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## Wayfinding search strategies and matching familiarity in the built environment through virtual navigation

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### Abstract

There is an underestimation of the conscious and unconscious wayfinding search strategies in a virtual built environment without signage information. Wayfinding is the process of determining and following a path or route between an origin and destination. This is the base of the experiment discussed in this paper. Herein, the assignment was to find the destination and then return to origin in a virtual maze-like building. Subjects perform three different assignments given different locations for the destination and the start; each assignment was repeated two times subsequently. Each of the routes was recorded. Analysis of the recorded data shows a significant increasing familiarity of wayfinding. Furthermore, the increase of the number of subjects, who had chooses a route with minimal links for performing subsequent routes, is striking. That indicates whether or not consciously applying a search strategy. This paper reports about the results of analysis of familiarity and search strategies.

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### 1. Introduction

Wayfinding is an everyday activity when we go somewhere, e.g. from our home to our work, or from the train station to the city center, etc. When finding our way we know where we are and where we want to go to (destination). The destination is our goal location and various situations may occur; we visited regularly our destination before and, therefore know this destination; or we visited the destination before, but irregular and with

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medium to large intervals. In the last case, we have familiarity with the environment to certain extent and should probably reorient using our cognitive map. If we have no idea where the destination is, we need verbal, signage and/or map information.

Wayfinding is defined by Golledge (1999) as the process of determining and following a path or route between origin and destination. One can assume that orientation mechanisms affect this process of determining and following a path; we can distinguish reorientation (to know where one is) and wayfinding (how one can get from here to a certain destination). Wang and Spelke (2002) distinguish three processes relevant for orientation, namely path integration, viewpoint-dependent place recognition and reorientation.

Meilinger (2008) defines reorientation as trying to regain one's position, i.e. location and heading, in relation to an internal and external representation of an environment. The cues for this reorientation can be divided into geometric layout of an environment (e.g. shape of a room) and features of a geometric layout; in order to find a location again, geometry is considered more important than landmarks.

Montello (2005) pointed out that, in contrast to reorientation, path integration does not involve the recognition of external features such as geometry or landmarks. In path integration, sensory inputs indicating locomotion are integrated over time to keep track of one or more locations in the environment. Working memory is seen as sufficient to do that, without the need for long-term memory. Apparently, no internal or long term representation of an environment is needed. Path integration is more difficult during imagined movement compared to physical movement (Meilinger (2008)). Especially, interference could occur from a conflict between the awareness of one's physical position in an environment and the discrepant position one has adopt in imagination.

As mentioned before, orientation mechanisms include reorientation as well as wayfinding. A wayfinding process encompasses route navigation, which assumes a process enabling us to reach a known location in an environmental space. It includes route knowledge: identification a location and from that location navigation towards a target location.

What we can see from the above literature are is the importance of geometric layout features of an environment and the conception that working memory satisfies keeping track of locations while navigating in the environment. In our approach of unconscious wayfinding, this is of interest to know. Worth mentioning in this approach are notions about cognitive map related to working memory and virtual navigation related to location navigation.

Tolman (1948) introduced the term "cognitive map" to illustrate the necessity of assuming a memory content in order to explain spatial behavior in rats and men. A cognitive map is an efficient way to represent spatial representations. In this context, Kaplan (1973a) distinguishes four types of knowledge in perception and thought, namely *where one is* (perceptual process), *what is likely to happen next* (essence of prediction), *what it will be good or bad* (payoff), and *some possible courses of actions* (activation). He extends the concept of cognitive maps to the area of environmental preference (1973b). Gunzelman (2007) provides a framework for understanding how human spatial abilities are applied to naturalistic spatial tasks with maps; he distinguishes the identification of a target on a map or within an egocentric view of a space. In his study, participants were able to tailor a general strategy to the requirements of particular tasks. In a neural/cognitive approach, Nadel (1990) shows, in the development of a relational spatial system, its susceptibility to variation as function of early experiences of each individual organism.

It has already been common practice to conduct experiments with virtual reality (e.g. Bailenson et al. (2001) Stanton et al. (1996), Wilson et al. (1997)) as well as navigation through virtual environments. In this context, experiments were performed on wayfinding behavior and spatial knowledge (e.g. Jansen-Osmann et al. (2007)), learning processes (e.g. Buchner et al. (2008)), and VR-based simulators for urban environments in applied contexts (e.g. Sun (2009), Ishikawa et al. (2006)).

In this paper, the term "egress" refers to a linkage between two rooms or a linkage between a corridor and room; it has nothing to do with an exit or egress in emergency situations. Therefore, in this paper, literature about this research domain (e.g. Kobes et al. (2010)) isn't under discussion. The focus is on unconscious wayfinding in a virtual built environment without signage. The basis for the described experiment and the provided data is provided by Chen (2012).

This paper gives in section 2 a description about the design of the experiment. Section 3 provides the approach about the used method and the data collection, and section 4 presents the results of the experiment. A discussion about the conclusions and future directions will conclude this paper.

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