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Exploratory spatial behaviour in real and virtual environments

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Abstract

Does real time navigation in a virtual urban environment of the same form as the real one reveal similar choices by first-time visitors? Movement in a path system introduces environmental information that may not be available in a virtual presentation; for example, feedback from one's own movement, the movement of others and other sensory stimuli. In this study, 43 visitors explored freely an enclosed path system in a real environment with which they were not familiar, comparing choices and providing motivations for their decisions. Another group of 25 participants explored a virtual reality (VR) presentation, also motivating their decisions. Both groups attempted to reconstruct their itineraries at conclusion. The path choices for the real and VR presentations were not statistically different, though clear preferences were expressed in the majority of the choice sets. Visitors to the real environment were able to remember about three times as much of their itinerary as the VR visitors. Information closely associated with the choice point itself dominates decision-making in both real and VR environments for first-time visitors, with a lesser role for cognitive mapping processes.

Keywords: Virtual reality; Computer navigation; Exploratory behaviour; Pedestrians; Pedestrian environment

1. Introduction

This article is concerned with how people make path choices while freely exploring a walking environment for the first time. The research is aimed at contributing to knowledge about the relative roles of layout of the environment and local visual stimulus in path choice. In particular, we consider whether an immersive simulation of the environment elicits the same motivated choices as a walkabout in the real environment. The walks of participants in a virtual reality (VR) simulation, composed of still panoramic views at choice points, are compared with those of participants on an exploratory walk of a pedestrian network. VR simulations are known to be more difficult to map than real, full-scale experiences (Rossano et al., 1999; Rossano and Moak, 1998). If it is important to pedestrians that they have a sense of the layout of their environment to be able to form a rational walking plan, then this activity is more difficult in VR. If people adjust their path choices according to information they acquire through successive decisions, we might expect that walks in the real environment would vary significantly from those in a VR. By comparing choice behaviours in the two

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experiential media, it is also possible to contribute to evidence for the appropriate use of visual simulation techniques as a surrogate for real world experience and judgement. On the other hand, people generally have good memory for their walking experiences, especially when they can reduce a trip to simple lines and turns, such that it might be possible to store in memory the whole pedestrian trip. The paper addresses the following questions: (1) are choices invariant across VR and real versions of the same environment? (2) Are choices related to visual information available at the decision point? (3) Do participants in the real and VR explorations differ in their stated motivations for path choice? (5) Do they differ in their ability to reconstruct their itineraries?

We know relatively little about spatial behaviour in large-scale space, since the great majority of published research is on small-scale, laboratory environments. The small-scale experiments have furnished a wealth of findings about how humans conceive of the built environment and themselves in it. We know relatively little about consequent spatial behaviour, especially in full-scale environments. It is reasonable to assume that walking in the full-scale environment is more than the accumulation of micro-scale orientation and displacement decisions; rather it should involve cognition of the large-scale environment that has a consequent effect on spatial decisions. In practice, we need to know more about how the plan of the walking system impacts on perceptions and behaviour.

The particular environment chosen for this study, the Montreal Indoor City, is an enclosed walking system below or at grade in the downtown of the city. Corridors within and between shopping centres create a grid network of clearly defined pathways with no views to the city outdoors, relatively uniform land use, lighting and temperature. The Indoor City of Montreal is also famous as a place where first-time visitors and even return visitors are often unsure just where they are.

2. Cognition of real environments

This research investigates whether exploratory navigation in a VR environment is the same as in the real environment. There are many compelling reasons in the literature to think they might differ. If the environment is conceived differently in a virtual setting and cognition of the whole environment is important in decisions taken while walking, then we could expect the choices to vary. Thus, we need to examine findings on the differences and similarities in cognition of real and virtual environments. Let us begin with cognition of real environments.

How do we learn an environment for the first time? Learning an environment is most often accomplished by experiencing it directly, where such exploratory behaviour is often guided by an internalized set of rules or protocols (Golledge, 1999). Learning is closely related to information derived from two principal sources: (1) body motion and orientation; (2) movement through the environment.

Path choices are multi-attribute (Gärling, 1999). While in some environments, the weighing of several attributes might lead to attention to just one dominant attribute, in others it would seem possible to manage path configuration, corridor length and stores content, for example. While the traveller is considering the utilities offered by various path options, trade-offs against non-spatial attributes like time and priority enter decision-making. In a novel environment, the time to travel to some imagined destination cannot be known, so only proximal information and intuitions of the way ahead based on the traversed path can be used. Such situations of uncertainty in decision-making and especially the motivational and cognitive forces in those decisions were the focus of decision field theory (Busemeyer and Townsend, 1993). In this procedural model, assessment of the situation upon approach is followed by direct experience. This experience calls up associations informing a preference state, which then informs an action.

We need first of all to distinguish between exploratory spatial behaviour and wayfinding. Wayfinding refers to the cognitive and behavioural ability to find a way from origin to destination. Exploration calls on the individual to continuously update the search, rather than fix on a distant objective. Moving toward a destination necessarily involves a selective search for relevant information, while exploration should involve a series of comprehensive assessments of the information available. Allen (1999) argues the mental processes are similar in three types of travel purpose—travel to familiar places, exploration and travel to novel destinations. The emphasis might well be different in each case however: a directed search