



Enhancing the benefits of outdoor walking with cognitive engagement strategies

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ABSTRACT

Being physically active in natural environments has been associated with improvements to physical health and mental well-being. Unfortunately, gaining access to outdoor settings that are supportive of both psychological well-being and year-round physical activity poses major challenges. Might altering how one engages in and interacts with the outdoor environment encouraging greater physical activity and enhance well-being? In order to investigate this approach, 117 adults were randomly assigned to one of two treatments — Standard Care (schedule setting, commitment) or Engagement (awareness plans) — and asked to take at least three, 30 minutes outdoor walks each week for two weeks. Participants in both treatment conditions reported significant increases in total time spent walking ($p \leq .05$). Only those in the Engagement condition, however, experienced significant improvements in multiple dimensions of psychological well-being, including attentional functioning and feelings of frustration. In addition, participants in the engagement-based condition who walked at low to moderate levels were more likely to obtain psychological benefits. The results of this study suggest that promoting cognitive engagement with the environment may make it easier for individuals to achieve the psychological benefits typically associated with outdoor physical activity, even in settings that are less than ideal.

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1. Introduction

The link between increased physical activity and improvements in physiological health, including the prevention of cardiovascular disease, diabetes, various types of cancer, hypertension, obesity, and osteoporosis has been well established (Warburton, Nicol, & Bredin, 2006). The ability of physical activity to influence psychological health, however, has received far less attention until relatively recently.

Fortunately, health researchers have begun to recognize the important role regular physical activity can play in maintaining and enhancing mental health and psychological well-being. Studies have shown that even moderate intensity activities, such as walking, are associated with reductions in anxiety (Biddle, 1995; Fox, 1999; Scully, Kremer, Meade, Graham, & Dudgeon, 1998), as well as improvements in mood (Biddle, 2000; Fox, 1999; Lichtman & Poser, 1983; Scully et al., 1998), cognitive functioning (Boutcher, 2000; Cotman & Berchtold, 2002; Kramer et al., 1999; Weuve et al., 2004), and overall quality of life (Oka et al., 2000).

Similar psychological benefits have also been shown as a result of exposure to natural environments, including improvements to

mood (Hull & Michael, 1995), attentional functioning (Hartig, Evans, Jamner, Davis, & Garling, 2003; Kuo, 2001; Taylor, Kuo, & Sullivan, 2001; Tennessen & Cimprich, 1996; Wells, 2000) and overall well-being (Kaplan, 2001). As a result, a number of researchers have attempted to bring these two parallel sets of findings together by proposing that physical activity that takes place in “green” environments may be particularly beneficial (Pretty, Griffin, Sellens, & Pretty, 2003; Pretty, Peacock, Sellens, & Griffin, 2005).

If true, this notion of ‘green exercise’ provides yet another powerful reason for health researchers and practitioners to develop strategies capable of encouraging regular outdoor physical activity. At the same time, this theory raises a number of interesting questions regarding how to select and utilize outdoor settings that are optimal for encouraging physical activity and enhancing psychological health.

1.1. Environments for physical activity

Settings which are most effective in supporting outdoor physical activity, such as biking or walking, typically possess a number of specific environmental attributes. In particular accesses to side-walks and trails (Eyler, Brownson, Bacak, & Housemann, 2003; Giles-Corti & Donovan, 2003), the amount of automobile traffic (Troped, Saunders, Pate, Reininger, & Addy, 2003; van Lenthe, Brug, & Mackenbach, 2005), the presence of street lighting (Addy et al.,

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2004), neighborhood cleanliness (Duncan & Mummery, 2005), and the aesthetic quality of the environment (Giles-Corti et al., 2005; Humpel, Owen, & Leslie, 2002; King et al., 2000) have all been shown to be associated with increased levels of activity.

1.2. Environments for psychological health

While exposure to more natural environments is generally associated with greater improvements in psychological health (De Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003), there is disagreement regarding what causes these changes and which environmental characteristics are most responsible. The two most widely accepted theories have attempted to explain these improvements by focusing on the ability of the environment to either reduce stress (Ulrich et al., 1991) or restore attentional resources (Kaplan & Kaplan, 1989).

Ulrich et al. (1991) proposed that improvements to mental health and well-being are due to a reduction in stress. According to this view, exposure to unthreatening, attractive natural settings makes it easier for humans to regulate states of emotional and physiological arousal, stimulate feelings of pleasure, and reduce negative affect. Therefore environments most capable of enhancing psychological health must be free of potential stressors and contain an aesthetically pleasing arrangement of natural elements.

Attention Restoration Theory (ART), on the other hand, hypothesizes that natural environments enhance psychological health and well-being by allowing individuals to reduce mental fatigue and replenish the attentional resources necessary for self-regulation and cognitive inhibition (Kaplan, 1995; Kaplan & Kaplan, 1989). According to ART, performing certain tasks, such as staying focused on and tracking uninteresting stimuli, requires an effortful form of attention. The capacity to voluntarily employ or direct attention is limited, however, and over time this capacity becomes depleted making it increasingly difficult to remain focused and regulate behavior. In order to regain the capacity to direct attention one must let it rest. One way to facilitate restoration is to seek out and spend time in settings that are engaging and able to effortlessly capture attention (Kaplan & Berman, 2010). Therefore, in order to be restorative, an environment needs to contain fascinating objects or events and provide opportunities for exploration and discovery. In addition the setting should allow one to take a break from problems and everyday demands and be supportive of one's goals and inclinations (Herzog, Maguire, & Nebel, 2003; Kaplan & Kaplan, 1989).

Although natural settings appear to be particularly good at meeting these criteria and restoring the capacity to direct attention, it is a mistake to assume the amount of restoration one receives is solely dependent on the content in the environment. It may instead be more accurate to think of restoration as an interactive process that occurs between the person and the external environment. In other words, the degree of restoration one receives depends not only on the structure of and features in that setting, but also on how one chooses to interact with the environment. For instance, the restorative potential of a setting abundant with nature may be decreased if one decides to use this environment to return neglected phone calls. Likewise, the restorative potential of a more modest natural setting may be enhanced if one chose to perform a task, such as listening to bird songs, that encourages greater engagement with the physical environment.

While finding environments that meet all of the criteria described above may be ideal for raising levels of physical activity and well-being, such settings are not widely available, especially in the urban context. Using readily available settings can all too often result in a boring or even frustrating experience which discourages physical activity. Interestingly, traditional interventions that encourage

outdoor physical activity tend to focus heavily on behavioral initiation strategies, such as scheduling and goal setting and largely ignore ways to make one's experience in these non-ideal environments more interesting and enjoyable.

The purpose of the present study is to investigate the usefulness of strategies designed to enhance the physical activity experience itself. In particular, the study explores the possibility of altering how one engages in and interacts with the environment. Such a cognitive engagement strategy may be effective in increasing outdoor physical activity because it relies on a number of cognitive processes that people find highly rewarding, namely recognizing objects, inferring what has happened in the past, predicting what could happen in the future, and evaluating different aspects of the world around us (Kaplan & Kaplan, 1982).

These strategies may also allow highly familiar or even uninteresting settings to be experienced in new ways, making it easier to deal with issues of boredom. This hypothesis is, in fact, supported by the work of Sansone and colleagues (Sansone & Smith, 2000; Sansone & Thoman, 2005; Sansone, Weir, Harpster, & Morgan, 1992), who have investigated how individuals regulate interest to make performance of a boring task more enjoyable. This research indicates that when individuals feel a task is personally meaningful they can deliberately employ interest-enhancing strategies to help them maintain motivation and stick with the task. This might include noticing different aspects of the behavior setting or varying how the task itself is preformed (e.g., turning the task into a game). These findings also suggest that continued use of these strategies could lead to redefining an activity more positively, thereby increasing the likelihood one would carry out the task again in the future. This notion is closely paralleled in the work of Hidi et al. (Hidi, 2000; Hidi & Harackiewicz, 2000; Hidi & Renninger, 2006) who have proposed that becoming more aware of environmental features can, over time, cause an activity to become more personally interesting and meaningful. Overall, this research lends support to the current approach of facilitating engagement with the environment and suggests this techniques may be a useful method for strengthening the intrinsic motives necessary for sustaining a physical activity routine (Ingledew, Markland, & Medley, 1998; Maltby & Day, 2001).

In addition, cognitive engagement strategies may be able to enhance the psychological benefits associated with outdoor physical activity. Since, according to ART, the restorative experience can vary depending on the nature of the person–environment interaction, it is reasonable to assume that encouraging active involvement in the walking environment may result in greater benefits to attentional functioning and psychological well-being (Kaplan, 2001). By contrast, using strategies which do not encourage engagement in the environment would presumably be less likely to produce these positive psychological outcomes.

Therefore, the goal of this study is to investigate whether an intervention which uses cognitive engagement strategies can increase outdoor walking behavior and improve psychological well-being. In order to do this, the effectiveness of an engagement-based intervention is compared to a more standard intervention that relies on setting and committing to a walking schedule.

2. Method

2.1. Participants

One hundred and seventeen adults were recruited during late spring and summer by posting flyers in various locations around the community and placing announcements in two local newspapers. The flyers and announcements invited adults interested in starting or restarting an outdoor walking routine to participate.

Eligible participants were at least 18 years of age and free of existing health conditions that could interfere with walking regularly outdoors. Participants were predominantly female (88%) and between 40 and 69 years of age (64%). A majority of the participants (86%) indicated that they had in the past made multiple attempts to initiate a regular walking routine. Fourteen participants withdrew from the study before completing the intervention (Engagement $n = 6$; Standard Care $n = 8$). Reasons given for dropping-out included injury ($n = 1$), lack of monetary incentives ($n = 2$), lack of time ($n = 2$), physical difficulty of walking ($n = 2$), and lack of interest ($n = 7$). Sixty-six individuals completed the two-week intervention and returned the follow-up survey four weeks later, resulting in a 56% overall completion rate. Comparisons between individuals who completed the entire intervention and those who dropped out showed no significant differences with respect to demographic characteristics, self-efficacy, previous experience maintaining a walking routine, walking behavior at baseline, or psychological well-being at baseline.

2.2. Treatment conditions

Initially participants were randomly assigned to either a waitlist control group or an experimental treatment group. Participants in this latter group ($n = 65$) were then randomly assigned to one of two treatment conditions, Standard Care or Engagement. After one-week waitlisted participants ($n = 52$) were randomly assigned to the same two treatment conditions. In order to balance the number of participants in each treatment condition, participants who withdrew from the study were replaced in subsequent random assignments.

Prior to beginning either treatment, participants met with the researcher, completed a pretest survey, and were given the goal of taking at least three 30-minute outdoor walks during each of the subsequent two weeks. Each participant received a binder containing walking logs, a short step-by-step guide of how to carry out the treatment, and a list of walking safety tips. At the end of the two-week treatment, participants completed a survey and returned all study materials. Four weeks later participants were mailed a follow up survey.

Participants in the waitlist group completed the pretest survey both when they initially met with the researcher and then again at the end of the week, before being instructed about the treatment to which they were assigned.

2.2.1. Standard Care

In addition to the materials described above, participants assigned to the Standard Care condition ($n = 58$) worked with the researcher to complete a personalized walking schedule. Once participants identified the days and times they intended to walk, they signed a pledge stating that they agreed to walk during the times specified.

2.2.2. Engagement

Instead of a walking schedule, participants in the Engagement condition ($n = 59$) received a list of awareness plans (see Table 1) designed to influence how they engaged in and interacted with the

physical environment (Leff, 1984; Leff & Gordon, 1979; Leff, Thousand, Nevin, & Quiocho, 2002). Participants were asked to use one of the awareness plans as the focus of each walk during the treatment period. While participants were free to experiment with different awareness plans or create their own, the majority of participants reported using one of the provided awareness plans multiple times during the two-week intervention.

2.3. Measures

2.3.1. Total time spent walking

Total time walking was measured using surveys, walking logs, and accelerometers. The survey instrument was used to assess the number and duration of walks taken during the preceding week. Surveys were administered before the start of the intervention, at the end of the one-week waitlist period, the end of the two-week treatment period, and at follow up. During the two-week intervention period, walking behavior was also assessed using walking logs which recorded the date of each walk, the time each walk started and ended, and whether the individual walked alone or with another person. A waist-mounted Actical accelerometer (Phillips Respironics, Bend, OR USA) was also used to obtain an objective measure of total time spent walking during the treatment period. The Actical device contains an omni-directional sensor, allowing one to measure acceleration in multiple planes and provides a reliable and valid measure of physical activity (Eslinger & Tremblay, 2006; Pfeiffer, Mciver, Dowda, Almeida, & Pate, 2006). Walking time was assessed by examining each participant's accelerometer data during the time periods indicated in the walking logs. To constitute a walk, participants were required to reach and maintain a minimum threshold of 500 activity counts per minute, indicating they had achieved at least light activity.

2.3.2. Psychological well-being

Survey items related to psychological well-being were included in the pretest, at the end of the two-week treatment, and four weeks later in the follow up surveys. The items assessed attentional functioning as well as vitality and affective experience. Attentional functioning was assessed using a modified version of the Attentional Functioning Index (AFI), which is designed to measure perceived effectiveness in 10 everyday activities which require self-regulation and executive control (Cimprich, 1992; Tennessen & Cimprich, 1996). Participants were asked to rate how well they felt they had been functioning using a 5-point scale (*not very well* to *extremely well*). The vitality and affective experience measure consisted of 12 positive and negative feelings which participants rated in terms of how frequently they experienced them on a 5-point scale (*never* to *always*). This measure was largely developed by adapting items included on the Subjective Vitality Scale (Ryan & Frederick, 1997) and the Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988). A complete set of items included in each of the psychological well-being measures can be found in Appendix A.

2.3.3. Background information

The pretest survey instrument included questions regarding demographic information (e.g., age, gender) and prior history of

Table 1
Samples of awareness plans included in the Engagement treatment condition.

Plan category	Example
Focus on your senses	Focus on sounds. If the area is quiet, listen to the silence. If the area is full of sounds, focus on each one and notice how they differ.
Take on a new job or role	Imagine you're an artist looking for beauty in everyday things.
Make guesses or inferences	How would this area be different if everyone had to grow their own food?
Use magic	If you could cast spells that changed the environment what would you change?

walking behavior, including frequency and duration of walks as well as previous experience initiating and maintaining a walking routine. Self-efficacy was also measured on the pretest survey using a modified version of the New General Self-Efficacy Scale (Chen, Gully, & Eden, 2001), which is intended to evaluate one's overall confidence in the ability to achieve goals and deal with adversity.

Surveys were also used to assess whether participants engaged in other forms of physical activity. Start of treatment, end of treatment, and follow up surveys all included questions about how much time participants spent doing physical activity other than walking.

2.4. Analysis

In order to ensure construct validity and identify common themes a factor analysis was conducted on the AFI and the vitality and affective experience items using principal-axis factoring with Varimax rotation. Factor structure was based on item loadings of at least .45, Eigenvalues greater than 1.0, and alpha coefficients of at least .75. Items loading on more than one factor were excluded.

Linear mixed models were used to examine the effect of the treatment conditions on walking behavior and psychological well-being over time. This method was chosen because it allows one to analyze correlated observations that are measured repeatedly, under different conditions (West, Welch, & Galecki, 2006). The linear mixed model also allows inclusion of subjects who have missing data, giving this approach a distinct advantage over more traditional repeated-measures analysis methods, which remove subjects who do not have data at all time points (West et al., 2006).¹

A model based on an unstructured covariance matrix was used to investigate survey, walking log, and accelerometer data related to total time walking. To evaluate data related to psychological well-being a model based on a compound symmetry covariance matrix was employed. In all cases a top-down model building strategy was used, which involves starting with the fixed effects of all possible covariates and interactions and removing non-significant fixed effects until the best overall fit is achieved (West et al., 2006). This procedure resulted in self-efficacy and participants' prior experience in maintaining a walking routine being included as covariates in the linear mixed models examining total time walking.² Self-efficacy and participants' walking behavior during the treatment period

¹ Because a sizable number of participants failed to return the follow-up survey a secondary analysis was conducted using only individuals providing data at the start of treatment, end of treatment, and follow up. Otherwise, this analysis used the same linear mixed model procedure described in the analysis subsection. Results of this secondary analysis were very similar to the initial linear mixed model results (see Appendix A and B). In terms of walking behavior, participants in both treatment groups experienced a significant increase in total time spent walking during the intervention period. However, neither group was able to maintain these increases at follow up. While results from the initial and secondary analysis of the psychological well-being data were comparable, there were several notable exceptions with regard to each of the well-being variables. First, there was a significant trend ($p = .054$) indicating individuals in the Engagement group reported greater attentional functioning than those in the Standard Care group at the end of the treatment period. Second, neither the Engagement nor the Standard Care group experienced significant changes in feeling of frustration. Finally, the Standard Care group failed to show any significant improvement in feelings of contentment. Overall, these results seem to support the conclusions based on the initial linear mixed model analysis, namely that while the Engagement-based approach produces changes in walking behavior that are comparable to the Standard Care treatment, it appears to be more effective at producing positive changes in psychological well-being.

² Participants' prior experience in maintaining a walking routine was found to have a significant main effect ($p = .011$) on survey-determined walking behavior, but did not have a significant main effect on walking log or accelerometer-determined walking behavior. Self-efficacy did not have a significant main effect with respect to any of the walking behavior measures.

Table 2
Psychological well-being measures.

Category name and items included	Alpha ^a
<i>Attentional functioning</i>	.88
Resisting distractions	
Remembering to do all the things I started	
Keeping my mind on what I am doing	
Planning my daily activities	
Finishing things that I started	
Deciding what is most important to do next	
Remember to do important things	
Pacing myself	
Not interrupting other people	
<i>Feelings of frustration</i>	.83
Irritable	
Impatient	
<i>Feelings of contentment</i>	.78
Content	
Satisfied	
Excited	
Energized	
Relaxed	

^a Alpha values represent the reliability of each cluster of items.

were included as covariates in the models used to investigate psychological well-being.³ Although the covariate data was initially continuous in nature, this data was treated as categorical in the models and homogeneously distributed between treatment conditions in order to simplify analysis and compare the effects of treatment while adjusting for covariate level.

After an appropriate fit was determined, the linear mixed model is able to calculate estimated marginal means for the dependent variables by adjusting for the presence of covariates. These are therefore predicted means, not observed, and are based on the specified linear model. Once generated these estimated marginal means are then used to examine all within and between group interactions by conducting a series of pairwise comparisons.

For the waitlist group, paired samples *T*-tests were used to analyze all walking and well-being data during the waitlist period. Unless otherwise noted, $p \leq .05$ is used to report significance. Three individuals (Engagement $n = 2$; Standard Care $n = 1$) were excluded from the analysis because their self-reported and objectively determined walking behavior far exceeded that of all other participants. In addition, some data were incomplete (between 1.0% and 7.7%) for walking behavior or psychological well-being on pre, post, and follow-up surveys. Walking logs and accelerometers also contained 3.9% and 13.6% missing data, respectively. Since data are assumed to be missing at random and the linear mixed model procedure is able to accommodate multiple missing data points (Edwards, 2000), no data imputation methods were used.

3. Results

3.1. Development of psychological well-being measures

Factor analysis of the AFI confirmed the items were part of a single factor related to one's ability to function effectively (see Table 2). One item, "being on time for appointments," failed to load

³ Self-efficacy and participants' walking behavior during the treatment period were found to have a significant main effects on attentional functioning (self-efficacy $p < .001$; walking behavior $p = .009$), feelings of frustration (self-efficacy $p = .015$; walking behavior $p = .012$), and feelings of contentment (self-efficacy $p < .001$; walking behavior $p = .013$).

on this factor and was dropped from the attentional functioning measure. Analysis of the vitality and affective experience items yielded two factors. The first, “feelings of frustration” consisted of items related to negative vitality and affective experience. The second factor, “feelings of contentment” included a number of items related to subjective well-being and reflects feelings of fulfillment and enthusiasm with current experience. Correlations among the three psychological well-being factors ranged between .48 and .59; given their high internal consistency and focus on different dimensions of well-being, they were kept as separate measures.

3.2. Time spent walking

Walking behavior of participants assigned to the waitlist condition remained unchanged during the one-week control period (see bottom portion of Table 3). *T*-test results indicated that individuals in this group reported no statistically significant change in total time spent walking.

Survey data of individuals in the treatment conditions show improvements in walking behavior, with the Engagement (mean difference = 85.50, $p \leq .001$) and the Standard Care group (mean difference = 80.54, $p \leq .001$) reporting a significant increase in total time walking. At follow up, a significant decline was experienced by individuals in the Engagement (mean difference = –55.56, $p \leq .001$) and Standard Care conditions (mean difference = –53.91, $p \leq .001$) from the end of treatment. In spite of this decline, there was a significant overall increase in total time walking from start of treatment to follow up for participants in the Engagement (mean difference = 29.94, $p = .023$) and Standard Care conditions (mean difference = 26.63, $p = .042$). There were no significant differences between treatment conditions at start of treatment (mean difference = 13.37, $p = .243$), end of treatment (mean difference = 8.41, $p = .606$), or at follow up (mean difference = 10.06, $p = .607$).

Walking log and accelerometer data confirm that participants were successful in achieving the goal of walking for at least 90 minutes each week (three 30-minutes walks). In addition, time spent walking did not differ significantly between the two conditions during the treatment period according to log (Mid treatment mean difference = 12.03, $p = .384$; End of treatment mean difference = 5.84, $p = .761$) and accelerometer data (Mid treatment mean difference = 21.48, $p = .195$; End of treatment mean difference = 22.29, $p = .216$). Within each treatment condition walking behavior also stayed

relatively stable with log and accelerometer data indicating no changes during the two-week treatment period for participants in the Engagement (Walking log mean difference = 2.78, $p = .807$; Accelerometer mean difference = –4.97, $p = .683$) or Standard Care conditions (Walking log mean difference = –3.41, $p = .763$; Accelerometer mean difference = –4.16, $p = .744$).

3.3. Psychological well-being

As with time spent walking, the psychological well-being of participants assigned to the waitlist condition also remained unchanged during the one-week control period (see bottom portion of Table 4). *T*-test results indicated that individuals in this group reported no significant changes in attentional functioning, feelings of frustration, or feelings of contentment.

As shown in Table 4, exposure to the Engagement condition was most effective at improving psychological well-being, with the Engagement group reporting significant increases in attentional functioning and feelings of contentment during the treatment period along with a significant decrease in feelings of frustration. Although attentional functioning of the Engagement group declined significantly from the end of treatment to follow up, feelings of frustration and contentment remained unchanged during this period. None of the three psychological well-being measures changed significantly from the start of treatment to follow up.

Conversely, individuals in the Standard Care condition reported no significant changes in either attentional functioning or feelings of frustration. This group did, however, experience a significant increase in feelings of contentment during the treatment period, a change which persisted and resulted in a significant improvement in feelings of contentment from the start of the treatment to follow up.

A number of interesting observations can also be drawn by comparing the two treatment conditions. The Engagement condition produces greater changes in both attentional functioning and frustration during the treatment period. The change in feelings of contentment, however, is strikingly similar between the two treatments. This suggests that attentional functioning and feelings of frustration can be influenced by altering how one interacts with the walking environment, while feelings of contentment are affected more by an increase in time spent walking.

Table 3
Total time spent walking per week based on treatment condition.

Treatment conditions	Total time walking (minutes)							
	Start of treatment		Mid treatment		End of treatment		Follow up	
	<i>n</i>	Est. marginal mean (SE)	<i>n</i>	Est. marginal mean (SE)	<i>n</i>	Est. marginal mean (SE)	<i>n</i>	Est. marginal mean (SE)
<i>Engagement</i>								
Survey	54	44.3 (8.04) ^a			51	129.8 (11.49) ^b	31	74.3 (13.82) ^c
Walking log			50	132.6 (9.73) ^a	50	135.4 (13.54) ^a		
Accelerometer			47	124.2 (11.36) ^a	47	119.2 (12.35) ^a		
<i>Standard Care</i>								
Survey	54	57.7 (8.04) ^a			50	138.3 (11.49) ^b	32	84.3 (13.75) ^c
Walking log			49	144.6 (9.71) ^a	49	141.2 (13.52) ^a		
Accelerometer			42	145.7 (11.90) ^a	42	141.5 (12.94) ^a		
Waitlist control condition	Change in total time walking (minutes)							
	<i>n</i> _{pairs}		Average Δ (SD)		<i>p</i>			
Survey	47		9.04 (47.82)		.201			

Note: Total time walking is based on estimated marginal means from the linear mixed model. Estimated marginal means sharing an alphabetic superscript in the same row are not different from one another at $p \leq .05$. The differences in total time walking for participants in the treatment conditions are based on mixed model results of pairwise comparisons between estimated marginal means. Change in total time walking for participants in the waitlist control condition is based on paired *T*-test results.

Table 4
Psychological well-being of participants over time.

Treatment conditions	Mean psychological well-being						Change in psychological well-being					
	Start of treatment		End of treatment		Follow up		Start to end of treatment		End of treatment to follow up		Start of treatment to follow up	
	<i>n</i>	Est. marginal mean (SE)	<i>n</i>	Est. marginal mean (SE)	<i>n</i>	Est. marginal mean (SE)	Mean difference	<i>p</i>	Mean difference	<i>p</i>	Mean difference	<i>p</i>
<i>Attentional functioning</i>												
Engagement	51	3.29 (.10)	51	3.68 (.10)	31	3.25 (.14)	.40	.001	–.44	.001	–.04	.768
Standard Care	50	3.30 (.10)	48	3.49 (.10)	32	3.43 (.12)	.19	.058	–.05	.709	.13	.349
<i>Feelings of frustration</i>												
Engagement	51	3.13 (.12)*	51	2.75 (.12)	31	3.02 (.18)	–.39	.006	.27	.158	–.12	.525
Standard Care	50	2.77 (.13)*	48	2.67 (.13)	32	2.78 (.19)	–.10	.473	.11	.588	.01	.968
<i>Feelings of contentment</i>												
Engagement	51	3.05 (.10)	51	3.44 (.09)	31	3.26 (.11)	.39	.001	–.18	.140	.21	.084
Standard Care	50	3.10 (.10)	48	3.46 (.09)	32	3.36 (.11)	.36	.001	–.10	.460	.26	.049
Waitlist control condition												
Change in psychological well-being												
						<i>n_{pairs}</i>	Average Δ (SD)				<i>p</i>	
Attentional functioning						50	.08 (.55)				.281	
Feelings of frustration						50	–.18 (.72)				.083	
Feelings of contentment						50	.12 (.45)				.072	

Note: Mean psychological well-being scores are based on estimated marginal means from the linear mixed model. Estimated marginal means sharing an asterisk (*) are different from one another at $p \leq .05$. Changes in psychological well-being for participants in the treatment conditions are based on mixed model results of pairwise comparisons between estimated marginal means. Changes in psychological well-being for participants in the waitlist control condition are based on paired *T*-test results.

3.4. Exploratory analyses of walking time and opportunity for cognitive engagement

A final question involves exploration of the relationship between the amount of time spent walking and the perceived benefits for each of the two treatments. These analyses are exploratory because we did not manipulate walking time; in addition, the overall interaction among treatment (Engagement/Standard Care), study phase (start of treatment and end of treatment), and walking behavior (three levels of walking duration) was not significant. Degree of walking behavior was operationalized in terms of the amount of time participants reported walking during the two-week intervention relative to the goal that participants walk at least 180 minutes over the two weeks (three 30-minute walks per week). Those who reported walking less than that amount were categorized as “low duration” (Engagement, $n = 9$; Standard Care, $n = 7$); those who walked an intermediate amount were categorized as “expected duration” (Engagement $n = 28$; Standard Care $n = 25$) and consisted of participants who reported walking between 180 and 300 minutes. Those who reported walking more than 300 minutes were considered “high duration” (Engagement $n = 14$; Standard Care $n = 16$) since they walked more than one and a half times longer than requested.

Pairwise comparisons showed that the effect of treatment on psychological well-being differed depending on the amount of time participants spent walking. Linear mixed model results indicated that there were no significant changes in any of the psychological well-being measures for those individuals who chose to walk less than requested in either treatment condition (see Table 5). Scores of low duration walkers in the Standard Care condition, however, were opposite the expected direction at the end of treatment both for feeling of frustration and attentional functioning. For the attentional functioning measure, the two treatment conditions differed significantly at the end of treatment (mean difference = .88, $p = .007$).

The expected duration walkers showed significant improvements in psychological well-being. In terms of attentional functioning, individuals in both the Engagement and Standard Care conditions reported significant increases during the treatment period. Expected duration walkers in both treatment conditions experienced significant declines in feelings of frustration. With respect to feelings of contentment, however, only expected duration walkers in the Engagement condition experienced a significant increase. While the results for the two conditions follow a similar pattern the amount of change between the baseline and post-treatment measurements is notably greater in the case of the Engagement group for each of the psychological variables.

Table 5
Change in psychological well-being of low, expected, and high duration walkers.

	Change in psychological well-being during the treatment period					
	Attentional functioning		Feelings of frustration		Feelings of contentment	
	Mean difference	<i>p</i>	Mean difference	<i>p</i>	Mean difference	<i>p</i>
<i>Low duration</i>						
Engagement	.26	.195	–.24	.405	.34	.065
Standard Care	–.12	.587	.37	.253	.35	.093
<i>Expected duration</i>						
Engagement	.58	.001	–.72	.001	.40	.001
Standard Care	.29	.016	–.49	.005	.20	.071
<i>High duration</i>						
Engagement	.35	.033	–.20	.403	.42	.005
Standard Care	.40	.008	–.19	.384	.53	.001

Notes: Changes in psychological well-being are based on mixed model results of pairwise comparisons between estimated marginal means.

The high duration walkers – those who far exceeded expectations regarding time spent walking – showed improvements in both attentional functioning and contentment, regardless of treatment condition. Interestingly, their feelings of frustration were not significantly affected.

While the overall patterns are quite similar for the two treatments, the changes are consistently in the expected direction and stronger for the Engagement condition. For the Standard Care condition in two instances the results are opposite of expectation, in one case the change is not significant where it is for the other condition, and in the other instances the changes are of lesser magnitude.

Although these findings are correlational in nature and therefore need to be interpreted with caution, they raise the possibility that the amount of time spent walking may have different outcomes depending on the treatment. The changes in attentional functioning and frustration provide some indication of this pattern. At high levels of walking participants in both conditions experienced similar changes. With decreasing amount of time spent walking, however, the Engagement condition seems to make more of a difference.

4. Discussion

4.1. Engagement vs. standard care

These findings present a strong case for incorporating cognitive engagement strategies into interventions designed to encourage outdoor walking. Not only did the Engagement-based approach produce changes in walking behavior that were comparable to the Standard Care treatment, it was also more effective at producing positive changes in psychological well-being.

There are several potential explanations for the differences in well-being between treatment conditions. One possibility is that adhering to the Standard Care condition makes sufficient demands on self-regulation and attentional resources to interfere with some aspects of well-being. These demands may have made it more difficult for Standard Care participants to experience improvements in attentional functioning or to reduce frustration within the two-week treatment period. It is possible that given more time Standard Care participants would have been able to gain greater familiarity with the action plan and less attentional resources would be needed, thus making it easier to achieve improvements in well-being.

This explanation, however, is perhaps less plausible since the instructions for the Standard Care condition minimize the need to make future decisions about when and how long to walk and hence are likely to conserve attentional resources. By contrast, individuals in the Engagement condition may have had to invest attentional resources in order to maintain their focus on an awareness plan while walking. Furthermore, the Engagement group received no help with the potentially demanding task of determining how to incorporate walking into their weekly routine, an activity that would require further use of attentional resources. Taken together, it is reasonable to assume that both treatment conditions require comparable investments of attentional resources.

Therefore, it seems likely that the awareness plans used in the Engagement condition were responsible for enabling participants to gain greater psychological benefits. It appears these strategies, which were intended to enhance the walking experience by creating interest in the setting, may have the added advantage of priming participants for a restorative experience by encouraging them to orient to the environment. This finding, not only provides a compelling reason to incorporate cognitive engagement strategies into walking interventions, but it is also consistent with ART.

The higher scores in psychological well-being for participants in the engagement condition are intriguing when one considers the ART assumption that altering the person–environment interaction can influence the restorative benefits one receives. While more research is clearly needed, these findings raise the possibility that using engagement strategies may help one to discover a larger number and greater diversity of fascinating stimuli. During a typical outdoor walking experience it is easy to overlook many aspects of the environment that, upon closer inspection, can be quite interesting. Strategies that help one to become more aware of these features could increase the richness and diversity of the setting, creating an environment that has more to explore. Finally, focusing on the awareness plan and being more attentive to the environment may make it easier to set aside distracting thoughts.

The analysis of interactions between treatment, well-being, and walking behavior also suggests that engagement strategies can be used to help one get more psychological benefits from time spent walking, particularly at low to moderate levels. Although participants who walked less than requested did not experience significant improvements in well-being in either condition, the data show the attentional functioning and frustration scores of the two treatments move in opposing directions. Participants who walked the expected duration, on the other hand, show significant increases in well-being for both treatments. However, only the Engagement condition was able to produce improvements on all three dimensions of well-being. High duration walkers in both treatment conditions experienced nearly identical changes with respect to attentional functioning, frustration, and commitment. Overall this suggests that, in terms of influencing well-being, efforts to promote engagement and involvement with the environment may be particularly salient at lower levels of outdoor activity. Naturally, true experiments are needed to fully evaluate these ideas.

These findings are also interesting from the perspective of health professionals. Results of the study suggest that efforts to help individuals become more engaged and involved during the actual walking experience may be just as valuable as traditional strategies, such as schedule setting, designed to help individuals initiate and sustain a walking routine. Techniques that encourage individuals to conduct a more detailed investigation of the walking environment or adopt a more playful, curious orientation toward the walking experience may be particularly effective in this regard. This approach is especially appealing since other research has suggested that using engagement strategies can make performance of relatively boring tasks more enjoyable (Sansone et al., 1992).

4.2. Limitations and future research

There are limitations that should be acknowledged when interpreting the findings from this study. First and foremost, the study consisted of a fairly motivated sample of middle-aged women, making it difficult to determine how generalizable these results are to other groups. While individuals who responded to the follow-up survey were not significantly different from non-responders in terms of background and demographic variables, it is possible that follow-up results may also represent the experience of more highly motivated participants. These results should, therefore, be viewed with caution. As a consequence, more research is needed that explores the potential benefits of engagement strategies with other populations, including more sedentary, less motivated individuals. The brevity of the intervention also makes it difficult to determine whether cognitive engagement strategies could have a positive impact on walking behavior or well-being in

the long term. This suggests future studies should attempt to incorporate engagement-based strategies into more standardized six to eight-week intervention periods. In addition, this study relied solely on a self-report measure of attentional functioning. While the AFI is theoretically sound and has proven to be a reliable measure of attentional capacity (Cimprich, 1992, 1993; Tennessen & Cimprich, 1996), it would be encouraging to see current findings replicated with behavioral measures, such as the Digit Span Forward/Backward or the Attentional Network Test (Posner & Rothbart, 2007). Finally, not restricting participants in where they chose to walk increased ecological validity but precludes examination of the role played by particular physical characteristics of the walking environment and their potential interaction with treatment conditions. Future research which accounts for the physical characteristics of the walking environment could help to determine whether certain settings are more compatible with particular types of engagement-based strategies.

5. Conclusions and implications

The finding that the Engagement condition was particularly effective in improving multiple dimensions of psychological well-being suggests that it is useful to promote strategies which encourage interaction and involvement with the external setting. Such cognitive engagement strategies may be able to help more individuals achieve the mental health benefits associated with 'green exercise.'

It is also useful to note that the cognitive engagement strategy proved as effective at increasing walking behavior as the more traditional approach. This raises the possibility that incorporating strategies designed to create greater interest in the physical setting within traditional interventions may help individuals to initiate and maintain an outdoor walking routine. Although the current study is limited to a two-week intervention, it is possible that influencing walking behavior in the long term may be enhanced if individuals are able to observe positive changes in their mood and cognitive functioning.

The engagement-based approach also provides health practitioners with a flexible and low cost way of helping individuals deal with environments that are not necessarily ideal for walking or for enhancing well-being. While physically redesigning communities may be needed to increase both physiological and psychological health in the long term, transforming communities will take both time and resources. In the meantime, the strategies proposed by this engagement-based approach may be able to help individuals use existing nearby environments more effectively.

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Appendix A. Total time spent walking per week based on survey data of participants providing complete data throughout the intervention and follow up period.

Treatment conditions	Mean total time walking (minutes)			Change in total time walking (minutes)					
	Start of treatment	End of treatment	Follow up	Start to end of treatment	End of treatment to follow up		Start of treatment to follow up		
	Est. marginal mean (SE)	Est. marginal mean (SE)	Est. marginal mean (SE)	Mean difference	<i>p</i>	Mean difference	<i>p</i>	Mean difference	<i>p</i>
Engagement (<i>n</i> = 28)	51.9 (12.52)	136.4 (15.46)	79.0 (16.31)	84.5	.001	−57.5	.001	27.1	.058
Standard care (<i>n</i> = 29)	57.0 (12.35)	149.7 (15.24)	82.6 (16.08)	92.7	.001	−67.1	.001	25.6	.068

Notes: Total time walking is based on estimated marginal means from the linear mixed model. The differences in total time walking for participants in the treatment conditions are based on mixed model results of pairwise comparisons between estimated marginal means.

Appendix B. Psychological well-being of participants providing complete data throughout the intervention and follow up period.

Treatment conditions	Mean psychological well-being			Change in psychological well-being					
	Start of treatment	End of treatment	Follow up	Start to end of treatment	End of treatment to follow up		Start of treatment to follow up		
	Est. marginal mean (SE)	Est. marginal mean (SE)	est. marginal mean (SE)	Mean difference	<i>p</i>	Mean difference	<i>p</i>	Mean difference	<i>p</i>
<i>Attentional functioning</i>									
Engagement (<i>n</i> = 30)	3.35 (.17)	3.67 (.17)*	3.33 (.17)	.32	.028	−.34	.020	−.02	.894
Standard care (<i>n</i> = 31)	3.05 (.16)	3.22 (.16)*	3.25 (.16)	.17	.214	.03	.822	.20	.143
<i>Feelings of frustration</i>									
Engagement (<i>n</i> = 30)	2.97 (.20)	2.58 (.20)	2.93 (.20)	−.39	.092	.35	.127	−.04	.870
Standard care (<i>n</i> = 31)	2.94 (.19)	2.74 (.19)	2.85 (.19)	−.20	.371	.11	.611	−.09	.699
<i>Feelings of contentment</i>									
Engagement (<i>n</i> = 30)	3.01 (.16)	3.35 (.16)	3.20 (.16)	.34	.015	−.15	.284	.19	.168
Standard care (<i>n</i> = 31)	3.05 (.15)	3.26 (.15)	3.27 (.15)	.21	.115	.01	.939	.22	.098

Notes: Mean psychological well-being scores are based on estimated marginal means from the linear mixed model. Estimated marginal means sharing an asterisk (*) are different from one another at *p* = .054. Changes in psychological well-being for participants in the treatment conditions are based on mixed model results of pairwise comparisons between estimated marginal means.

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