# Abstract

Natural environments can be used to promote health through facilitating recreational walking. However, brochures encouraging this often neglect messages identified in psychological research that are effective at influencing intentions to walk. This is in spite of the National Institute for Health and Care Excellence stating that these promotional efforts should be based on theoretical frameworks of behaviour change and targeted towards less active adults. This experiment therefore compared a prototypical recreational walking brochure with an “enhanced” version including such persuasive messages on people’s intentions to walk for recreation in natural environments. The enhanced brochure heightened intentions for inexperienced recreational walkers through our hypothesised mechanisms, but appeared to dissuade already-experienced walkers. Optimal messaging strategies in recreational walking brochures require tailoring to more and less active readerships. Guidelines are provided for authors of recreational walking brochures, though the principles and techniques could easily be extended to other means of outdoor walking promotion.

# Keywords

Physical activity; health communication; reasoned action; greenspace

# Introduction

Physical inactivity is a key public health challenge, contributing to non-communicable diseases and premature mortality (Guthold *et al.* 2018). Increasing walking is a manageable way for most people to increase physical activity (Ogilvie *et al.* 2007) and is therefore a public health priority (National Institute for Health and Care Excellence 2012). Natural environments support brisk walking (Sellers *et al.* 2012), and provide various landscapes for health-enhancing energy expenditure (Blinded for review, 2015). Furthermore, positive affect experienced while walking in natural environments (Thompson Coon *et al.* 2011) may also be associated with sustained physical activity behaviour (Rhodes and Kates 2015) and improved mental health in the long-term (Robertson *et al.* 2012).

Natural environments may therefore be an appropriate setting for promoting recreational walking. According to the National Institute for Health and Care Excellence (NICE), local authority directors for countryside management, the environment, parks, public health, and leisure services, should collaborate to “develop walking programmes for adults who are not active enough, based on an accepted theoretical framework for behaviour change,” and “ensure groups that are likely to be the least active are encouraged to participate, by addressing issues that may act as a barrier” (NICE, 2012, p.18). However, a content analysis of behaviour change messages in recreational walking brochures produced by such authorities in the UK concluded that their text frequently does not target theory-based behaviour change mechanisms known to influence physical activity uptake (Blinded for review, 2016) and thus may not promote recreational walking optimally for less active adults.

This is important because interventions which aim to promote the physically active use of green spaces often use such materials (Hunter *et al.* 2015; Roberts *et al.* 2016), but give little regard to how their text may persuade or dissuade certain individuals from undertaking recreational walking in those environments. The possibility therefore exists that accessing recreational walking brochures demotivates less active adults from recreational walking in natural environments, exacerbating inequalities in recreational walking (Dahmann *et al.* 2010; Rind and Jones 2011). Their increasing popularity as either central or adjunct means of physical activity promotion in exercise prescriptions (McKay *et al.* 2009) and ‘green prescriptions’ (Van den Berg 2017), means that it is crucial that messages in recreational walking brochures adhere to the NICE guidelines above.

One way of achieving this is through providing guidance on which persuasive messages are effective at encouraging less active adults to form stronger intentions to undertake recreational walking. These messages should target psychological change mechanisms (processes by which behaviour change occurs) and corresponding behaviour change techniques (ways of affecting change mechanisms) proposed by psychological theories (Michie *et al.* 2009; Gainforth *et al.* 2011). Messages should be tailored to how motivated people are to change their recreational walking behaviour because the psychological change mechanisms that underlie the adoption of physical activity are different from those that underlie the maintenance of physical activity (Sniehotta, Scholz and Schwarzer 2005). For example, the theories of reasoned action and planned behaviour (Ajzen 1991; Fishbein 2008) have been used to describe how the change mechanisms of changing attitudes, raising normative beliefs, and heightening perceived behavioural control can transition less active adults from physical activity motivation to volition (Courneya *et al.* 2001), but adults attempting to maintain physical activity behaviours may require messages which target self-regulation processes (Fjeldsoe *et al.* 2011).

This study therefore hypothesised that ‘enhancing’ a recreational walking brochure with messages targeting attitudes, normative beliefs, and perceived behavioural control could encourage so-called “non-walkers” to form stronger intentions for recreational walking in natural environments compared to an existing brochure. We further hypothesised that such enhancements would *not* have comparable effects for people who already regularly undertook recreational walking. Ultimately, we aimed to provide guidance to local authority directors on how simple modifications could be made to existing recreational walking brochures (and by extension, potentially similar promotional materials) in order to adhere to NICE guidelines and thus more optimally promote recreational walking in natural environments for those who would usually be less likely to do this.

# Materials and methods

## Sample

Participants of the Cint panel (<https://www.cint.com/consumer-insights-network/>) were invited by email in September 2015 to participate. Cint participants earn small financial rewards for completing online surveys. Participants who exhibit systematic responses biases are removed (Meade and Craig 2012), and precautions minimise the likelihood that surveys are automatically completed by machines. While socially desirable responses are possible (Behrend *et al.* 2011), web-based recruitment methods typically attract diverse demographics (Gosling *et al.* 2004).

## Experimental conditions

A two-page extract from an existing recreational walking brochure from Devon, UK (Blinded for review, 2016) was used as the “original brochure” condition (Supplementary Figure A). It described a riverside walk between two villages. Place names were fictionalised to reduce potential familiarity with the route; and a copyrighted map was replaced with an equivalent produced by Edina Digimap. The “enhanced brochure” was kept as similar to the original brochure as possible, with only elements of the text being altered (Supplementary Figure B). The following steps were taken to redesign the text of the enhanced walking brochure:

1. A content analysis of the original brochure was performed using a coding scheme (Blinded for review, 2016) which identified potentially persuasive messages in recreational walking brochures (and their corresponding behaviour change techniques and psychological change mechanisms).
2. Text was omitted which was unable to be ascribed a persuasive message category according to the above coding scheme.
3. Repetitive text was also omitted (i.e. other messages in the brochure already targeted the corresponding behaviour change technique/mechanisms multiple times).
4. Guidance on behaviour change techniques that can be incorporated into written materials was consulted (Abraham and Kools 2011). Potential techniques were selected if they targeted the psychological change mechanisms of changing attitudes, raising normative beliefs, or heightening perceived behavioural control, as these have been shown to transition people from motivation to volition previously (Courneya *et al.* 2001).
5. Messages operationalising these techniques were written into the enhanced brochure being mindful not to interrupt the route directions which constituted the main narrative of the brochure. Supplementary Table A displays a table of the change mechanisms and behaviour change techniques that were selected, together with the persuasive messages which were written into the 'enhanced' brochure to target these techniques and mechanisms.
6. Piloting these brochures helped clarify messages targeting injunctive normative beliefs (e.g. “your friends and family would support you completing this walk”), as too artificial. Such messages were deleted.

## Measures

Supplementary Table B contains the full wording, response options, and internal consistency coefficients (where applicable) pertaining to the measures described in the sections below.

### Outcome variables

Recreational walking intentions were operationalised in two ways. The primary outcome analysed was a binary response to whether or not a participant requested further walking information about outdoor recreational walking in natural environments at the end of the survey. Requesting further information was interpreted as reflective of greater intentions to engage in such walks in the future. Two 7-point Likert-scale items measuring behavioural intentions (Ajzen 2006) were collapsed as a secondary outcome variable. We refer to these two variables as ‘revealed intentions’ (more proximal to actual behaviour) and ‘stated intentions’ (more distal from actual behaviour), respectively (Ben-Akiva *et al.* 1994).

### Recreational walking status

To distinguish people who do not regularly undertake recreational walks in natural environments from those who do, an item which classified participants into five stages of readiness to change their recreational walking behaviour (Prochaska and Velicer 1997) was created. Responses to the former three response options (reflecting amotivation, or contemplation about changing behaviour in the long- or short-term) categorised participants as “non-walkers” and responses to the latter two options (reflecting recent changes to behaviour, or stable behaviour patterns) categorised participants as “walkers”. Similar measures have good construct validity for exercise adoption (Cardinal 1997).

### Mediators

Items were created to assess whether the enhanced brochure impacted “non-walkers” intentions through the proposed psychological change mechanisms of changing attitudes, raising normative beliefs, and heightening perceived behavioural control (Ajzen 2006). Items measuring affective attitudes, instrumental attitudes, normative beliefs, and perceived behavioural control were separately collapsed due to their high internal consistency (Supplementary Table B). Collapsed instrumental and affective attitude items were further combined into a single 'attitudes' construct for the same reason (*α*=0.89).

### Covariates

The experiment also collected a series of demographic details which were operationalised in analyses as follows: sex (male, female), age (18-34, 35-48, 49-65), ethnicity (White-British, all other ethnicities), long-standing illness (yes, no), and annual pre-tax household income (five quintiles or “don’t know”). Ethnicity (Office for National Statistics 2016), long-standing illness (Office for National Statistics 2001), and income (Office for National Statistics 2013) were collected according to national norms. These covariates have been independently shown to predict physical activity intentions or their antecedents (Wilson *et al.* 2004; Ziegelmann, Lippke and Schwarzer 2006; Kosma *et al.* 2007; Amireault *et al.* 2008; Gavin, Fox and Grandy 2011). Measures adapted from a national survey (Natural England 2017) queried the participant’s short- and long-term propensity for visiting natural environments as this has been shown to affect physical activity more generally (Coombes, Jones and Hillsdon 2010) and therefore could affect intentions to be physically active (Calogiuri and Chroni 2014).

## Procedure

Participants were randomised to one of the conditions based on a hyperlink sent to them in an invitation email. After giving consent, participants responded to questions concerning recreational walking status, short- and long-term propensity for visiting natural environments, ethnicity, long-standing illness, and income on successive pages. Prior to seeing the brochure, they read text that was adapted from a study concerning immersion in natural environments (Weinstein, Przybylski and Ryan 2009) in order to engage them with the task. They then could take as much as time as needed to read either the original or enhanced brochure in a new browser window.

Following this, they were asked whether they had read the brochure extract fully with those that did not being redirected to a debriefing page. Those that had proceeded to answer questions concerning the attitudes, descriptive norms, perceived behaviour control, and stated intentions. After this, they could also enter free responses as to what, if anything, had changed their motivation for recreational walking. Lastly, they responded to the item concerning revealed intentions. Supplementary Text A contains a transcript of the full experiment.

## Analysis

Piloting suggested the brochure took a minimum of two minutes to read, so participants completing the experiment in less than three minutes were excluded *a priori*. Following guidance, participants were also excluded if they took one standard deviation longer than the mean completion time (Malhotra 2008).

Logistic and linear regression models were constructed to analyse the impact of the brochures on revealed and stated intentions respectively. The original brochure was used as a reference category as it is analogous to a ‘usual care’ condition in behavioural interventions (Freedland *et al.* 2011). Models controlled for covariates and recreational walking status. Secondly, an interaction term was added between the experimental condition and recreational walking status to determine whether effects were stronger for “non-walkers”. Consistent with theories of reasoned action and planned behaviour, subsidiary mediation models tested whether differences in responses to the attitude, descriptive norm, and perceived behavioural control items mediated the effect of brochure condition on the two intention outcomes for “non-walkers” (i.e. whether the enhanced brochure worked through the psychological change mechanisms we targeted).

Analyses were conducted in R v3.4.0 (R Core Team 2018) using the “lavaan” package (Rosseel 2012).

# Results

Originally, 535 participants were randomised to the two conditions (original *n*=269; enhanced *n*=266). Participants who indicated that they had not read the leaflet (n=22), completed the experiment in under three minutes (n=96) or over 20.26 minutes (n=18), or had missing data (n=4) were excluded. This left a total of n=395, with 202 (51%) in the original brochure condition and 193 (49%) in the enhanced brochure condition. Females comprised 54% of the sample and the mean age was 42. “Non-walkers” comprised 46% of the sample.

Participants did not differ between experimental conditions in terms of age (*F*(1, 393)=0.00, *p*=.99, *ηp*=.00), sex (*X2*(2)=0.17, *p*=.68), ethnicity (*X2*(2)=0.00, *p*=.95), household income (*X2*(5)=3.59, *p*=.61), illness/disability (*X2*(1)=0.13, *p*=.72), or propensity for visiting natural environments in the short-term (*F*(1, 393)=0.00, *p*=.99, *ηp*=.00), or long-term (*X2*(7)=6.21, *p*=.52). Recreational walking status also did not differ with experimental condition (*X2*(1)=0.85, *p*=.36). Descriptive statistics for the outcomes and mediators as a function of recreational walking status can be seen in Table 1. Of note, measures of dispersion were generally higher among "non-walkers," potentially signifying more individual differences within this subgroup.

[Insert Table 1 here]

## Did the enhanced brochure strengthen recreational walking intentions overall?

Analysing all participants and controlling for potential confounds, the enhanced brochure did *not* prompt more requests for further recreational walking information than the original brochure (*OR*=0.82; *95% CI*: 0.54, 1.25; Supplementary Table C), but did prompt stronger *stated* intentions (*b*=0.32; *95% CI*: 0.03, 0.62). As expected, people classified as “walkers” reported stronger revealed (*OR*=2.10; *95% CI*: 1.33, 3.34) and stated (*b*=1.03; *95% CI*: 0.71, 1.35) intentions than “non-walkers” overall.

## Were these effects stronger for “non-walkers”?

After adding an interaction term between the experimental brochure condition and recreational walking status, distinct patterns for "non-walkers" and "walkers" emerged in terms of both outcome variables (Figure 1). First, supporting our hypotheses, "non-walkers" who read the enhanced brochure made significantly more requests for recreational walking information than "non-walkers" who read the original brochure (*OR*=2.56; *95% CI*: 1.33, 5.07; Supplementary Table C). Secondly, "walkers" who read the original brochure made significantly more requests than "non-walkers" who read the original brochure (*OR*=5.77; *95% CI*: 3.00, 11.51). Lastly, and unexpectedly, "walkers" who read the enhanced brochure made significantly *fewer* requests than "non-walkers" who read the original brochure (*OR*=0.14; *95% CI*: 0.06, 0.33). The pattern was the same for stated intentions, though effects were slightly weaker, and in the case of the latter unexpected finding, not significant (Figure 1 and Supplementary Table C). Associations between the other potential confounds and the outcome variables remained broadly consistent after the addition of this interaction term.

[Insert Figure 1 here]

These analyses were repeated including participants with atypically short or long completion times (see ‘Analysis’) and all effects were weaker (Supplementary Table C), justifying our decision to exclude on this basis.

## Did differences in attitudes, descriptive norms, and perceived behavioural control mediate the effect of the brochures on recreational walking intentions for "non-walkers"?

As coefficients did not change substantially following the inclusion of covariates, the mediation models excluded covariates in favour of just the experimental conditions, outcomes, and mediators. For “non-walkers,” perceived behavioural control significantly mediated the effects of the enhanced brochure on stated intentions (*b*=0.26; *95% CI*: 0.02, 0.50), explaining ≈45% of the variance in the total effect; but attitudes and subjective norms did not mediate the effect (Figure 2). The combination of all three constructs also mediated the effects of the enhanced brochure on stated intentions for “non-walkers” (*b*=0.42; *95% CI*: 0.05, 0.79), explaining ≈73% of the variance in the total effect.

[Insert Figure 2 here]

None of the three constructs significantly mediated the effects of the enhanced brochure on the revealed intentions for “non-walkers” on their own; but the combination of all three did (*b*=0.15; *95% CI*: 0.01, 0.30), explaining ≈25% of the variance in the total effect. As a comparison, the same models were performed for “walkers” (Supplementary Figure C) and as predicted, neither differences in attitudes, descriptive norms, perceived behavioural control, nor their sum, mediated the relationship between the experimental brochure condition and either outcome variable.

# Discussion

In order to maximise the potential that natural environments have for encouraging recreational walking, such experiences need to be optimally promoted, especially to less active people. This experiment compared an archetypal walking brochure with one which had been “enhanced” using persuasive messages which targeted theory-based psychological change mechanisms. As hypothesised, this enhanced brochure prompted stronger recreational walking intentions among “non-walkers” – they made over twice as many requests for further walking information and on average reported intentions half a point higher compared with reading the original brochure. Conversely, “walkers” who read the enhanced brochure were much *less* likely to request further walking information than “walkers” who read the original brochure. We also demonstrated that differences in the three psychological change mechanisms targeted were responsible for influencing the intentions of “non-walkers,” especially perceived behavioural control.

## Implications for the creation of outdoor recreational walking brochures for ‘non-walkers’

The main implication of these findings is that two distinct types of outdoor recreational walking brochure could be developed to heighten outdoor walking intentions among two target audiences. The first of these are "non-walkers," that is, those who have not contemplated recreational walking in natural environments, or those that have contemplated this, but have currently failed to act on these thoughts. Consistent with previous research (Courneya *et al.* 2001), this study suggests that as well as route instructions, adding text to brochures which attempts to change people's attitudes towards outdoor recreational walking, promote normative beliefs about what similar others may do, or raise confidence for such walking, may help “non-walkers” form stronger intentions to walk in natural environments by encouraging them to contemplate further how to undertake such action.

Brochure designers can consider influencing both instrumental attitudes (advantages of undertaking outdoor recreational walking) and affective attitudes (emotions stimulated by performing outdoor recreational walking). This study cannot deconstruct which type of message may be more persuasive, but studies have previously suggested that affective attitudes may be more important for predicting the uptake of physical activity (Lowe, Eves and Carroll 2002; French *et al.* 2005). Brochure designers also have the opportunity to describe the outdoor recreational walking behaviour of peers or encourage recipients to seek social comparison opportunities (e.g. encouraging people to interact with others in walking groups; Supplementary Table A). However, normative beliefs are typically weak predictors of physical activity uptake (Downs and Hausenblas 2005) which may explain their weaker influence in our mediation models.

There are multiple ways in which brochure designers can promote perceived behavioural control (i.e. raising people's confidence for performing recreational walking in natural environments). In this study, we targeted this change mechanism in a number of ways (Supplementary Table A): (a) prompting reattribution of past failures (e.g. past failed attempts to start outdoor recreational walking); (b) prompting barrier identification and planning in relation to anticipated barriers (e.g. difficulty in climbing hills); (c) setting graded tasks/goals (e.g. prompting practice of multiple, shorter walks); (d) providing feedback on performance (e.g. commending the recipient on successful completion of a stage); (e) using arguments to bolster confidence (e.g. arguing against self-doubt and asserting that they can succeed in changing their behaviour); and (f) prompting organisation of social support (e.g. joining a walking group). This change mechanism (enhancing confidence) may be prompted by a variety of behaviour change techniques (Abraham and Kools 2011) and was the most frequently targeted in the enhanced brochure, potentially explaining why it was the most important construct in relation to predicting behavioural intentions.

Previous research has further demonstrated that confidence-building aspects of perceived behavioural control are particularly important for forming intentions to take up physical activity more generally (Hagger, Chatzisarantis and Biddle 2002). "Non-walkers’" quotes about the enhanced brochure illustrated the persuasive nature of these messages: *"it is a very positive leaflet that made me feel comfortable in taking it on despite having no experience"*; and *"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…it made me want to start walking again*.*"* While there were not sufficient responses to this open question to undertake systematic qualitative analysis, these quotes at least suggest that for some "non-walkers," enhancing confidence for walking in natural environments was the primary means by which they formed stronger intentions, supporting the quantitative findings. All responses to this open question can be found in the raw data upon request from the authors.

While this discussion suggests that designing persuasive messages targeting perceived behavioural control and attitudes (especially affective attitudes) may be most effective at encouraging “non-walkers” to contemplate future outdoor recreational walking, our mediation models also suggest that the combination of our three key change mechanisms is also important. Brochure designers are encouraged to consult practical guidance (e.g. Abraham & Kools, 2011) on how to incorporate persuasive messages targeting these change mechanisms in a wider variety of ways which go beyond the techniques employed in the present study.

## Implications for the creation of outdoor recreational walking brochures for ‘walkers’

Brochure designers may also wish to design persuasive messages for “walkers” who are more familiar with walking trails. In this study, these were classified as people who were already undertaking outdoor recreational walking in natural environments. These people were substantially *less* likely to request further walking information after reading the enhanced brochure, suggesting that the changes to the original brochure actually *dissuaded* these individuals from walking in natural environments.

While qualitative responses were too scarce to draw definitive conclusions, some responses revealed that the enhanced brochure may have lowered intentions for these “walkers” because they found the language within to be patronising: *“The tone of the leaflet was quite condescending*,*”* and *“leave the motivational stuff to a separate section…it is annoying and patronising.”* This could be seen as analogous to the notion of ‘baby talk’ in health psychology research where a healthcare provider underestimates the patient’s knowledge and uses language perceived as patronising, thus leading to disengagement (Waitzkin 1985).

Generally speaking, the effects of both brochures on “walkers’” intentions were the strongest observed effects in the present study; greater than, for example, the effects of sex, age, ethnicity, or income on these intentions (Supplementary Table C). Thus, “walkers,” even more so than “non-walkers,” could be particularly responsive to the written content of recreational walking brochures.

The original brochure may appeal more to “walkers” because it already contained the sort of information that was more persuasive for this group (Blinded for review, 2016). This could be messages which highlighted heritage features in natural environments, or signposted the reader to nearby amenities (McCormack *et al.* 2010). While these messages could be construed to be related to material consequences of recreational walking (and thus, could change attitudes towards the behaviour), we are unable to provide definitive guidance on what types of message may be most persuasive for “walkers” because our mediation models did not identify differences in attitudes, normative beliefs, or perceived behavioural control between the two brochures for this audience (Supplementary Figure C). However, we do recommend that intentionally designing theory-derived persuasive messages in recreational walking brochures for this group should not involve the use of text that could be construed as “patronising”, regardless of the change mechanisms that are targeted.

Without further knowledge of the guidelines and management considerations that factor into how a brochure advertising recreational walking in natural environments is created and written, it is difficult to make recommendations on how different design guidelines could be implemented in reality. Nonetheless, this study provides evidence that the implementation of guidelines which encourage the use of evidence-based persuasive messages is effective at changing recreational walking intentions. While only intentions were measured in the current study, meta-analysis has shown that targeting the same mechanisms have small but significant effects on actual behaviour change (Webb and Sheeran 2006). Furthermore such tailored media could support so-called “green prescriptions,” i.e. direct recommendations from health care professionals to spend more time in natural settings to improve health and wellbeing (Van den Berg 2017).

## Limitations

Firstly, while only the text component of the original brochure was manipulated in this study, there are numerous stylistic features that may aid or inhibit comprehension of the written text e.g. graphical illustrations of specific behaviours (Kools *et al.* 2006), or coloured tabs and pictorials (Kools *et al.* 2007). Secondly, the brochures used in this experiment described a linear route in a semi-rural riverside location, but people’s preferences for features of recreational walking routes differ with their demographics (Davies, Lumsdon and Weston 2012). Replications of the present study with different audiences and different exemplar brochures are necessary to determine how generalisable the current findings are.

Thirdly, the three psychological change mechanisms we targeted do not necessarily support maintenance of behaviour change (Kwasnicka *et al.* 2016), i.e. the brochure does not propose an explanation as to how individuals could maintain physically active behaviours once they have initiated these behaviours. Future attempts to design persuasive messages in recreational walking brochures may wish to draw on other behavioural models, such as the model of behavioural maintenance (Rothman 2000), in order to elicit more sustained changes in people’s walking behaviour.

We are also aware that specific text substitutions may have influenced our outcomes in unintended ways. For example, we changed the text *“a steep climb… and a fairly steep descent”* to *“there is one climb and descent. These are not too difficult if you shorten your stride and pace yourself – this will make it feel much easier”*, with additional text reading *“climbing hills can be difficult, but pace yourself and you’ll find it much easier.”* Removing the word ‘steep,’ notwithstanding other factors affecting perceived steepness (Schnall *et al.* 2008; Schnall, Zadra and Proffitt 2010; Taylor-Covill and Eves 2016), may have affected intentions, or their antecedents, measured in this study. However, rather than misleading readers, we were simply acknowledging that individuals may find the terrain difficult and that by implementing a simple strategy this challenge could be overcome.

# Conclusions

To ensure natural environments are used for recreational walking, especially by people who are typically less active, these opportunities should be effectively promoted using appropriate persuasive messages. However, current texts may not do so optimally. This study investigated the effect of systematically adding theory-derived persuasive messages to an existing recreational walking brochure on future intentions to walk for recreation in natural environments. We demonstrated a need for two types of recreational walking brochure: (a) those appealing to “non-walkers” which attempt to increase intentions to engage in outdoor recreational walking in natural environments by targeting determinants such as perceived behavioural control; and, (b) those aimed at already-motivated “walkers” which can assume motivation, avoid the use of patronising language, and focus on extrinsic features of a recreational walking route with clear instructions, thus supporting walking maintenance. Brochure authors are encouraged to make use of these guidelines and other existing practical guidance on how to construct messages which target evidence-based antecedents of physical activity behaviour change and to be vigilant to the variability in effective communication strategies for different target audiences.

# References

Abraham C, Kools M. *Writing Health Communication: An Evidence-Based Guide*. SAGE, 2011.

Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process* 1991;**50**:179–211.

Ajzen I. Constructing a theory of planned behavior questionnaire. *TPB Quest Constr* 2006.

Amireault S, Godin G, Vohl M-C *et al.* Moderators of the intention-behaviour and perceived behavioural control-behaviour relationships for leisure-time physical activity. *Int J Behav Nutr Phys Act* 2008;**5**:7.

Behrend TS, Sharek DJ, Meade AW *et al.* The viability of crowdsourcing for survey research. *Behav Res Methods* 2011;**43**:800–13.

Ben-Akiva M, Bradley M, Morikawa T *et al.* Combining revealed and stated preferences data. *Mark Lett* 1994;**5**:335–349.

Calogiuri G, Chroni S. The impact of the natural environment on the promotion of active living: an integrative systematic review. *BMC Public Health* 2014;**14**:873.

Cardinal BJ. Construct Validity of Stages of Change for Exercise Behavior. *Am J Health Promot* 1997;**12**:68–74.

Coombes E, Jones AP, Hillsdon M. The relationship of physical activity and overweight to objectively measured green space accessibility and use. *Soc Sci Med* 2010;**70**:816–22.

Courneya KS, Plotnikoff RC, Hotz SB *et al.* Predicting exercise stage transitions over two consecutive 6-month periods: A test of the theory of planned behaviour in a population-based sample. *Br J Health Psychol* 2001;**6**:135–50.

Dahmann N, Wolch J, Joassart-Marcelli P *et al.* The active city? Disparities in provision of urban public recreation resources. *Health Place* 2010;**16**:431–45.

Davies NJ, Lumsdon LM, Weston R. Developing Recreational Trails: Motivations for Recreational Walking. *Tour Plan Dev* 2012;**9**:77–88.

Downs DS, Hausenblas HA. The Theories of Reasoned Action and Planned Behavior Applied to Exercise: A Meta-analytic Update. *J Phys Act Health* 2005;**2**:76–97.

Fishbein M. A Reasoned Action Approach to Health Promotion. *Med Decis Making* 2008;**28**:834–44.

Fjeldsoe B, Neuhaus M, Winkler E *et al.* Systematic review of maintenance of behavior change following physical activity and dietary interventions. *Health Psychol* 2011;**30**:99–109.

Freedland KE, Mohr DC, Davidson KW *et al.* Usual and Unusual Care: Existing Practice Control Groups in Randomized Controlled Trials of Behavioral Interventions. *Psychosom Med* 2011;**73**:323–35.

French DP, Sutton S, Hennings SJ *et al.* The importance of affective beliefs and attitudes in the theory of planned behavior: Predicting intention to increase physical activity. *J Appl Soc Psychol* 2005;**35**:1824–1848.

Gainforth HL, Barg CJ, Latimer AE *et al.* An investigation of the theoretical content of physical activity brochures. *Psychol Sport Exerc* 2011;**12**:615–20.

Gavin JR, Fox KM, Grandy S. Race/Ethnicity and gender differences in health intentions and behaviors regarding exercise and diet for adults with type 2 diabetes: A cross-sectional analysis. *BMC Public Health* 2011;**11**:533.

Gosling SD, Vazire S, Srivastava S *et al.* Should We Trust Web-Based Studies? A Comparative Analysis of Six Preconceptions About Internet Questionnaires. *Am Psychol* 2004;**59**:93–104.

Guthold R, Stevens GA, Riley LM *et al.* Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. *Lancet Glob Health* 2018, DOI: 10.1016/S2214-109X(18)30357-7.

Hagger MS, Chatzisarantis NLD, Biddle SJH. A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: predictive validity and the contribution of additional variables. *J Sport Exerc Psychol* 2002;**24**:3–32.

Hunter RF, Christian H, Veitch J *et al.* The impact of interventions to promote physical activity in urban green space: A systematic review and recommendations for future research. *Soc Sci Med* 2015;**124**:246–56.

Kools M, Ruiter RAC, van de Wiel MWJ *et al.* Testing the usability of access structures in a health education brochure. *Br J Health Psychol* 2007;**12**:525–41.

Kools M, van de Wiel MWJ, Ruiter RAC *et al.* Pictures and text in instructions for medical devices: Effects on recall and actual performance. *Patient Educ Couns* 2006;**64**:104–11.

Kosma M, Ellis R, Cardinal BJ *et al.* The Mediating Role of Intention and Stages of Change in Physical Activity among Adults with Physical Disabilities: An Integrative Framework. *J Sport Exerc Psychol* 2007;**29**:21–38.

Kwasnicka D, Dombrowski SU, White M *et al.* Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychol Rev* 2016;**10**:277–96.

Lowe R, Eves F, Carroll D. The influence of affective and instrumental beliefs on exercise intentions and behavior: A longitudinal analysis. *J Appl Soc Psychol* 2002;**32**:1241–1252.

Malhotra N. Completion Time and Response Order Effects in Web Surveys. *Public Opin Q* 2008;**72**:914–34.

McCormack GR, Rock M, Toohey AM *et al.* Characteristics of urban parks associated with park use and physical activity: A review of qualitative research. *Health Place* 2010;**16**:712–26.

McKay J, Wright A, Lowry R *et al.* Walking on prescription: The utility of a pedometer pack for increasing physical activity in primary care. *Patient Educ Couns* 2009;**76**:71–6.

Meade AW, Craig SB. Identifying careless responses in survey data. *Psychol Methods* 2012;**17**:437–55.

Michie S, Abraham C, Whittington C *et al.* Effective techniques in healthy eating and physical activity interventions: a meta-regression. *Health Psychol* 2009;**28**:690.

National Institute for Health and Care Excellence. *Walking and Cycling: Local Measures to Promote Walking and Cycling as Forms of Travel or Recreation*., 2012.

Natural England. *Monitor of Engagement with the Natural Environment: Technical Report to the 2009-16 Surveys*., 2017.

Office for National Statistics. Census 2001 questionnaires. 2001.

Office for National Statistics. *The Effects of Taxes and Benefits on Household Income, 2011/12*., 2013.

Office for National Statistics. Guidance and Methodology: Measuring equality: Ethnic Group, National Identity and Religion: Ethnic group [ARCHIVED CONTENT] UK Government Web Archive - The National Archives. 2016.

Ogilvie D, Foster CE, Rothnie H *et al.* Interventions to promote walking: systematic review. *BMJ* 2007;**334**:1204–1204.

Prochaska JO, Velicer WF. The Transtheoretical Model of Health Behavior Change. *Am J Health Promot* 1997;**12**:38–48.

R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria, 2018.

Rhodes RE, Kates A. Can the Affective Response to Exercise Predict Future Motives and Physical Activity Behavior? A Systematic Review of Published Evidence. *Ann Behav Med* 2015;**49**:715–31.

Rind E, Jones AP. The geography of recreational physical activity in England. *Health Place* 2011;**17**:157–65.

Roberts H, McEachan R, Margary T *et al.* Identifying Effective Behavior Change Techniques in Built Environment Interventions to Increase Use of Green Space: A Systematic Review. *Environ Behav* 2016:0013916516681391.

Robertson R, Robertson A, Jepson R *et al.* Walking for depression or depressive symptoms: A systematic review and meta-analysis. *Ment Health Phys Act* 2012;**5**:66–75.

Rosseel Y. lavaan: An R Package for Structural Equation Modeling. *J Stat Softw* 2012;**48**, DOI: 10.18637/jss.v048.i02.

Rothman AJ. Toward a theory-based analysis of behavioral maintenance. *Health Psychol* 2000;**19**:64–9.

Schnall S, Harber KD, Stefanucci JK *et al.* Social support and the perception of geographical slant. *J Exp Soc Psychol* 2008;**44**:1246–55.

Schnall S, Zadra JR, Proffitt DR. Direct Evidence for the Economy of Action: Glucose and the Perception of Geographical Slant. *Perception* 2010;**39**:464–82.

Sellers CE, Grant PM, Ryan CG *et al.* Take a walk in the park? A cross-over pilot trial comparing brisk walking in two different environments: Park and urban. *Prev Med* 2012;**55**:438–43.

Sniehotta FF, Scholz U, Schwarzer R. Bridging the intention–behaviour gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychol Health* 2005;**20**:143–60.

Taylor-Covill GAH, Eves FF. Carrying a biological “backpack”: Quasi-experimental effects of weight status and body fat change on perceived steepness. *J Exp Psychol Hum Percept Perform* 2016;**42**:331–8.

Thompson Coon J, Boddy K, Stein K *et al.* 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. *Environ Sci Technol* 2011;**45**:1761–72.

Tversky A, Kahneman D. Judgment under uncertainty: Heuristics and biases. *Science* 1974;**185**:1124–31.

Van den Berg AE. From Green Space to Green Prescriptions: Challenges and Opportunities for Research and Practice. *Front Psychol* 2017;**8**, DOI: 10.3389/fpsyg.2017.00268.

Waitzkin H. Information Giving in Medical Care. *J Health Soc Behav* 1985;**26**:81.

Webb TL, Sheeran P. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol Bull* 2006;**132**:249–68.

Weinstein N, Przybylski AK, Ryan RM. Can Nature Make Us More Caring? Effects of Immersion in Nature on Intrinsic Aspirations and Generosity. *Pers Soc Psychol Bull* 2009;**35**:1315–29.

Wilson PM, Rodgers WM, Fraser SN *et al.* Relationships between Exercise Regulations and Motivational Consequences in University Students. *Res Q Exerc Sport* 2004;**75**:81–91.

Ziegelmann JP, Lippke S, Schwarzer R. Adoption and maintenance of physical activity: Planning interventions in young, middle-aged, and older adults. *Psychol Health* 2006;**21**:145–63.

Blinded for review, 2015.

Blinded for review, 2016.

|  |
| --- |
| Table 1. Descriptive statistics for the two outcome variables and three proposed mediator variables. |
|  |  | Overall (n=395) |  | Non-walkers (n=182) |  | Walkers (n=213) |
|  |  | Original brochure (n=202) | Enhanced brochure (n=193) |  | Original brochure (n=88) | Enhanced brochure (n=94) |  | Original brochure (n=114) | Enhanced brochure (n=99) |
| Revealed intentions | *%SE* | 43.563.49 | 38.863.51 |  | 21.594.39 | 42.555.10 |  | 60.534.58 | 35.354.80 |
| Stated intentions | *MSD* | 4.991.77 | 5.321.54 |  | 4.201.69 | 4.781.63 |  | 5.601.59 | 5.831.25 |
| Attitudes | *MSD* | 5.271.18 | 5.511.27 |  | 4.881.22 | 5.201.38 |  | 5.581.05 | 5.801.09 |
| Normative beliefs | *MSD* | 5.161.39 | 5.321.46 |  | 4.681.38 | 4.971.52 |  | 5.531.30 | 5.651.32 |
| Perceived behavioural control | *MSD* | 4.591.52 | 5.301.47 |  | 4.331.65 | 4.851.64 |  | 5.431.21 | 5.731.15 |
| Notes: Mean self-reported intention scores represent the average of two 7-point rating scales which were recoded: 1=strongly disagree and 7=strongly agree. Mean attitude score comprised the average score of four 7-point attitudinal items. Mean descriptive norm score and mean self-efficacy score comprised the average of two 7-point items each. Recreational walking status was dichotomized into two groups representing those who self-reported being in the precontemplation, contemplation, and preparation stages of change (“non-walkers”), and those who self-reported being in the action and maintenance stages of change (“walkers”). |

Figure captions

Figure 1. The effect of the interaction between the experimental condition and recreational walking status on both outcome variables

Figure 2. Mediation models demonstrating the effect of reading the enhanced brochure (vs. original brochure) on revealed intentions and stated intentions (in italics) through attitudes, subjective norms, and perceived behavioural control for “non-walkers”. Significant effects and covariances are highlighted in bold. Estimates and 95% confidence intervals are presented. DE=direct effect, IE=indirect effect. NB: For revealed intentions, the diagonally-weighted least squares estimator with probit link function was used (Rosseel, 2012), hence the estimates cannot be compared to odds ratios or log odds. For stated intentions, the maximum likelihood estimator was used. Slightly different confidence intervals for covariances and regressions of the mediators on the experimental brochure condition are a consequence of the number of iterations of the model before successful convergence.