Outdoor environments for people with dementia: an exploratory study using virtual reality

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ABSTRACT

Few studies have investigated how outdoor environments might disable people with dementia. The issue is rarely considered in planning and design guidelines and not at all in regulations, despite dementia being within the scope of disability discrimination legislation in the United Kingdom and other countries. This article reports a study that involved older people with mild to moderate dementias taking two walks, one in a real town centre and one in a virtual reality (VR) simulation. Adaptations were made to the VR simulation to test possible design improvements. Overall, the town centre posed relatively few problems for the 38 older people with dementia who participated, although more difficulty was evident with greater impairment. Some features of particular places were liked more than others, particularly the segregation of spaces from motor traffic. There were measurable benefits from using clear textual signs to support wayfinding and to identify objects and places in the environment. Diminished outdoor activity is likely to be experienced as a decrease in quality of life and may accelerate the progression of dementia. We conclude that older people with mild to moderate dementia should be encouraged to be active outdoors and that this can be facilitated by small environmental modifications. Some limitations of the VR technology used for the study are also reported.

KEY WORDS – dementia, environment, virtual reality, walking.

Introduction

Dementia is a common disabling condition among older people, and the prevalence is growing in all ageing societies. Both of the main dementias, Alzheimer's disease and vascular dementia, cause disorientation and difficulty with comprehension, and these can make navigating and

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understanding everyday environments challenging. Although severe dementia may eventually necessitate moving into a residential or nursing home, in the United Kingdom an estimated 80 per cent of people with dementia live in the community (Audit Commission 2000). Many remain active outdoors until this becomes impossible. Rarely, however, are outdoor environments considered by planners or designers in terms of the opportunities and barriers they present for a person with dementia (Blackman *et al.* 2003).

There is evidence that the more that older people walk and take exercise, the less their risk of dementia (Abbott *et al.* 2004; Larson *et al.* 2006; Scherder *et al.* 2005). There are several possible explanations for this association, including the effects of walking on cognitive activity and cardiovascular health. A study by Weuve *et al.* (2004) found that older women who were more physically active had better cognitive function across general cognition, memory, fluency and attention. Women with cognitive impairment who walked more also experienced less cognitive decline. Despite this evidence, little is known about how the outdoor environment may disable a person with mild to moderate dementia and therefore discourage walking, and exclude them from the benefits.

There is a body of work on dementia-friendly design but this concentrates on indoor care settings such as day centres and residential homes, although adjacent gardens have received attention. Much of this evidence is reported in a useful review by Zeisel *et al.* (2003). Paths with features of interest along the way have been found to decrease exit seeking from homes and improve the mood of residents. Gardens have been found to reduce attempts to leave the home, reduce aggression, improve sleep and engage family members with residents. Common spaces that are homely have been observed to reduce social withdrawal, and an ambience with meaningful and understandable sounds, sights and activities has been found to reduce agitation. Privacy has been linked with reduced aggression and agitation and better sleep.

These findings are inevitably biased towards the severer end of dementia and people who are more likely to be in residential care. They promote a relatively recent concern with making the environment as easy as possible for people with dementia to understand and navigate. However, just as learned dependency can result from institutionalisation, there is also a possibility of over-compensating with design and planning adaptations so that the environment no longer offers stimulation or challenge (Lawton 1980, 1982, 1989, 1998; Scheidt and Windley 2003). If the result is that people with dementia stay indoors and have no or little outdoor activity, it may be more difficult for them to retain those cognitive capacities such as wayfinding that are no longer activated.

Only one study of dementia and the outdoor environment has been published, based on the observations of people with mild to moderate dementia who were accompanied on short walks around their neighbourhoods (Burton, Mitchell and Raman 2004). The authors recommended measures that would help people with dementia recognise and remember streets, places and buildings, such as limiting changes in the physical environment to minor and incremental alterations, creating variety in urban forms such as street scenes, and ensuring that seating, telephone boxes and entrances to buildings are easily understood by making their function obvious and using traditional designs. They recommended retaining distinctive landmarks to assist with wayfinding and keeping signs simple, with the use of obvious symbols and large, clear lettering. They also identified some features that they recommended should be avoided: changes in level that are not clearly marked, paving patterns with sharp colour contrasts, exposure to loud traffic, and areas of extreme light contrasts. The major limitation of this study was that it did not test whether environmental adaptations had positive outcomes for older people with dementia. This is clearly important, given the implications of some of their recommendations and how restrictive they would be if required by regulations, such as traditional designs and incremental change. The recommendations were deduced from observing and interviewing the participants but not from a comparison of a 'dementia-friendly' environment with one lacking specific adaptations. Making 'real world' environmental changes would of course entail considerable practical problems and costs.

This article reports a study that tackled this issue by experimenting with the use of computer-generated environmental simulations that enable a person with dementia to take a virtual walk. On-screen simulations have the potential of enabling participants to identify what helps or hinders them, and then for changes to be made to the simulation that can in turn be evaluated. In virtual reality, the participant repeats a programmed walk with successive changes or environmental adaptations. As a new field of research, the aim of the study was as much to evaluate the validity and reliability of the technology as to produce substantive findings or recommendations for physical planning and design practice.

Methodology

A computer-generated virtual environment (VE) can be readily changed by a programmer, enabling participants to experience and test the adapted setting. The resulting person–environment interaction can then be

observed and a participant's performance measured on various tasks before and after an adaptation. A useful feature of VEs is that a person can interact directly by using a joystick, which they manipulate to move through the VE as if really there (an experience called 'presence'). Prior to the main study, a pilot project with six older participants with dementia successfully demonstrated that they could navigate a VE, that they perceived elements in it as real, and that they could accomplish several tasks outdoors, such as posting a letter and finding somewhere to sit down (Flynn *et al.* 2003).[1]

The first stage of the main study was to plan a walk through the town centre of Middlesbrough, a town in northeast England.[2] The walk offered various environmental encounters such as crossing roads and finding different destinations. Three parts of the town centre were selected as appropriate. The route was along a quiet side street to a fairly quiet shopping street, and then along the street to a post office, across to a taxi rank, through a modern shopping precinct, and finally along a busy road with bus stops that ended at public toilets. These environments were simulated in a detailed virtual reality (VR) model using three-dimensional modelling and an animation software package. Pavements, kerbs, signs, road markings, diverse street furniture, pedestrians and moving traffic were represented. The model was transferred to a visualisation package run on a personal computer, and the images projected onto a large curved 6 × 2 metre screen, and accompanied by ambient street sounds. The participants viewed the virtual environment (VE) by sitting in front of the screen and moving themselves through it using the joystick.

The participants walked the routes through both the VE and in the real-world, enabling their behaviour and performance to be compared as between the real and virtual environments. The research was conducted in two phases. In the first, the participants undertook the real-world and simulated VE walks. In the second, the participants undertook an adapted VE walk. These adaptations were based on the findings from the first phase. The VE walks followed a set route with a researcher sitting next to the participant. After an initial familiarisation exercise, the participants were invited to proceed towards the first destination, a quiet side street. The walk continued with invitations to make their way to a destination or to undertake a specific task. All the walks were recorded on video. Navigability was investigated by how well each participant proceeded to destinations and managed at junctions and other decision points. Legibility was evaluated by how well each participant recognised and located features in the environment, such as the taxi rank or post office. Safety was assessed by observing each participant's behaviour at points such as road-crossings and asking them about their own perception of

safety. Comfort and wellbeing were assessed by asking the participants about how they felt at different stages of the walks and about their likes and dislikes regarding features of the environment.

The walks were accompanied by an interview schedule that was administered conversationally. The use of quantitative measures was important to demonstrate any measurable change in how well participants managed the walks and the tasks along the way. The video of each session was then scored for navigation, legibility, safety, task performance and the participant's expressed level of comfort. The scores used Likert scales for degrees of success or the number of prompts and were undertaken by two independent raters. Reliability between the raters was analysed using the intra-class correlation coefficient.[3] Most tasks were scored using a four-point scale, from '1' for best performance (*e.g.* needed few prompts or acted safely) to '4' for worst (*e.g.* could not do the task or did not act safely). The median and semi-interquartile ranges were computed for each task for the real-world walk, the VR model of the real-world walk, and the adapted VE walk.

Comparisons were made between these measures to assess (a) differences between the real-world town centre and its VR model, to evaluate the validity of the VR simulation, and (b) differences between the VR model of the real-world town centre, and the adapted VR model of the town centre. The Wilcoxon matched-pairs signed-ranks test was used to compare the walks in the real-world and the virtual model. The Mann-Whitney U test was used to compare the real-world walk and its virtual model with the adapted virtual model. The different tests were used because whilst all participants undertook the real-world walk *and* the simulated real-world walk in the virtual model, not all participants who undertook the walk in the adapted virtual model had undertaken the Phase 1 walks.

The participants

Participants were recruited with their carers by referral from local National Health Service (NHS) consultant psychiatrists of old age. The inclusion criteria were that the person had a diagnosis of mild to moderate dementia of the Alzheimer's or vascular types and were mobile outdoors. A total of 38 people participated (19 men, 19 women) and they were aged between 71 and 84 years. All had Mini Mental-State Examination (MMSE) scores between 15 and 29 (Folstein, Folstein and McHugh 1975). The consultant established the participant's initial agreement to participate, after which a researcher arranged a home visit where they showed a short video of the VR cinema and invited the volunteer and their main

T A B L E 1. *Task performance in real, virtual (non-adapted) and virtual (adapted) town centres*

Tasks	Real town centre	Virtual simulation	Virtual simulation with adaptations	Real compared to virtual	Virtual adapted compared to virtual unadapted	Real compared to virtual adapted
	Medians (semi-interquartile range)			*Effect sizes (r)*		
Finding a house number along a quiet side road	1 (0.5)	2 (1.0)	2 (1.5)	−0.43*	Ns	0.37*
Locating a landmark to find a post office	1 (0.3)	2 (0.5)	1 (0.0)	Ns	−0.43*	Ns
Finding a taxi-rank sign	1 (0.0)	2 (1.0)	1 (0.0)	−0.50**	−0.70***	Ns
Distinguishing between pedestrian and motor traffic surfaces	1 (1.0)	1 (0.5)	1 (0.0)	Ns	−0.34*	−0.39*
Finding the number 65 bus stop	1 (0.5)	2 (0.5)	1 (0.5)	−0.49*	−0.64**	Ns
Using third toilet sign to remember where to go	2 (1.5)	4 (1.5)	1 (0.0)	Ns	−0.51**	−0.50**
Crossing car park exit to public toilets	1 (0.5)	3 (0.5)	1 (0.0)	−0.53**	−0.71***	Ns

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Ns = not significant.

carer to sign a consent form. Subsequently, the participants and their carers were interviewed separately at home to gather background data about their outdoor lives. They then took part a few days later in the walking exercises. The participants in Phase 2 were either the same as in Phase 1 or, if a person's condition had changed, a new participant was recruited matched by age, gender, MMSE score and Activities of Daily Living (ADL) score based on the Bristol ADL Scale (Bucks *et al.* 1996).

Results

The walks incorporated a series of tasks. Table 1 shows the medians and the semi-interquartile ranges (Q) for the tasks that generated significant differences as between (a) the real world and its VR simulation, (b) the real town centre and the adapted VR town centre, and (c) the original and the adapted VR models of the town centre. These comparisons therefore explore both the extent to which the real town centre was successfully

simulated and the effects of adaptations to the virtual environment on task performance.

The first task was to find Baker Street, a quiet side street just ahead of the starting point. In both the real-world walk and the VE walk, the participants found the street easily, with a median score of 1 and a semi-interquartile range (Q) of 0. They used the street name sign, which was located on a wall at the entrance to the street. No change was made in Phase 2 to this clear and easily visible sign. The next task, to find house number 17 along the street, was also completed successfully, with a median score of 1 in the real world and a Q of 0.5. The VR simulation presented more of a challenge because the visual resolution of the house numbers was not as clear as on the houses in the actual street, and the scores were poorer (median 2, Q=1). The participants walked along Baker Street and emerged onto a street of shops where they were invited to find somewhere to sit down. This involved locating circular, stainless steel, modern seating across the road. It was thought that this might be difficult because the seating was not of traditional design, but all participants found it easily and there was little difference in performance between the real world and VE (both medians 1, Q=0 real world, Q=0.5 VE).

The next task was to find a post office, which was not visible from the seating and required participants to find their way using a landmark, which was a church in both the real world and the VE. The landmark was generally used successfully in both the real world and the VE. Although the median score of 1 in the real world (Q=0.3) was better than that of 2 in the VE (Q=0.5), the difference was not statistically significant ($z = -1.51$, $p=0.13$). The landmark was changed in the adapted VR model to a prominent red post box and, although this led to a significant improvement, there was no significant change in scores compared with performance in the real world. It is likely that this change helped the participants perceive the projected image but had no real-world implications. In both the real-world and virtual walks, all participants located the post office with its traditional insignia without difficulty.

A short route from the post office to a taxi rank involved crossing a road with no curbs although a string of bollards separated the pedestrian path from the road. One participant commented that they thought the bollards meant no traffic was allowed along the road; another believed that because no road-crossing was marked, pedestrians were not allowed to cross the road. In both the real world and the unadapted VR model, some participants had difficulty distinguishing between the pedestrian path and the road. The adapted VE in Phase 2 clearly differentiated the colours of these two surfaces, and resulted in a significant improvement in the participants' ability to distinguish them: (a) as between the original and

adapted VEs ($z = -2.12$, $p = 0.03$), and (b) in the adapted VE compared to the real world ($z = -2.34$, $p = 0.02$).

The next section of the walk entered a modern shopping precinct and ended with the task of locating the entrance to a bus station. On the way, the participants were invited to find somewhere to sit down; they had no difficulty locating the green metal seating. This was also the case when asked to deposit some litter, with all but one participant locating the green litter bins. All participants successfully located the entrance to the bus station. This entrance was not obviously to a bus station (buses could not be seen or heard), except for a large sign 'Bus Station' that most participants understood without difficulty. Navigating within the precinct presented some problems. The participants found it impossible to use a 'You are Here' map that was displayed both at the entrance and inside the precinct to find their way to the bus station. In the adapted VE these map displays were replaced with two directional landmarks, a fish sculpture and a ship, both of which pointed the way to the bus station (although with no text signs). The participants were told that these landmarks would lead them to the bus station, but they were not found helpful and there was no significant improvement compared to the maps. The contrast with simple word signs was striking.

The walk continued along a busy road and the participants were asked to locate modern glass-and-steel bus shelters. The shelters generally proved easy to find and no adaptations were made for Phase 2. The bus numbers were displayed above head level on the bus-stop posts and on a small notice board inside the shelters. The participants were asked to find the bus stop for 'the number 65'. Most did this successfully in the real world (median 1, $Q = 0.5$), but less successfully in the VE (median 2, $Q = 0.5$), a statistically significant difference. This again appeared to be a resolution issue. In Phase 2, clearly displayed bus numbers were added at eye level on the outside of the shelters. There was a significant improvement between the original and the adapted VEs ($z = -3.97$, $p < 0.001$). In effect, the clearer display of the bus numbers in the VE meant that participants performed as well in the VE as in the real world with finding the bus stop for the Number 65.

The participants were asked to locate a new-style steel-and-glass telephone box and most did so with little difficulty. Two types of wayfinding were then tested. In the real world and the original VR model, the participants were invited to find their way to public toilets using telephone boxes that cued a right turn. In Phase 2, the adapted VE included three signs that pointed the way to the toilets. The participants performed poorly using the telephone boxes to remember where to go but much better using the signs. There were significant differences between the real

world and the adapted VE ($z = -3.02$, $p = 0.003$) and between the un-adapted VE and the adapted VE ($z = -3.17$, $p = 0.003$).

The use of signs was tested further in the Phase 2 adapted VEs by including three different types of directional signs: picture symbols widely used in the UK (male and female black figure silhouettes on a white background), a text sign ('Public Toilets'), and a combined symbol and text sign. There was a significant difference between the symbol and the text sign in favour of the latter ($z = -2.12$, $p = 0.03$, $r = -0.34$), and between the symbol and the combined symbol/text sign in favour of the latter. There was no significant difference between the text sign and the combined sign. In the real world and in the unadapted VE, the participants had no difficulty with recognising the 'Public Toilets' sign and arriving at this destination.

The attractiveness and safety of environments

At various stages of the walk, the participants were asked how attractive and how safe they found the environment, and their safety behaviour was observed and scored. The traffic-free shopping precinct was the best-liked environment, and prompted comments such as 'plenty of room to walk about', 'plenty of seats', 'nice paving patterns' and 'no traffic'. Its median score for attractiveness was '1' ($Q = 0.5$) in the real world and '1' ($Q = 0.1$) in the VE. The first shopping street encountered on the walk scored less well, with a median of '2' ($Q = 0.5$) in the real world and VE. Although less liked than the shopping precinct, the shopping street was not disliked and prompted positive remarks such as, 'good variety of shops', 'not too many people about' and 'bright and wide'. The next street, encountered towards the end of the walk, was busier and, although compared unfavourably with the shopping precinct, received a similar score to the shopping street. Wide and relatively litter-free pavements were commented upon favourably, as well as the modern bus shelters, which were approved as places to wait for a bus.

The least liked environment was the first side street, Baker Street, about which the participants made remarks such as 'scruffy', 'too many cars' and 'too narrow'. The virtual model appeared to simulate this well, with no significant difference compared to the real-world street. Having taken advice from the local authority planner on the project's advisory group, the attractiveness of the street was improved in the adapted VR model by adding street furniture, small trees and traffic calming modifications. This resulted in a more positive rating of how inviting it was,

and the scores were significantly higher than in the real world ($z = -2.32$, $p = 0.02$).

Crossing roads

The VR technology had limitations in its simulation of road-crossing be-haviour. Despite the semi-immersive wide-screen projection, it was not possible to reproduce the extent of peripheral vision experienced in the real world. Although during the real-world walks all roads were generally crossed safely, much of the road-crossing behaviour in the virtual en-vironment was unsafe. Crossing the first shopping street was undertaken marginally more safely than crossing a goods entrance later in the walk ($z = -1.90$, $p = 0.06$, $r = -0.33$). This may be because there was more traffic along the shopping street and that this led the participants to act more safely.

Many believe that dementia at the mild to moderate stages presents particular risks when crossing roads, but overall we found that the par-ticipants were very aware of the dangers of motor traffic. It may be that people with dementia are discouraged too much from using outdoor spaces with traffic. The popularity of the shopping precinct, however, had much to do with the absence of motor traffic, while the busy shopping street elicited positive comments about the width of both the pavements and the road, which contrasted strongly with the widely disliked first side street. At the end of the walks, the participants were asked whether they would have liked to have walked the route on their own. The most com-mon response for the real world, unadapted and adapted VE walks was 'possibly'. When asked if they would like to walk the route with someone else, the answers were generally positive for all environments. There was least variation for the adapted VE, with all participants answering that they would be confident to walk the route with someone else.

Cognitive impairment and performance

The participants' task performance was analysed by their level of cognitive impairment, as assessed using the MMSE score. In the real world, the lower the MMSE score, the more likely participants were to act unsafely in the first side street (Spearman's $rho = -0.70$, $p = 0.002$). This suggests that focusing on the task of finding a particular address distracted the more cognitively-impaired participants from the dangers of road traffic. A lower MMSE score was also associated with navigating less well out of the shopping precinct, liking the busy road less, and being less likely to identify the function of the modern phone boxes.[4]

Discussion

The results of the reported trials suggest that a real town centre offers relatively few obstacles for people with mild to moderate dementia; road crossing was generally safe and the street furniture was recognised. Some improvements, however, made a measurable difference, particularly those to signage. Signs that identified a bus station, a post office and bus stops and that indicated the direction for public toilets worked well, and the straightforward descriptive text signs in clear lettering worked best. We conclude that clearly displayed signs using explicit words or numbers deliver a significant benefit for people with dementia, and effectively indicate both the way to destinations and the function of buildings and other objects in the environment. This finding is consistent with other evidence that people with dementia are better at understanding words than photographs, in particular when the subject is less familiar (Gross *et al.* 2004). The retention of semantic memory among many people with Alzheimer's disease, despite the impairment of episodic memory, also points to the likely value of clear word signs, for many are understandable even though other abilities are significantly impaired. Maps, however, proved impossible to use as a navigation device.

Crossing roads safely was generally not a problem, although participants with greater cognitive impairment experienced more difficulty, including problems with surfaces shared between pedestrians and motor traffic unless very clearly demarcated. Participants tended to dislike motor traffic, which was reflected in how much they liked the pedestrianised shopping precinct compared to other settings, although wide pavements and roads appeared to ameliorate the effects of traffic. Contrary to Burton, Mitchell and Raman (2004), we found no significant problems with most participants' ability to recognise the function and purpose of modern designs of seating, telephone boxes and bus shelters, although those with greater impairment were again more likely to have difficulty with the legibility of these objects. Adding landmarks as navigation aids was not successful, although landmarks in familiar environments may still be important (Sheenan, Burton and Mitchell 2006).

We did find that as impairment increased, the environment became more challenging for our participants, even with the attempted improvements or adaptations. It is difficult to generalise about a cut-off point at which adaptations become irrelevant, not least because people with severe dementia were excluded from our study. The changes we propose are quite modest but are likely to be of benefit to those with mild to moderate impairment. Whether they would actually encourage more outdoor walking would need further research, but this seems likely and could

be promoted to raise awareness about the benefits of staying active outdoors.

Overall, the participants enjoyed the walks and encountered relatively few problems, although they preferred to be accompanied. During the interviews with the participants and their carers prior to the walks, there were many expressions of appreciation of both the social and aesthetic features of outdoor environments. Diminished outdoor activity was experienced as a decrease in quality of life. The most common reason for going out was shopping. Walking in a town centre and other outdoor environments should therefore be encouraged for people with dementia, and those at the mild to moderate stages appear able to undertake many activities independently. Improving signage along recommended lines, and creating more spaces free from or generously separated from traffic and with convenient seating, are likely to support this independence and also to enhance the experience of being outdoors when the support of a carer is needed.

Technical limitations

There were technical limitations to the VR and projection technology, especially with detailed resolution and the ability to reproduce the full extent of the participants' real-world peripheral vision. Although the latter affected our ability to simulate road-crossing behaviour, safe road-crossing was not a problem in the real world, so this limitation does not affect our recommendations. Resolution problems with signage were more of an issue. While improving the visibility of the bus numbers on the shelters at the stops clearly helped in the VE, the lack of an effect compared to the real world suggests that the VE effect is associated with its poorer resolution when compared with the real world. In addition, although we found that our participants were able to use a joystick to navigate the VEs, this presented more of a challenge than navigating the real-world environment because of the skill needed to co-ordinate joystick movements with movements in the VE.

Conclusions

The United Nations Organisation identifies 45 countries that have passed disability-specific laws, but the institutional frameworks within which disability policies are established and implemented vary (United Nations, Committee on a Comprehensive and Integral International Convention on the Protection and Promotion of the Rights and Dignities of Persons

with Disabilities 2006). For example, Sweden incorporates disability rights into other legislation, such as its *Planning and Building Act* that requires the built environment to be designed with 'means enabling people with limited mobility or orientation capacity to use the area' (Sweden, National Board of Housing, Building and Planning 2006: 13). Although Sweden is one of the few countries that explicitly recognises orientation capacity as a disability, there is little guidance about how the built environment should be designed to take this into account, in Sweden or elsewhere.

We conclude that planners and designers should make more use of simple text signs as aids for navigation and for identifying the purpose of objects and places in the environment. This labelling of features in the outdoor environment as an explicit adaptation for those with dementia would benefit others and raise awareness of dementia. Because the number of people with dementia is considerable and growing, even the small improvements from such changes would represent a large global gain. These improvements could also complement and even enhance the benefits of drugs that help with the symptoms of dementia. Further benefits may extend to family carers by helping to make shared outdoor trips a more enjoyable experience. Yet it is important not to exaggerate how much the outdoor environment should be adapted. Our participants enjoyed their walks and some clearly would have liked to go out more. Although some problems with negotiating the outdoor environment were identified, there seems little reason why people with mild to moderate dementia should regard a town centre like Middlesbrough's as generally unfriendly to their impairment.

Acknowledgements

NOTES

1 A subsequent grant application to support a major project was successful and also received National Health Service (NHS) research ethics approval (as did the pilot research). The study was guided by an advisory group comprising two consultant psychiatrists of old age, an architect, a representative of a company manufacturing street furniture, a local authority town planner, a local authority social worker and a carer.

2 The area is close to the Virtual Reality Centre at the University of Teesside that was used for the VE exercises.

3 All coefficients were significant and the average exceeded 0.7 for both types of walk. Given this degree of reliability, only the research assistant's scores was used in the analysis (he had accompanied the participants on the walks).

4 The successive test statistics (*rho*, *p*) were: -0.50, 0.04 for poorer navigation; -0.57, 0.02 for dislike of the road; and -0.61, 0.01 for poor identification of telephone boxes.

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