

**Redesigning walking brochures using behaviour change theory: Implications for walking intentions in natural environments**

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## 1     **ABSTRACT**

2     Natural environments can be used to promote health through facilitating recreational walking.

3     However, ~~brochures efforts to~~ encourage~~ing~~ this often neglect messages identified in  
4     psychological research that are effective at influencing intentions to walk. This is ~~in spite~~  
5     of~~despite~~ the National Institute for Health and Care Excellence stating that ~~these~~ promotional  
6     efforts should ~~be based on~~ utilise theoretical frameworks of behaviour change and be targeted  
7     towards less active adults. As an illustrative example, ~~T~~this experiment ~~therefore~~ compared a  
8     prototypical recreational walking brochure with an “enhanced” version including such  
9     persuasive messages on people’s intentions to walk for recreation in natural environments.

10    The enhanced brochure heightened intentions for inexperienced recreational walkers through  
11    our hypothesised mechanisms, but appeared to dissuade already-experienced walkers.

12    Optimal messaging strategies in recreational walking brochures require tailoring to more and  
13    less active readerships. Guidelines are provided for authors of recreational walking  
14    brochures, though the principles and techniques could easily be extended to other means of  
15    outdoor walking promotion.

## 17    **KEYWORDS**

18    Physical activity; health communication; reasoned action; greenspace

## 19 INTRODUCTION

### 20 Physical activity, natural environments, and health and wellbeing

21  
22 Physical inactivity is a key public health challenge, contributing to non-communicable  
23 diseases and premature mortality (Guthold *et al.* 2018) with substantial economic costs  
24 (Scarborough *et al.* 2011). There is therefore an urgent need for strategies which tackle  
25 physical inactivity at the community- or population-level (Baker *et al.* 2015). Across all age  
26 groups, walking is one of the most important contributors to health-enhancing physical  
27 activity (Bélanger *et al.* 2011) and is therefore seen as ~~Increasing walking is~~ a manageable  
28 way for most people to increase their physical activity (Ogilvie *et al.* 2007) and is therefore as  
29 well as -a public health priority (National Institute for Health and Care Excellence 2012).  
30 Walking, even independently of other physical activity, has been associated with reduced  
31 risks of cardiovascular disease (Hamer and Chida 2008) and reduced symptoms of depression  
32 (Robertson *et al.* 2012). Despite its widespread accessibility, popularity, and substantial  
33 health benefits, the success of traditional interventions to promote increased walking is mixed  
34 (Foster *et al.* 2011). Research has therefore shifted towards place-based approaches to  
35 support physical activity at a community- or population-level (van Holle *et al.* 2012).  
36  
37 The use of natural environments such as green spaces (e.g. parks, woods) or blue spaces (e.g.  
38 rivers, coastline) for recreational walking is one such place-based strategy.- Natural  
39 environments support brisk levels of walking (Sellers *et al.* 2012), and provide various  
40 landscapes for health-enhancing energy expenditure (Blinded for review, 2015). They also  
41 elicit more positive affective responses compared with walking in more urbanised  
42 environments (Thompson Coon *et al.* 2011), which may be particularly important for  
43 sustained physical activity behaviour (Rhodes and Kates 2015). There is also a large body of

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3 44 evidence that suggests those with greater availability of green (Coombes *et al.* 2010) and blue  
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5 45 (White *et al.* 2014) space tend to achieve higher levels of physical activity. Finally, there are  
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7 46 financial benefits, with recreational physical activity in natural environments worth an  
8  
9 47 estimated £2.2 billion in cost savings to health in England alone (White *et al.* 2016).  
10  
11 48 Furthermore, positive affect experienced while walking in natural environments (Thompson  
12  
13 49 Coon *et al.* 2011) may also be associated with sustained physical activity behaviour (Rhodes  
14  
15 50 and Kates 2015) and improved mental health in the long-term (Robertson *et al.* 2012).  
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### 22 Promoting physical activity behaviour change in natural environments

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26 54 Natural environments, therefore, appear to be a promising setting for promoting health-  
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28 55 enhancing physical activity, in particular recreational walking, which may be sustainable in  
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30 56 the longer-term. However, interventions to promote physical activity in natural environments  
31  
32 57 have had limited success (Hunter *et al.* 2015). Contemporary approaches to supporting  
33  
34 58 physical activity behaviour change focus on the complex socio-ecological systems which  
35  
36 59 influence health (Sallis and Owen 2015; Mohammadi 2019). In contrast to the linear  
37  
38 60 processes which underlie theoretical models of individual-level health behaviour change,  
39  
40 61 these models embrace policy-level decisions, environmental change, behavioural settings,  
41  
42 62 and their likely recurring feedback loops as key influencers of physical activity behaviour.  
43  
44 63 This is especially true of the proliferation of ecological and planetary models of public health  
45  
46 64 (Gagné and Lapalme 2019). Despite such complexity, it is still recognised that individuals are  
47  
48 65 at core of such models; their characteristics and motivations having the ability to alter  
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50 66 processes in the 'system' (Sniehotta *et al.* 2017).  
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4 68 ~~Natural environments may therefore be an appropriate setting for promoting recreational~~  
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6 69 ~~walking. Regarding recreational walking in natural environments, there is policy-level~~  
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8 70 ~~precedent for its promotion. According to~~ The National Institute for Health and Care  
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10 71 Excellence (NICE) ~~encourage~~; local authority directors for countryside management, the  
11  
12 72 environment, parks, public health, and leisure services, ~~should to~~ collaborate to “develop  
13  
14 73 walking programmes for adults who are not active enough, based on an accepted theoretical  
15  
16 74 framework for behaviour change,” and “ensure groups that are likely to be the least active are  
17  
18 75 encouraged to participate, by addressing issues that may act as a barrier” (NICE, 2012, p.18).  
19  
20  
21 76 ~~Thus, even policy-level approaches acknowledge the necessity of understanding individual~~  
22  
23 77 ~~cognitions and actions when developing community-wide approaches to physical activity~~  
24  
25 78 ~~promotion. However~~ ~~Despite this recommendation though~~, a content analysis of behaviour  
26  
27 79 change messages in recreational walking brochures produced by such authorities in the UK  
28  
29 80 concluded that their text frequently does not target theory-based behaviour change  
30  
31 81 mechanisms known to influence physical activity uptake (Blinded for review, 2016) and thus  
32  
33 82 may not promote recreational walking optimally for less active adults. ~~While brochures or~~  
34  
35 83 ~~leaflets, even if effectively optimised, do not represent a solution on their own, they are a~~  
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37 84 ~~commonly used way to communicate the appeal of an area and walking opportunities.~~  
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45 86 ~~This is important because interventions which aim to promote the physically active use of~~  
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47 87 ~~green spaces often use such materials~~ While paper or digital brochures are commonly used in  
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49 88 ~~interventions~~ (Hunter *et al.* 2015); ~~Roberts et al. 2016~~), but ~~they~~ give little regard to ~~how their~~  
50  
51 89 ~~text may persuade or dissuade certain individuals from undertaking~~ tailoring messages to  
52  
53 90 ~~individual needs and readiness to engage in~~ recreational walking in ~~those~~ natural  
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55 91 environments (*Roberts et al. 2016*). The possibility therefore exists that accessing  
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57 92 recreational walking brochures demotivates less active adults from recreational walking in  
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3 93 natural environments due to assumptions about those reading them, potentially exacerbating  
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5 94 inequalities in recreational walking (Dahmann *et al.* 2010; Rind and Jones 2011). Their  
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7 95 increasing popularity as either central or adjunct means of physical activity promotion in  
8  
9 96 exercise prescriptions (McKay *et al.* 2009) and ‘green prescriptions’ (Van den Berg 2017),  
10  
11 97 means that it is crucial that messages in recreational walking brochures adhere to the NICE  
12  
13 98 guidelines above. Basing the design of promotional materials on health behaviour change  
14  
15 99 theory is not a new idea (Bandura 1977; Carver and Scheier 1982) but is imperative for  
16  
17 100 transparency and understanding of how this material produces changes in behaviour  
18  
19 101 (Abraham and Michie 2008).  
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26 103 One way of achieving helping local authorities produce theory-informed messages ~~this~~ is  
27  
28 104 through providing guidance on which persuasive messages are effective at encouraging less  
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30 105 active adults to form stronger intentions to undertake recreational walking. These messages  
31  
32 106 should target ~~psychological change~~ mechanisms (processes by which behaviour change  
33  
34 107 occurs) and corresponding ~~behaviour change~~ techniques (ways of affecting ~~change~~  
35  
36 108 mechanisms) proposed by psychological theories (~~Michie et al. 2009~~ Abraham et al. 2007;  
37  
38 109 Gainforth *et al.* 2011). Messages should be tailored to how motivated people are to change  
39  
40 110 their recreational walking behaviour because the psychological change mechanisms that  
41  
42 111 underlie the adoption of physical activity are different from those that underlie the  
43  
44 112 maintenance of physical activity (Sniehotta, Scholz and Schwarzer 2005). For example, the  
45  
46 113 theories of reasoned action and planned behaviour (Ajzen 1991; Fishbein 2008) have been  
47  
48 114 used to describe how the change mechanisms of changing attitudes, raising normative beliefs,  
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50 115 and heightening perceived behavioural control can transition less active adults from physical  
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52 116 activity motivation to volition (Courneya *et al.* 2001), but adults attempting to maintain  
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3 117 physical activity behaviours may require messages which target self-regulation processes  
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5 118 (e.g. continuous self-monitoring of behaviour; Fjeldsoe *et al.* 2011).  
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10 120 **Present study**

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12 121 This study therefore hypothesised that ‘enhancing’ a recreational walking brochure with  
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14 122 messages targeting attitudes, normative beliefs, and perceived behavioural control could  
15  
16 123 encourage so-called “non-walkers” to form stronger intentions for recreational walking in  
17  
18 124 natural environments compared to an existing brochure. We further hypothesised that such  
19  
20 125 enhancements would *not* have comparable effects for people who already regularly undertook  
21  
22 126 recreational walking. Ultimately, we aimed to provide guidance to local authority directors on  
23  
24 127 how simple modifications could be made to existing recreational walking brochures (and by  
25  
26 128 extension, potentially similar promotional materials) in order to adhere to NICE guidelines  
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28 129 and thus more optimally promote recreational walking in natural environments for those who  
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30 130 would usually be less likely to do this.  
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37 132 **MATERIALS AND METHODS**

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40 133 **Sample**

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43 134 Participants of the Cint panel (<https://www.cint.com/consumer-insights-network/>) were  
44  
45 135 invited by email in September 2015 to participate. Cint participants earn small financial  
46  
47 136 rewards for completing online surveys. Participants who exhibit systematic responses biases  
48  
49 137 are removed (Meade and Craig 2012), and precautions minimise the likelihood that surveys  
50  
51 138 are automatically completed by machines. While socially desirable responses are possible  
52  
53 139 (Behrend *et al.* 2011), web-based recruitment methods typically attract diverse demographics  
54  
55 140 (Gosling *et al.* 2004). While not a representative sample, participants were recruited from  
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57 141 across the breadth of the United Kingdom.  
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### 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 AFigure 1](#)). 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 BFigure 2](#)). The following steps were taken to redesign the text of the enhanced walking brochure:

[\[Insert Figure 1 here\]](#)

[\[Insert Figure 2 here\]](#)

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,



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3 167 raising normative beliefs, or heightening perceived behavioural control, as these have  
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5 168 been shown to transition people from motivation to volition previously (Courneya *et*  
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7  
8 169 *al.* 2001).

9  
10 170 5. Messages operationalising these techniques were written into the enhanced brochure  
11  
12 171 being mindful not to interrupt the route directions which constituted the main  
13  
14 172 narrative of the brochure. Supplementary Table A displays a table of the change  
15  
16 173 mechanisms and behaviour change techniques that were selected, together with the  
17  
18 174 persuasive messages which were written into the 'enhanced' brochure to target these  
19  
20 175 techniques and mechanisms.

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23 176 6. Piloting these brochures helped clarify messages targeting injunctive normative  
24  
25 177 beliefs (e.g. “your friends and family would support you completing this walk”), as  
26  
27 178 too artificial. Such messages were deleted.

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### 32 33 180 **Measures**

34  
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36 181 Supplementary Table B contains the full wording, response options, and internal consistency  
37  
38 182 coefficients (where applicable) pertaining to the measures described in the sections below.

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### 42 43 184 **Outcome variables**

44  
45 185 Recreational walking intentions were operationalised in two ways. The primary outcome  
46  
47 186 analysed was a binary response to whether or not a participant requested further walking  
48  
49 187 information about outdoor recreational walking in natural environments at the end of the  
50  
51 188 survey. Requesting further information was interpreted as reflective of greater intentions to  
52  
53 189 engage in such walks in the future. Two 7-point Likert-scale items measuring behavioural  
54  
55 190 intentions (Ajzen 2006) were collapsed as a secondary outcome variable. We refer to these  
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3 191 two variables as ‘revealed intentions’ (more proximal to actual behaviour) and ‘stated  
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5 192 intentions’ (more distal from actual behaviour), respectively (Ben-Akiva *et al.* 1994).  
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### 194 **Recreational walking status**

195 To distinguish people who do not regularly undertake recreational walks in natural  
196 environments from those who do, an item which classified participants into five stages of  
197 readiness to change their recreational walking behaviour (Prochaska and Velicer 1997) was  
198 created. Responses to the former three response options (reflecting amotivation, or  
199 contemplation about changing behaviour in the long- or short-term) categorised participants  
200 as “non-walkers” and responses to the latter two options (reflecting recent changes to  
201 behaviour, or stable behaviour patterns) categorised participants as “walkers”. Similar  
202 measures have good construct validity for exercise adoption (Cardinal 1997).  
203

### 204 **Mediators**

205 Items were created to assess whether the enhanced brochure impacted “non-walkers”  
206 intentions through the proposed psychological change mechanisms of changing attitudes,  
207 raising normative beliefs, and heightening perceived behavioural control (Ajzen 2006). Items  
208 measuring affective attitudes, instrumental attitudes, normative beliefs, and perceived  
209 behavioural control were separately collapsed due to their high internal consistency  
210 (Supplementary Table B). Collapsed instrumental and affective attitude items were further  
211 combined into a single 'attitudes' construct for the same reason ( $\alpha=0.89$ ).  
212

### 213 **Covariates**

214 The experiment also collected a series of demographic details which were operationalised in  
215 analyses as follows: sex (male, female), age (18-34, 35-48, 49-65), ethnicity (White-British,

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3 216 all other ethnicities), long-standing illness (yes, no), and annual pre-tax household income  
4  
5 217 (five quintiles or “don’t know”). Ethnicity (Office for National Statistics 2016), long-standing  
6  
7 218 illness (Office for National Statistics 2001), and income (Office for National Statistics 2013)  
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10 219 were collected according to national norms. These covariates have been independently shown  
11  
12 220 to predict physical activity intentions or their antecedents (Wilson *et al.* 2004; Ziegelmann,  
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14 221 Lippke and Schwarzer 2006; Kosma *et al.* 2007; Amireault *et al.* 2008; Gavin, Fox and  
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16 222 Grandy 2011). Measures adapted from a national survey (Natural England 2017) queried the  
17  
18 223 participant’s short- and long-term propensity for visiting natural environments as this has  
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20 224 been shown to affect physical activity more generally (Coombes, Jones and Hillsdon 2010)  
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22  
23 225 and therefore could affect intentions to be physically active (Calogiuri and Chroni 2014).  
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## 27 28 227 **Procedure**

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31 228 Participants were randomised to one of the conditions based on a hyperlink sent to them in an  
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33 229 invitation email. After giving consent, participants responded to questions concerning  
34  
35 230 recreational walking status, short- and long-term propensity for visiting natural environments,  
36  
37 231 ethnicity, long-standing illness, and income on successive pages. Prior to seeing the brochure,  
38  
39 232 they read text that was adapted from a study concerning immersion in natural environments  
40  
41 233 (Weinstein, Przybylski and Ryan 2009) in order to engage them with the task. They then  
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43 234 could take as much as time as needed to read either the original or enhanced brochure in a  
44  
45 235 new browser window.  
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52 237 Following this, they were asked whether they had read the brochure extract fully with those  
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54 238 that did not being redirected to a debriefing page. Those that had proceeded to answer  
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56 239 questions concerning the attitudes, descriptive norms, perceived behaviour control, and stated  
57  
58 240 intentions. After this, they could also enter free responses as to what, if anything, had  
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3 241 changed their motivation for recreational walking. Lastly, they responded to the item  
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5 242 concerning revealed intentions. Supplementary Text A contains a transcript of the full  
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8 243 experiment.

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## 11 12 245 **Analysis**

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15 246 Piloting suggested the brochure took a minimum of two minutes to read, so participants  
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17 247 completing the experiment in less than three minutes were excluded *a priori*. Following  
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19 248 guidance, participants were also excluded if they took one standard deviation longer than the  
20  
21  
22 249 mean completion time (Malhotra 2008).

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26 251 Logistic and linear regression models were constructed to analyse the impact of the brochures  
27  
28 252 on revealed and stated intentions respectively. The original brochure was used as a reference  
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30 253 category as it is analogous to a ‘usual care’ condition in behavioural interventions (Freedland  
31  
32 254 *et al.* 2011). Models controlled for covariates and recreational walking status. Secondly, an  
33  
34 255 interaction term was added between the experimental condition and recreational walking  
35  
36 256 status to determine whether effects were stronger for “non-walkers”. Consistent with theories  
37  
38 257 of reasoned action and planned behaviour, subsidiary mediation models tested whether  
39  
40 258 differences in responses to the attitude, descriptive norm, and perceived behavioural control  
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42 259 items mediated the effect of brochure condition on the two intention outcomes for “non-  
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44 260 walkers” (i.e. whether the enhanced brochure worked through the psychological change  
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46 261 mechanisms we targeted).

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50 263 Analyses were conducted in R v3.4.0 (R Core Team 2018) using the “lavaan” package  
51  
52 264 (Rosseel 2012).

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## 266 RESULTS

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

274

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

284

285 [Insert Table 1 here]

286

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

288 Analysing all participants and controlling for potential confounds, the enhanced brochure did  
289 *not* prompt more requests for further recreational walking information than the original  
290 brochure ( $OR=0.82$ ; 95%  $CI$ : 0.54, 1.25; Supplementary Table C), but did prompt stronger

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3 291 *stated* intentions ( $b=0.32$ ; 95% *CI*: 0.03, 0.62). As expected, people classified as “walkers”  
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5 292 reported stronger revealed ( $OR=2.10$ ; 95% *CI*: 1.33, 3.34) and stated ( $b=1.03$ ; 95% *CI*: 0.71,  
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7 293 1.35) intentions than “non-walkers” overall.  
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### 11 12 295 **Were these effects stronger for “non-walkers”?**

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15 296 After adding an interaction term between the experimental brochure condition and  
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17 297 recreational walking status, distinct patterns for “non-walkers” and “walkers” emerged in  
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19 298 terms of both outcome variables (Figure 31). First, supporting our hypotheses, “non-walkers”  
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21 299 who read the enhanced brochure made significantly more requests for recreational walking  
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23 300 information than “non-walkers” who read the original brochure ( $OR=2.56$ ; 95% *CI*: 1.33,  
24  
25 301 5.07; Supplementary Table C). Secondly, “walkers” who read the original brochure made  
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27 302 significantly more requests than “non-walkers” who read the original brochure ( $OR=5.77$ ;  
28  
29 303 95% *CI*: 3.00, 11.51). Lastly, and unexpectedly, “walkers” who read the enhanced brochure  
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31 304 made significantly *fewer* requests than “non-walkers” who read the original brochure  
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33 305 ( $OR=0.14$ ; 95% *CI*: 0.06, 0.33). The pattern was the same for stated intentions, though effects  
34  
35 306 were slightly weaker, and in the case of the latter unexpected finding, not significant (Figure  
36  
37 307 13 and Supplementary Table C). Associations between the other potential confounds and the  
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39 308 outcome variables remained broadly consistent after the addition of this interaction term.  
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47 310 [Insert Figure 13 here]  
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52 312 These analyses were repeated including participants with atypically short or long completion  
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54 313 times (see ‘Analysis’) and all effects were weaker (Supplementary Table C), justifying our  
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56 314 decision to exclude on this basis.  
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3 316 **Did differences in attitudes, descriptive norms, and perceived behavioural control**  
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5 317 **mediate the effect of the brochures on recreational walking intentions for "non-**  
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7 318 **walkers"?**  
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10 319 As coefficients did not change substantially following the inclusion of covariates, the  
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12 320 mediation models excluded covariates in favour of just the experimental conditions,  
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14 321 outcomes, and mediators. For “non-walkers,” perceived behavioural control significantly  
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16 322 mediated the effects of the enhanced brochure on stated intentions ( $b=0.26$ ; 95% *CI*: 0.02,  
17  
18 323 0.50), explaining  $\approx 45\%$  of the variance in the total effect; but attitudes and subjective norms  
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20 324 did not mediate the effect (Figure 24). The combination of all three constructs also mediated  
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22 325 the effects of the enhanced brochure on stated intentions for “non-walkers” ( $b=0.42$ ; 95% *CI*:  
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24 326 0.05, 0.79), explaining  $\approx 73\%$  of the variance in the total effect.  
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31 328 [Insert Figure 24 here]  
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36 330 None of the three constructs significantly mediated the effects of the enhanced brochure on  
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38 331 the revealed intentions for “non-walkers” on their own; but the combination of all three did  
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40 332 ( $b=0.15$ ; 95% *CI*: 0.01, 0.30), explaining  $\approx 25\%$  of the variance in the total effect. As a  
41  
42 333 comparison, the same models were performed for “walkers” (Supplementary Figure A6) and  
43  
44 334 as predicted, neither differences in attitudes, descriptive norms, perceived behavioural  
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46 335 control, nor their sum, mediated the relationship between the experimental brochure  
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48 336 condition and either outcome variable.  
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54 338 **DISCUSSION**  
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57 339 In order to maximise the potential that natural environments have for encouraging  
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59 340 recreational walking, such experiences need to be optimally promoted, especially to less  
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3 341 active people. This experiment compared an archetypal walking brochure with one which had  
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5 342 been “enhanced” using persuasive messages which targeted theory-based psychological  
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7 343 change mechanisms. As hypothesised, this enhanced brochure prompted stronger recreational  
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9 344 walking intentions among “non-walkers” – they made over twice as many requests for further  
10  
11 345 walking information and on average reported intentions half a point higher compared with  
12  
13 346 reading the original brochure. Conversely, “walkers” who read the enhanced brochure were  
14  
15 347 much *less* likely to request further walking information than “walkers” who read the original  
16  
17 348 brochure. We also demonstrated that differences in the three psychological change  
18  
19 349 mechanisms targeted were responsible for influencing the intentions of “non-walkers,”  
20  
21  
22 350 (especially perceived behavioural control), but not “walkers”. This study further justifies the  
23  
24 351 need for behaviour change theory when designing recreational walking brochures, and indeed  
25  
26 352 physical activity interventions more generally (Rhodes *et al.* 2019). However, this study also  
27  
28 353 demonstrates that brochure authors (or intervention designers) need to be flexible with their  
29  
30 354 approach to selecting theories (Peters and Crutzen 2017), as the kinds of persuasive messages  
31  
32 355 (and underlying behaviour change techniques) that successfully strengthen intentions for one  
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34 356 audience, may not work for a different audience.  
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### 358 **Implications for the creation of outdoor recreational walking brochures for ‘non-** 359 **walkers’**

360 The main implication of these findings is that two distinct types of outdoor recreational  
361 walking brochure could be developed to heighten outdoor walking intentions among two  
362 target audiences. The first of these are “non-walkers,” that is, those who have not  
363 contemplated recreational walking in natural environments, or those that have contemplated  
364 this, but have currently failed to act on these thoughts. Consistent with previous research  
365 (Courneya *et al.* 2001), this study suggests that as well as route instructions, adding text to  
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3 366 brochures which attempts to change people's attitudes towards outdoor recreational walking,  
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5 367 promote normative beliefs about what similar others may do, or raise confidence for such  
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7 368 walking, may help “non-walkers” form stronger intentions to walk in natural environments  
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9  
10 369 by encouraging them to contemplate further how to undertake such action.  
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14 371 Brochure designers can consider influencing both instrumental attitudes (advantages of  
15  
16 372 undertaking outdoor recreational walking) and affective attitudes (emotions stimulated by  
17  
18 373 performing outdoor recreational walking). This study cannot deconstruct which type of  
19  
20 374 message may be more persuasive, but studies have previously suggested that affective  
21  
22 375 attitudes may be more important for predicting the uptake of physical activity (Lowe, Eves  
23  
24 376 and Carroll 2002; French *et al.* 2005). Brochure designers also have the opportunity to  
25  
26 377 describe the outdoor recreational walking behaviour of peers or encourage recipients to seek  
27  
28 378 social comparison opportunities (e.g. encouraging people to interact with others in walking  
29  
30 379 groups; Supplementary Table A). However, normative beliefs are typically weak predictors  
31  
32 380 of physical activity uptake (Downs and Hausenblas 2005) which may explain their weaker  
33  
34 381 influence in our mediation models.  
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42 383 There are multiple ways in which brochure designers can promote perceived behavioural  
43  
44 384 control (i.e. raising people's confidence for performing recreational walking in natural  
45  
46 385 environments). In this study, we targeted this change mechanism in a number of ways  
47  
48 386 (Supplementary Table A): (a) prompting reattribution of past failures (e.g. past failed  
49  
50 387 attempts to start outdoor recreational walking); (b) prompting barrier identification and  
51  
52 388 planning in relation to anticipated barriers (e.g. difficulty in climbing hills); (c) setting graded  
53  
54 389 tasks/goals (e.g. prompting practice of multiple, shorter walks); (d) providing feedback on  
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56 390 performance (e.g. commending the recipient on successful completion of a stage); (e) using  
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3 391 arguments to bolster confidence (e.g. arguing against self-doubt and asserting that they can  
4  
5 392 succeed in changing their behaviour); and (f) prompting organisation of social support (e.g.  
6  
7 393 joining a walking group). This change mechanism (enhancing confidence) may be prompted  
8  
9  
10 394 by a variety of behaviour change techniques (Abraham and Kools 2011) and was the most  
11  
12 395 frequently targeted in the enhanced brochure, potentially explaining why it was the most  
13  
14 396 important construct in relation to predicting behavioural intentions.  
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19 398 Previous research has further demonstrated that confidence-building aspects of perceived  
20  
21 399 behavioural control are particularly important for forming intentions to take up physical  
22  
23 400 activity more generally (Hagger, Chatzisarantis and Biddle 2002). "Non-walkers" quotes  
24  
25 401 about the enhanced brochure illustrated the persuasive nature of these messages: *"it is a very*  
26  
27 402 *positive leaflet that made me feel comfortable in taking it on despite having no experience"*;  
28  
29 403 and *"it was very encouraging and felt like it was addressing me as an individual and not just*  
30  
31 404 *giving the route directions, which is the norm...it made me want to start walking again."*  
32  
33 405 While there were not sufficient responses to this open question to undertake systematic  
34  
35 406 qualitative analysis, these quotes at least suggest that for some "non-walkers," enhancing  
36  
37 407 confidence for walking in natural environments was the primary means by which they formed  
38  
39 408 stronger intentions, supporting the quantitative findings. All responses to this open question  
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41 409 can be found in the raw data upon request from the authors.  
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49 411 While this discussion suggests that designing persuasive messages targeting perceived  
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51 412 behavioural control and attitudes (especially affective attitudes) may be most effective at  
52  
53 413 encouraging "non-walkers" to contemplate future outdoor recreational walking, our  
54  
55 414 mediation models also suggest that the combination of our three key change mechanisms is  
56  
57 415 also important. Brochure designers are encouraged to consult practical guidance (e.g.  
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3 416 Abraham & Kools, 2011) on how to incorporate persuasive messages targeting these change  
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5 417 mechanisms in a wider variety of ways which go beyond the techniques employed in the  
6  
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8 418 present study.  
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### 12 420 **Implications for the creation of outdoor recreational walking brochures for ‘walkers’**

15 421 Brochure designers may also wish to design persuasive messages for “walkers” who are more  
16  
17 422 familiar with walking trails. In this study, these were classified as people who were already  
18  
19 423 undertaking outdoor recreational walking in natural environments. These people were  
20  
21 424 substantially *less* likely to request further walking information after reading the enhanced  
22  
23 425 brochure, suggesting that the changes to the original brochure actually *dissuaded* these  
24  
25 426 individuals from walking in natural environments.  
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31 428 While qualitative responses were too scarce to draw definitive conclusions, some responses  
32  
33 429 revealed that the enhanced brochure may have lowered intentions for these “walkers” because  
34  
35 430 they found the language within to be patronising: “*The tone of the leaflet was quite*  
36  
37 431 *condescending,*” and “*leave the motivational stuff to a separate section...it is annoying and*  
38  
39 432 *patronising.*” This could be seen as analogous to the notion of ‘baby talk’ in health  
40  
41 433 psychology research where a healthcare provider underestimates the patient’s knowledge and  
42  
43 434 uses language perceived as patronising, thus leading to disengagement (Waitzkin 1985).  
44  
45 435 Generally speaking, the effects of both brochures on “walkers” intentions were the strongest  
46  
47 436 observed effects in the present study; greater than, for example, the effects of sex, age,  
48  
49 437 ethnicity, or income on these intentions (Supplementary Table C). Thus, “walkers,” even  
50  
51 438 more so than “non-walkers,” could be particularly responsive to the written content of  
52  
53 439 recreational walking brochures.  
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3 441 The original brochure may appeal more to “walkers” because it already contained the sort of  
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5 442 information that was more persuasive for this group (Blinded for review, 2016). This could  
6  
7 443 be messages which highlighted heritage features in natural environments, or signposted the  
8  
9 444 reader to nearby amenities (McCormack *et al.* 2010). While these messages could be  
10  
11 445 construed to be related to material consequences of recreational walking (and thus, could  
12  
13 446 change attitudes towards the behaviour), we are unable to provide definitive guidance on  
14  
15 447 what types of message may be most persuasive for “walkers” because our mediation models  
16  
17 448 did not identify differences in attitudes, normative beliefs, or perceived behavioural control  
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19 449 between the two brochures for this audience (Supplementary Figure [A€](#)). However, we do  
20  
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24 450 recommend that intentionally designing theory-derived persuasive messages in recreational  
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26 451 walking brochures for this group should not involve the use of text that could be construed as  
27  
28 452 “patronising”, regardless of the change mechanisms that are targeted.  
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33 454 Without further knowledge of the guidelines and management considerations that factor into  
34  
35 455 how a brochure advertising recreational walking in natural environments is created and  
36  
37 456 written, it is difficult to make recommendations on how different design guidelines could be  
38  
39 457 implemented in reality. Nonetheless, this study provides evidence that the implementation of  
40  
41 458 guidelines which encourage the use of evidence-based persuasive messages is effective at  
42  
43 459 changing recreational walking intentions. While only intentions were measured in the current  
44  
45 460 study, meta-analysis has shown that targeting the same mechanisms have small but  
46  
47 461 significant effects on actual behaviour change (Webb and Sheeran 2006). Furthermore such  
48  
49 462 tailored media could support so-called “green prescriptions,” i.e. direct recommendations  
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51 463 from health care professionals to spend more time in natural settings to improve health and  
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53 464 wellbeing (Van den Berg 2017).  
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## 466 **Limitations**

467 Firstly, while only the text component of the original brochure was manipulated in this study,  
468 there are numerous stylistic features that may aid or inhibit comprehension of the written text  
469 e.g. graphical illustrations of specific behaviours (Kools *et al.* 2006), or coloured tabs and  
470 pictorials (Kools *et al.* 2007). Secondly, the brochures used in this experiment described a  
471 linear route in a semi-rural riverside location, but people's preferences for features of  
472 recreational walking routes differ with their demographics (Davies, Lumsdon and Weston  
473 2012). Replications of the present study with different audiences and different exemplar  
474 brochures are necessary to determine how generalisable the current findings are.

475  
476 Thirdly, the three psychological change mechanisms we targeted do not necessarily support  
477 maintenance of behaviour change (Kwasnicka *et al.* 2016), i.e. the brochure does not propose  
478 an explanation as to how individuals could maintain physically active behaviours once they  
479 have initiated these behaviours. Future attempts to design persuasive messages in recreational  
480 walking brochures may wish to draw on other behavioural models, such as the model of  
481 behavioural maintenance (Rothman 2000), in order to elicit more sustained changes in  
482 people's walking behaviour.

483  
484 We are also aware that specific text substitutions may have influenced our outcomes in  
485 unintended ways. For example, we changed the text "*a steep climb... and a fairly steep*  
486 *descent*" to "*there is one climb and descent. These are not too difficult if you shorten your*  
487 *stride and pace yourself – this will make it feel much easier*", with additional text reading  
488 "*climbing hills can be difficult, but pace yourself and you'll find it much easier.*" Removing  
489 the word 'steep,' notwithstanding other factors affecting perceived steepness (Schnall *et al.*  
490 2008; Schnall, Zadra and Proffitt 2010; Taylor-Covill and Eves 2016), may have affected

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3 491 intentions, or their antecedents, measured in this study. However, rather than misleading  
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5 492 readers, we were simply acknowledging that individuals may find the terrain difficult and that  
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8 493 by implementing a simple strategy this challenge could be overcome.  
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10 494  
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12 495 More generally, the generalisability of our results to other contexts is questionable. The  
13  
14 496 materials used in our present study may be culturally specific to a British population, and our  
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17 497 analysis cannot address how likely less active populations are to access such materials. Future  
18  
19 498 research could therefore focus on replication in populations with different cultures of walking  
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21 499 and qualitative explorations of similar materials with target populations as part of their  
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24 500 development. We also recognise that tailored communication messages are already  
25  
26 501 ubiquitous in mobile health applications, but applications like these are typically geared  
27  
28 502 towards populations already motivated to change their behaviour (Bardus *et al.* 2016), and in  
29  
30 503 any case we contend that there is still good evidence to suggest that greenspace interventions  
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32 504 fail to make the best use of potentially persuasive physical activity behaviour change  
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34 505 messages (Roberts *et al.* 2016).  
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40 507 Lastly, our findings cannot be seen in isolation from the wider socio-ecological systems that  
41  
42 508 influence physical activity (Sallis and Owen 2015). If the ultimate public health goal is  
43  
44 509 reducing physical inactivity, then policy-level initiatives such as improving accessibility or  
45  
46 510 safety of walking settings may be most effective (Panter *et al.* 2019). Nonetheless,  
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48 511 intervening without understanding behavioural complexities and motivations of individuals  
49  
50 512 would ignore a key part of these complex socio-ecological systems and potentially undermine  
51  
52 513 interventions (Rhodes *et al.* 2019), so explorations like those in the present study remain  
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54 514 worthwhile endeavours.  
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## 516 CONCLUSIONS

517 To ensure natural environments are used for recreational walking, especially by people who  
518 are typically less active, these opportunities should be effectively promoted using appropriate  
519 persuasive messages. However, current ~~texts-materials~~ may not do so optimally. This study  
520 ~~investigated the effect of systematically adding theory-derived persuasive messages to an~~  
521 ~~existing recreational walking brochure on future intentions to walk for recreation in natural~~  
522 ~~environments~~ found that enhancing existing materials with theory-based persuasive messaging  
523 was effective at strengthening walking intentions among less active adults. We demonstrated  
524 a need for two types of recreational walking brochure: (a) those appealing to “non-walkers”  
525 which attempt to increase intentions to engage in outdoor recreational walking in natural  
526 environments by targeting determinants such as perceived behavioural control; and, (b) those  
527 aimed at already-motivated “walkers” which can assume motivation, avoid the use of  
528 patronising language, and focus on extrinsic features of a recreational walking route with  
529 clear instructions, thus supporting walking maintenance. Brochure authors are encouraged to  
530 make use of these guidelines and other existing practical guidance on how to construct  
531 messages which target evidence-based antecedents of physical activity behaviour change and  
532 to be vigilant to the variability in effective communication strategies for different target  
533 audiences. Provision of supportive natural environments for physical activity is necessary,  
534 but it is not a sufficient means of altering community- or population-level physical activity  
535 behaviour. Individualised approaches, such as those presented in this manuscript remain  
536 fundamental to altering physical activity behaviours.

**REFERENCES**

Abraham C, Michie S. A taxonomy of behavior change techniques used in interventions. *Health psychology* 2008;**27**:379.

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

Abraham C, Southby L, Quandt S *et al.* What's in a leaflet? Identifying research-based persuasive messages in European alcohol-education leaflets. *Psychology & Health* 2007;**22**:31–60.

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.

Baker PR, Francis DP, Soares J *et al.* Community wide interventions for increasing physical activity. *Cochrane Database of Systematic Reviews* 2015, DOI: 10.1002/14651858.CD008366.pub3.

Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychological review* 1977;**84**:191–215.

Bardus M, van Beurden SB, Smith JR *et al.* A review and content analysis of engagement, functionality, aesthetics, information quality, and change techniques in the most



1  
2  
3 [popular commercial apps for weight management. \*International Journal of\*](#)  
4 [\*Behavioral Nutrition and Physical Activity\* 2016;\*\*13\*\*:35.](#)  
5  
6  
7

8  
9 Behrend TS, Sharek DJ, Meade AW *et al.* The viability of crowdsourcing for survey  
10 research. *Behav Res Methods* 2011;**43**:800–13.  
11  
12

13  
14 [Bélangier M, Townsend N, Foster C. Age-related differences in physical activity profiles of](#)  
15 [English adults. \*Preventive Medicine\* 2011, DOI: 10.1016/j.ypmed.2011.02.008.](#)  
16  
17  
18

19  
20 Ben-Akiva M, Bradley M, Morikawa T *et al.* Combining revealed and stated preferences  
21 data. *Mark Lett* 1994;**5**:335–349.  
22  
23

24  
25 Calogiuri G, Chroni S. The impact of the natural environment on the promotion of active  
26 living: an integrative systematic review. *BMC Public Health* 2014;**14**:873.  
27  
28

29  
30 Cardinal BJ. Construct Validity of Stages of Change for Exercise Behavior. *Am J Health*  
31 *Promot* 1997;**12**:68–74.  
32  
33

34  
35 [Carver CS, Scheier MF. Control theory: A useful conceptual framework for personality–](#)  
36 [social, clinical, and health psychology. \*Psychological Bulletin\* 1982;\*\*92\*\*:111–35.](#)  
37  
38  
39

40  
41  
42  
43 Coombes E, Jones AP, Hillsdon M. The relationship of physical activity and overweight to  
44 objectively measured green space accessibility and use. *Soc Sci Med* 2010;**70**:816–22.  
45  
46

47  
48  
49 Courneya KS, Plotnikoff RC, Hotz SB *et al.* Predicting exercise stage transitions over two  
50 consecutive 6-month periods: A test of the theory of planned behaviour in a  
51 population-based sample. *Br J Health Psychol* 2001;**6**:135–50.  
52  
53  
54

55  
56  
57 Dahmann N, Wolch J, Joassart-Marcelli P *et al.* The active city? Disparities in provision of  
58 urban public recreation resources. *Health Place* 2010;**16**:431–45.  
59  
60

1  
2  
3 Davies NJ, Lumsdon LM, Weston R. Developing Recreational Trails: Motivations for  
4  
5 Recreational Walking. *Tour Plan Dev* 2012;**9**:77–88.  
6  
7

8  
9 Downs DS, Hausenblas HA. The Theories of Reasoned Action and Planned Behavior  
10  
11 Applied to Exercise: A Meta-analytic Update. *J Phys Act Health* 2005;**2**:76–97.  
12  
13

14  
15 Fishbein M. A Reasoned Action Approach to Health Promotion. *Med Decis Making*  
16  
17 2008;**28**:834–44.  
18  
19

20  
21 Fjeldsoe B, Neuhaus M, Winkler E *et al.* Systematic review of maintenance of behavior  
22  
23 change following physical activity and dietary interventions. *Health Psychol*  
24  
25 2011;**30**:99–109.  
26  
27

28  
29 Freedland KE, Mohr DC, Davidson KW *et al.* Usual and Unusual Care: Existing Practice  
30  
31 Control Groups in Randomized Controlled Trials of Behavioral Interventions.  
32  
33 *Psychosom Med* 2011;**73**:323–35.  
34  
35

36  
37 French DP, Sutton S, Hennings SJ *et al.* The importance of affective beliefs and attitudes in  
38  
39 the theory of planned behavior: Predicting intention to increase physical activity. *J*  
40  
41 *Appl Soc Psychol* 2005;**35**:1824–1848.  
42  
43

44  
45 Foster CE, Brennan G, Matthews A *et al.* Recruiting participants to walking intervention  
46  
47 studies: a systematic review. *International Journal of Behavioral Nutrition and*  
48  
49 *Physical Activity* 2011;**8**:137.  
50  
51

52  
53 Gagné T, Lapalme J. Multidisciplinarity in health promotion and the era of planetary health.  
54  
55 *Health Promot Int* 2019;**34**:378–378.  
56  
57

- 1  
2  
3 Gainforth HL, Barg CJ, Latimer AE *et al.* An investigation of the theoretical content of  
4  
5 physical activity brochures. *Psychol Sport Exerc* 2011;**12**:615–20.  
6  
7  
8  
9 Gavin JR, Fox KM, Grandy S. Race/Ethnicity and gender differences in health intentions and  
10  
11 behaviors regarding exercise and diet for adults with type 2 diabetes: A cross-  
12  
13 sectional analysis. *BMC Public Health* 2011;**11**:533.  
14  
15  
16  
17 Gosling SD, Vazire S, Srivastava S *et al.* Should We Trust Web-Based Studies? A  
18  
19 Comparative Analysis of Six Preconceptions About Internet Questionnaires. *Am*  
20  
21 *Psychol* 2004;**59**:93–104.  
22  
23  
24  
25 Guthold R, Stevens GA, Riley LM *et al.* Worldwide trends in insufficient physical activity  
26  
27 from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9  
28  
29 million participants. *Lancet Glob Health* 2018, DOI: 10.1016/S2214-109X(18)30357-  
30  
31 7.  
32  
33  
34  
35 Hagger MS, Chatzisarantis NLD, Biddle SJH. A meta-analytic review of the theories of  
36  
37 reasoned action and planned behavior in physical activity: predictive validity and the  
38  
39 contribution of additional variables. *J Sport Exerc Psychol* 2002;**24**:3–32.  
40  
41  
42  
43 Hamer M, Chida Y. Walking and primary prevention: a meta-analysis of prospective cohort  
44  
45 studies. *British Journal of Sports Medicine* 2008;**42**:238–43.  
46  
47  
48  
49 Hunter RF, Christian H, Veitch J *et al.* The impact of interventions to promote physical  
50  
51 activity in urban green space: A systematic review and recommendations for future  
52  
53 research. *Soc Sci Med* 2015;**124**:246–56.  
54  
55  
56  
57 Kools M, Ruiter RAC, van de Wiel MWJ *et al.* Testing the usability of access structures in a  
58  
59 health education brochure. *Br J Health Psychol* 2007;**12**:525–41.  
60

- 1  
2  
3 Kools M, van de Wiel MWJ, Ruiter RAC *et al.* Pictures and text in instructions for medical  
4 devices: Effects on recall and actual performance. *Patient Educ Couns* 2006;**64**:104–  
5 11.  
6  
7  
8  
9  
10  
11 Kosma M, Ellis R, Cardinal BJ *et al.* The Mediating Role of Intention and Stages of Change  
12 in Physical Activity among Adults with Physical Disabilities: An Integrative  
13 Framework. *J Sport Exerc Psychol* 2007;**29**:21–38.  
14  
15  
16  
17  
18  
19 Kwasnicka D, Dombrowski SU, White M *et al.* Theoretical explanations for maintenance of  
20 behaviour change: a systematic review of behaviour theories. *Health Psychol Rev*  
21 2016;**10**:277–96.  
22  
23  
24  
25  
26  
27 Lowe R, Eves F, Carroll D. The influence of affective and instrumental beliefs on exercise  
28 intentions and behavior: A longitudinal analysis. *J Appl Soc Psychol* 2002;**32**:1241–  
29 1252.  
30  
31  
32  
33  
34  
35  
36 Malhotra N. Completion Time and Response Order Effects in Web Surveys. *Public Opin Q*  
37 2008;**72**:914–34.  
38  
39  
40  
41 McCormack GR, Rock M, Toohey AM *et al.* Characteristics of urban parks associated with  
42 park use and physical activity: A review of qualitative research. *Health Place*  
43 2010;**16**:712–26.  
44  
45  
46  
47  
48  
49 McKay J, Wright A, Lowry R *et al.* Walking on prescription: The utility of a pedometer pack  
50 for increasing physical activity in primary care. *Patient Educ Couns* 2009;**76**:71–6.  
51  
52  
53  
54  
55 Meade AW, Craig SB. Identifying careless responses in survey data. *Psychol Methods*  
56 2012;**17**:437–55.  
57  
58  
59  
60

1  
2  
3 [Keshavarz Mohammadi N. One step back toward the future of health promotion: complexity-](#)  
4 [informed health promotion. \*Health Promot Int\* 2019;\*\*34\*\*:635–9.](#)  
5  
6

7  
8  
9 [Michie S, Abraham C, Whittington C et al. Effective techniques in healthy eating and](#)  
10 [physical activity interventions: a meta-regression. \*Health Psychol\* 2009;\*\*28\*\*:690.](#)  
11  
12

13  
14  
15 National Institute for Health and Care Excellence. *Walking and Cycling: Local Measures to*  
16 *Promote Walking and Cycling as Forms of Travel or Recreation.*, 2012.  
17  
18

19  
20  
21 Natural England. *Monitor of Engagement with the Natural Environment: Technical Report to*  
22 *the 2009-16 Surveys.*, 2017.  
23  
24

25  
26 Office for National Statistics. Census 2001 questionnaires. 2001.  
27  
28

29  
30 Office for National Statistics. *The Effects of Taxes and Benefits on Household Income,*  
31 *2011/12.*, 2013.  
32  
33

34  
35 Office for National Statistics. Guidance and Methodology: Measuring equality: Ethnic  
36 Group, National Identity and Religion: Ethnic group [ARCHIVED CONTENT] UK  
37 Government Web Archive - The National Archives. 2016.  
38  
39  
40

41  
42  
43 Ogilvie D, Foster CE, Rothnie H et al. Interventions to promote walking: systematic review.  
44 *BMJ* 2007;**334**:1204–1204.  
45  
46

47  
48  
49 [Panter J, Guell C, Humphreys D et al. Title: Can changing the physical environment promote](#)  
50 [walking and cycling? A systematic review of what works and how. \*Health & Place\*](#)  
51 [2019;\*\*58\*\*:102161.](#)  
52  
53  
54

55  
56  
57 [Peters G-JY, Crutzen R. Pragmatic nihilism: how a Theory of Nothing can help health](#)  
58 [psychology progress. \*Health Psychology Review\* 2017;\*\*11\*\*:103–21.](#)  
59  
60

1  
2  
3 Prochaska JO, Velicer WF. The Transtheoretical Model of Health Behavior Change. *Am J*  
4  
5 *Health Promot* 1997;**12**:38–48.

6  
7  
8  
9 R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria,  
10  
11 2018.

12  
13  
14 Rhodes RE, Kates A. Can the Affective Response to Exercise Predict Future Motives and  
15  
16 Physical Activity Behavior? A Systematic Review of Published Evidence. *Ann Behav*  
17  
18 *Med* 2015;**49**:715–31.

19  
20  
21  
22  
23 Rhodes RE, McEwan D, Rebar AL. Theories of physical activity behaviour change: A history  
24  
25 and synthesis of approaches. *Psychology of Sport and Exercise* 2019;**42**:100–9.

26  
27  
28 Rind E, Jones AP. The geography of recreational physical activity in England. *Health Place*  
29  
30 2011;**17**:157–65.

31  
32  
33  
34 Roberts H, McEachan R, Margary T *et al*. Identifying Effective Behavior Change Techniques  
35  
36 in Built Environment Interventions to Increase Use of Green Space: A Systematic  
37  
38 Review. *Environ Behav* 2016:0013916516681391.

39  
40  
41  
42 Robertson R, Robertson A, Jepson R *et al*. Walking for depression or depressive symptoms:  
43  
44 A systematic review and meta-analysis. *Ment Health Phys Act* 2012;**5**:66–75.

45  
46  
47  
48 Rosseel Y. lavaan: An R Package for Structural Equation Modeling. *J Stat Softw* 2012;**48**,  
49  
50 DOI: 10.18637/jss.v048.i02.

51  
52  
53  
54 Rothman AJ. Toward a theory-based analysis of behavioral maintenance. *Health Psychol*  
55  
56 2000;**19**:64–9.

1  
2  
3 Sallis JF, Owen N. Ecological models of health behavior. *Health Behavior: Theory,*  
4 *Research, and Practice.* 5th ed. San Francisco, CA: John Wiley & Sons, 2015.

5  
6  
7  
8  
9 Scarborough P, Bhatnagar P, Wickramasinghe KK *et al.* The economic burden of ill health  
10 due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to  
11 2006-07 NHS costs. *Journal of Public Health* 2011;**33**:527–35.

12  
13  
14  
15  
16  
17 Schnall S, Harber KD, Stefanucci JK *et al.* Social support and the perception of geographical  
18 slant. *J Exp Soc Psychol* 2008;**44**:1246–55.

19  
20  
21  
22  
23 Schnall S, Zadra JR, Proffitt DR. Direct Evidence for the Economy of Action: Glucose and  
24 the Perception of Geographical Slant. *Perception* 2010;**39**:464–82.

25  
26  
27  
28  
29 Sellers CE, Grant PM, Ryan CG *et al.* Take a walk in the park? A cross-over pilot trial  
30 comparing brisk walking in two different environments: Park and urban. *Prev Med*  
31 2012;**55**:438–43.

32  
33  
34  
35  
36 Sniehotta FF, Araújo-Soares V, Brown J *et al.* Complex systems and individual-level  
37 approaches to population health: a false dichotomy? *The Lancet* 2017;**2**, DOI:  
38 10.1016/S0140-6736(17)31267-9.

39  
40  
41  
42  
43  
44  
45 Sniehotta FF, Scholz U, Schwarzer R. Bridging the intention–behaviour gap: Planning, self-  
46 efficacy, and action control in the adoption and maintenance of physical exercise.  
47 *Psychol Health* 2005;**20**:143–60.

48  
49  
50  
51  
52  
53 Stanton R, Reaburn P. Exercise and the treatment of depression: A review of the exercise  
54 program variables. *Journal of Science and Medicine in Sport* 2014;**17**:177–82.

1  
2  
3 Taylor-Covill GAH, Eves FF. Carrying a biological “backpack”: Quasi-experimental effects  
4  
5 of weight status and body fat change on perceived steepness. *J Exp Psychol Hum*  
6  
7 *Percept Perform* 2016;**42**:331–8.

10  
11 Thompson Coon J, Boddy K, Stein K *et al.* Does Participating in Physical Activity in  
12  
13 Outdoor Natural Environments Have a Greater Effect on Physical and Mental  
14  
15 Wellbeing than Physical Activity Indoors? A Systematic Review. *Environ Sci*  
16  
17 *Technol* 2011;**45**:1761–72.

20  
21 Tversky A, Kahneman D. Judgment under uncertainty: Heuristics and biases. *Science*  
22  
23 1974;**185**:1124–31.

26  
27 Van den Berg AE. From Green Space to Green Prescriptions: Challenges and Opportunities  
28  
29 for Research and Practice. *Front Psychol* 2017;**8**, DOI: 10.3389/fpsyg.2017.00268.

32  
33 van Holle V, Deforche B, Van Cauwenberg J *et al.* Relationship between the physical  
34  
35 environment and different domains of physical activity in European adults: a  
36  
37 systematic review. *BMC public health* 2012;**12**:807.

40  
41 Waitzkin H. Information Giving in Medical Care. *J Health Soc Behav* 1985;**26**:81.

44  
45 Webb TL, Sheeran P. Does changing behavioral intentions engender behavior change? A  
46  
47 meta-analysis of the experimental evidence. *Psychol Bull* 2006;**132**:249–68.

49  
50 Weinstein N, Przybylski AK, Ryan RM. Can Nature Make Us More Caring? Effects of  
51  
52 Immersion in Nature on Intrinsic Aspirations and Generosity. *Pers Soc Psychol Bull*  
53  
54 2009;**35**:1315–29.



1  
2  
3 White MP, Elliott LR, Taylor T *et al.* Recreational physical activity in natural environments  
4 and implications for health: A population based cross-sectional study in England.  
5  
6 *Preventive Medicine* 2016;**91**:383–8.  
7  
8  
9

10  
11 White MP, Wheeler BW, Herbert S *et al.* Coastal proximity and physical activity: Is the coast  
12 an under-appreciated public health resource? *Preventive Medicine* 2014;**69**:135–40.  
13  
14  
15  
16

17 Wilson PM, Rodgers WM, Fraser SN *et al.* Relationships between Exercise Regulations and  
18  
19 Motivational Consequences in University Students. *Res Q Exerc Sport* 2004;**75**:81–  
20  
21 91.  
22  
23  
24

25 Ziegelmann JP, Lippke S, Schwarzer R. Adoption and maintenance of physical activity:  
26  
27 Planning interventions in young, middle-aged, and older adults. *Psychol Health*  
28  
29 2006;**21**:145–63.  
30  
31  
32

33 Blinded for review, 2015.  
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36 Blinded for review, 2016.  
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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	%	43.56	38.86	21.59	42.55	60.53	35.35
	<i>SE</i>	3.49	3.51	4.39	5.10	4.58	4.80
Stated intentions	<i>M</i>	4.99	5.32	4.20	4.78	5.60	5.83
	<i>SD</i>	1.77	1.54	1.69	1.63	1.59	1.25
Attitudes	<i>M</i>	5.27	5.51	4.88	5.20	5.58	5.80
	<i>SD</i>	1.18	1.27	1.22	1.38	1.05	1.09
Normative beliefs	<i>M</i>	5.16	5.32	4.68	4.97	5.53	5.65
	<i>SD</i>	1.39	1.46	1.38	1.52	1.30	1.32
Perceived behavioural control	<i>M</i>	4.59	5.30	4.33	4.85	5.43	5.73
	<i>SD</i>	1.52	1.47	1.65	1.64	1.21	1.15

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

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3 each. Recreational walking status was dichotomized into two groups representing those who self-reported being in the precontemplation, contemplation, and preparation  
4 stages of change (“non-walkers”), and those who self-reported being in the action and maintenance stages of change (“walkers”).  
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For Peer Review

## Figure captions

Figure 1. The original brochure.

Figure 2. The 'enhanced' brochure.

Figure 34. The effect of the interaction between the experimental condition and recreational walking status on both outcome variables.

Figure 42. 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.

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**Stage 1:**  
**Forhampton to Wickbury**  
Distance: 5 miles (8 km)

**Difficulties:** Uneven surfaces, including fields, grassy lanes and woodland tracks. Some muddy stretches after heavy rain.  
**Gradient:** A steep climb away from the West Forment River below Peldon Viaduct. Fairly steep descents 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.

**4** 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.

**5** 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.

**6** 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.

**7** 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.

**8** 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.

**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.

**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.

The original brochure.

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**Stage 1:**  
**Forhampton to Wickbury**  
Distance: 5 miles (8 km)

**Staircases:** Whatever your previous experience, this leaflet will help you tackle all the surfaces on this walk.  
**Gradient:** 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.  
**Obstructions:** 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.



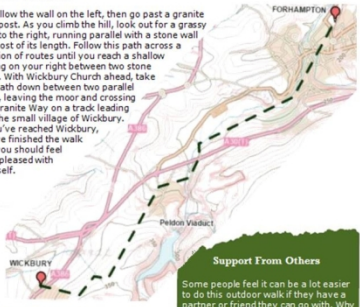
**4** Walking every day can have a variety of health benefits. Completing a walk like this will reduce your blood pressure and may help you stay more relaxed for the rest of the day. Experts say a 30 minute walk 5 days a week can sustain these benefits long-term. Lots of people walk on a daily basis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

**5** 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.

**6** 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.

**7** 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.

**8** 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 finished the walk and you should feel very pleased with yourself.

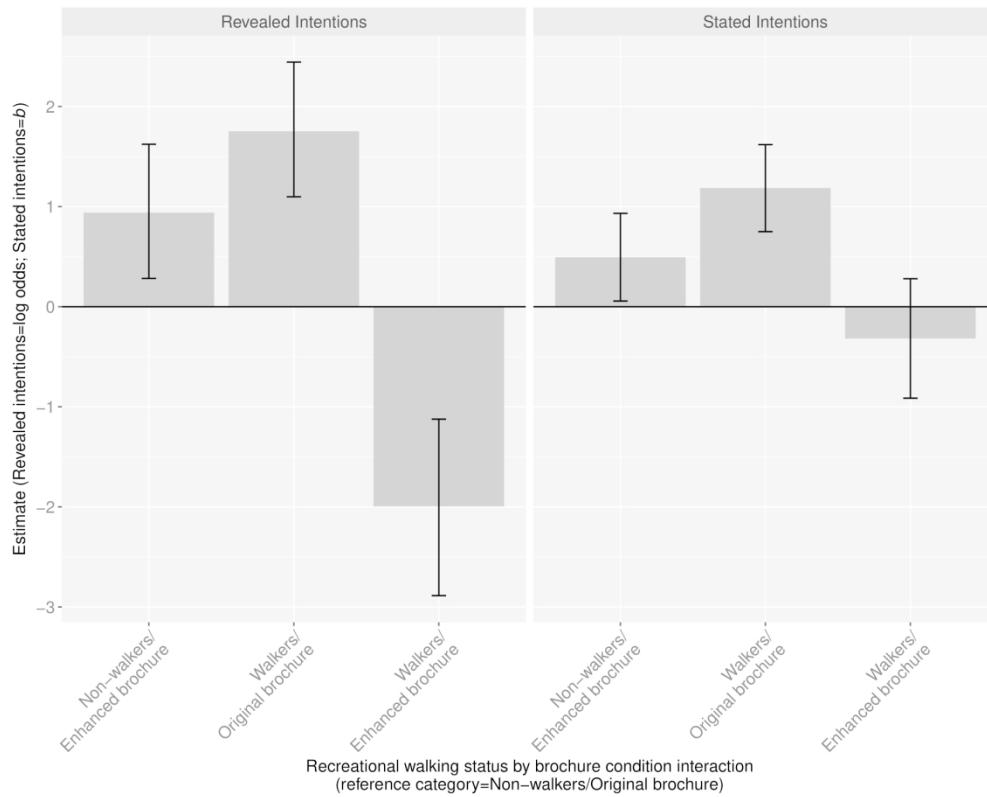


**Regular Walkers**  
Walking is simple, free and one of the easiest ways to become healthier - all you need is a pair of shoes. It's ideal for people of all ages and fitness levels who want to be more active. Regular outdoor walkers tend to be healthy and sociable types of people. They also provide 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.rambles.org.uk/go-walking.aspx> and enter a postcode to find a walking group in a specific location.

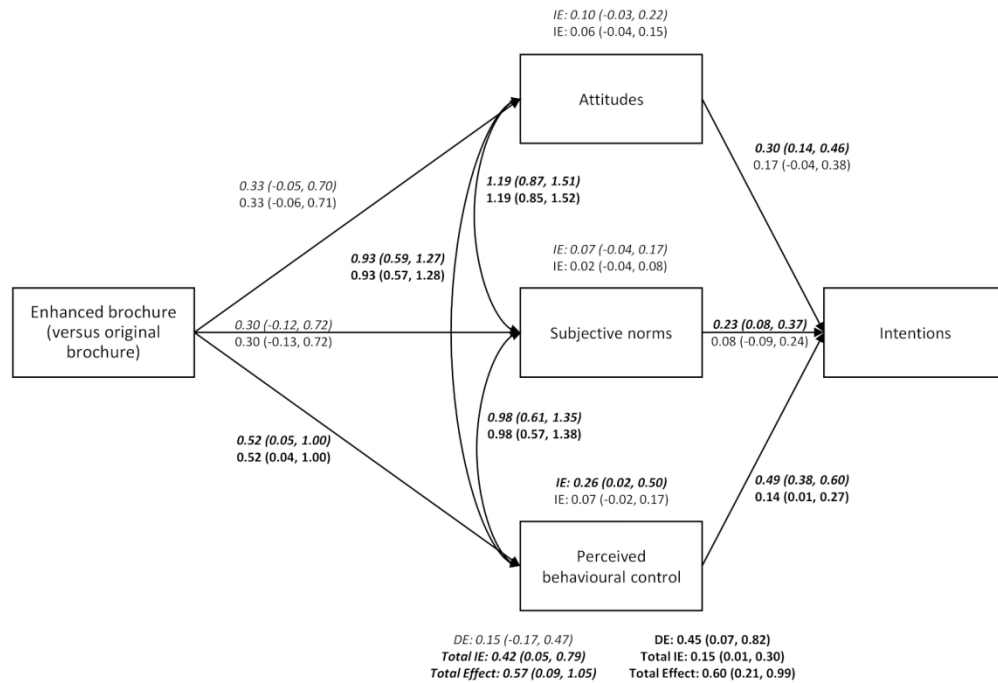
The 'enhanced' brochure.

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

705x564mm (72 x 72 DPI)



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.

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