & Exercise, 34*(12), 1996-2001.

Tucker, P., & Gilliland, J. (2007). The effect of season and weather on physical activity: a systematic review. *Public Health, 121*(12), 909-922.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kaźmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: a literature review. *Landscape and Urban Planning, 81*(3), 167-178.

Ulrich, R. S. (1981). Natural versus urban scenes: Some psychophysiological effects. *Environment and Behavior, 13*(5), 523-556.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*(3), 201-230.

UK National Ecosystem Assessment. (2011). *The UK national ecosystem assessment technical report.* Cambridge, UK: The United Nations Environment Programme's World Conservation Monitoring Centre. Retrieved from: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

United Nations. (2014). World urbanization prospects: the 2014 revision, highlights. New York, USA: Department of Economic and Social Affairs, Population Division.

Valtchanov, D., Barton, K. R., & Ellard, C. (2010). Restorative effects of virtual nature settings. *Cyberpsychology, Behavior, and Social Networking, 13*(5), 503-512.

Valtchanov, D., & Ellard, C. G. (2015). Cognitive and affective responses to natural scenes: effects of low level visual properties on preference, cognitive load and eye-movements. *Journal of Environmental Psychology, 43,* 184-195.

Van Beurden S. B., Greaves, C. J., Smith, J. R., & Abraham, C. (in press). Techniques for modifying impulsive processes associated with unhealthy eating: a systematic review. *Health Psychology.*

Van Rensburg, K. J., Taylor, A., Benattayallah, A., & Hodgson, T. (2012). The effects of exercise on cigarette cravings and brain activation in response to smoking-related images. *Psychopharmacology, 221*(4), 659-666.

Van Rensburg, K. J., Taylor, A., & Hodgson, T. (2009). The effects of acute exercise on attentional bias towards smoking-related stimuli during temporary abstinence from smoking. *Addiction, 104*(11), 1910-1917.

Veitch, J., Ball, K., Crawford, D., Abbott, G. R., & Salmon, J. (2012). Park improvements and park activity: a natural experiment. *American Journal of Preventive Medicine, 42*(6), 616-619.

Vitousek, P. M., & Walker, L. R. (1989). Biological invasion by Myrica faya in Hawai'i: plant demography, nitrogen fixation, ecosystem effects. *Ecological Monographs, 59*(3), 247-265.

Völker, S., & Kistemann, T. (2013). “I'm always entirely happy when I'm here!” Urban blue enhancing human health and well-being in Cologne and Düsseldorf, Germany. *Social Science & Medicine, 78,* 113-124.

Waitzkin, H. (1985). Information giving in medical care. *Journal of Health and Social Behavior, 26*(2) 81-101.

Walters, S. J., & Brazier, J. E. (2005). Comparison of the minimally important difference for two health state utility measures: EQ-5D and SF-6D. *Quality of Life Research, 14*(6), 1523-1532.

Wang, D., Wang, Y., Wang, Y., Li, R., & Zhou, C. (2014). Impact of physical exercise on substance use disorders: a meta-analysis. *PLoS one, 9*(10), 1-15.

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal, 174*(6), 801-809.

Ward Thompson, C. (2011). Linking landscape and health: The recurring theme. *Landscape and Urban Planning, 99*(3), 187-195.

Ward Thompson, C. (2013). Activity, exercise and the planning and design of outdoor spaces. *Journal of Environmental Psychology, 34,* 79-96.

Ward Thompson, C., & Aspinall, P. A. (2011). Natural environments and their impact on activity, health, and quality of life. *Applied Psychology: Health and Well‐Being, 3*(3), 230-260.

Ward Thompson, C., & Travlou, P. (2009). A critical review of research in landscape and woodland perceptions, aesthetics, affordances and experience. Report prepared for the forestry commission. Edinburgh, UK: OPENspace research centre. Retrieved from: http://www.openspace.eca.ac.uk/pdf/FORCOM_LitReview.pdf

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*(2), 249-268.

Weinstein, N., Przybylski, A. K., & Ryan, R. M. (2009). Can nature make us more caring? Effects of immersion in nature on intrinsic aspirations and generosity. *Personality and Social Psychology Bulletin, 35*(10), 1315-1329.

Wendel-Vos, G. C. W., Schuit, A. J., Feskens, E. J. M., Boshuizen, H. C., Verschuren, W. M. M., Saris, W. H. M., & Kromhout, D. (2004). Physical activity and stroke. A meta-analysis of observational data. *International Journal of Epidemiology, 33*(4), 787-798.

Wheeler, B. W., Cooper, A. R., Page, A. S., & Jago, R. (2010). Greenspace and children's physical activity: a GPS/GIS analysis of the PEACH project. *Preventive Medicine, 51*(2), 148-152.

Wheeler, B. W., Lovell, R., Higgins, S. L., White, M. P., Alcock, I., Osborne, N. J., ... & Depledge, M. H. (2015). Beyond greenspace: an ecological study of population general health and indicators of natural environment type and quality. *International Journal of Health Geographics, 14*(17), 1-17.

Wheeler, B. W., White, M., Stahl-Timmins, W., & Depledge, M. H. (2012). Does living by the coast improve health and wellbeing? *Health & Place, 18*(5), 1198-1201.

Whelton, S. P., Chin, A., Xin, X., & He, J. (2002). Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Annals of Internal Medicine, 136*(7), 493-503.

White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013a). Coastal proximity, health and well-being: Results from a longitudinal panel survey. *Health & Place, 23,* 97-103.

White, M. P., Alcock, I., Wheeler, B. W., & Depledge, M. H. (2013b). Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science, 24*(6), 920-928.

White, M. P., Elliott, L. R., Taylor, T., Wheeler, B.W., Spencer. A., King. H., … & Fleming. L. (in preparation). The value of physical activity in natural environments for population health.

White, M. P., Pahl, S., Ashbullby, K. J., Burton, F., & Depledge, M. H. (2015). The effects of exercising in different natural environments on psycho-physiological outcomes in post-menopausal women: a simulation study. *International Journal of Environmental Research and Public Health, 12*(9), 11929-11953.

White, M. P., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology, 35,* 40-51.

White, M., Smith, A., Humphryes, K., Pahl, S., Snelling, D., & Depledge, M. (2010). Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology, 30*(4), 482-493.

White, M. P., Wheeler, B. W., Herbert, S., Alcock, I., & Depledge, M. H. (2014). Coastal proximity and physical activity: Is the coast an under-appreciated public health resource? *Preventive Medicine, 69,* 135-140.

Whitehead, J. C., Haab, T. C., & Huang, J. C. (2000). Measuring recreation benefits of quality improvements with revealed and stated behavior data. *Resource and Energy Economics, 22*(4), 339-354.

Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise, 9*(3), 231-245.

Williams, D. M., Dunsiger, S., Jennings, E. G., & Marcus, B. H. (2012). Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? *Annals of Behavioral Medicine, 44*(1), 43-51.

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J., ... & Biddle, S. J. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia, 55,* 2895-2905.

Wilson, E. O. (1984). *Biophilia.* Massachusetts, USA: Harvard University Press.

Wilson, J. J., O'Neill, B., Collins, E. G., & Bradley, J. (2015). Interventions to increase physical activity in patients with COPD: a comprehensive review. COPD: *Journal of Chronic Obstructive Pulmonary Disease, 12*(3), 339-354.

Wilson, M. I., Robertson, L. D., Daly, M., & Walton, S. A. (1995). Effects of visual cues on assessment of water quality. *Journal of Environmental Psychology, 15*(1), 53-63.

Woodall, L. C., Sanchez-Vidal, A., Canals, M., Paterson, G. L., Coppock, R., Sleight, V., ... & Thompson, R. C. (2014). The deep sea is a major sink for microplastic debris. *Royal Society Open Science, 1*(4), 1-8.

World Health Organization (2010). Global recommendations on physical activity for health. Geneva, Switzerland: World Health Organization.

Wuensch, K. L. (2009). Placing a confidence interval on multiple R^2. Retrieved from: http://core.ecu.edu/psyc/wuenschk/StatHelp/CI-R2.htm

Wyles, K. J., Pahl, S., Thomas, K., & Thompson, R. C. (2015). Factors that can undermine the psychological benefits of coastal environments exploring the effect of tidal state, presence, and type of litter. *Environment and Behavior,* 1-32. DOI: 10.1177/0013916515592177.

Wyles, K. J., Pahl, S., & Thompson, R. C. (2014). Perceived risks and benefits of recreational visits to the marine environment: Integrating impacts on the environment and impacts on the visitor. *Ocean & Coastal Management, 88,* 53-63.

Yang, W., & Kang, J. (2005). Soundscape and sound preferences in urban squares: a case study in Sheffield. *Journal of Urban Design, 10*(1), 61-80.

Yantis, S. (1993). Stimulus-driven attentional capture. *Current Directions in Psychological Science, 2*(5), 156-161.

Yantis, S., & Jonides, J. (1990). Abrupt visual onsets and selective attention: voluntary versus automatic allocation. *Journal of Experimental Psychology: Human Perception and Performance, 16*(1), 121-134.

Yantis, S., & Jonides, J. (1996). Attentional capture by abrupt onsets: New perceptual objects or visual masking? *Journal of Experimental Psychology: Human Perception and Performance, 22*(6), 1505–1513.

Yik, M. S., Russell, J. A., & Barrett, L. F. (1999). Structure of self-reported current affect: integration and beyond. *Journal of Personality and Social Psychology, 77*(3), 600-619.

Yu, G., Renton, A., Schmidt, E., Tobi, P., Bertotti, M., Watts, P., & Lais, S. (2011). A multilevel analysis of the association between social networks and support on leisure time physical activity: evidence from 40 disadvantaged areas in London. *Health & Place, 17*(5), 1023-1029.

Zettler, E. R., Mincer, T. J., & Amaral-Zettler, L. A. (2013). Life in the “plastisphere”: microbial communities on plastic marine debris. *Environmental Science & Technology, 47*(13), 7137-7146.