Place Space & Monkey Brains: Cognitive Mapping in Games & Other Media

Erik Champion
Information Environments Program
School of ITEE, University of Queensland
QLD 4072 Australia
Ph: +61 7 3365-4194
erikc@itee.uq.edu.au

ABSTRACT

This paper attempts to ground the relationship of architecture to game space, suggest ways in which real world design of places can help the design of game spaces, and distinguish between our experience and recall of *episodic* space as scene via film and literature, to our experience and recall of *sequential* and *interstitial* space in three-dimensional games.

The following argument is based on informal feedback of game players, formal observations of navigation in virtual environments, and from discussions with researchers of medical visualization technologies. My hypothesis is that having an ergodically embodied sense of self (such as in computer games) enhances sequential spatial memory over traditional non-ergodic forms of entertainment (such as adventure books with survey maps, or traditional cinematic media). My proposed method of evaluation for analyzing and evaluating spatial cognition in an interactive virtual environment (such as a computer game), is to use brain scanning equipment.

Keywords

computer games, place theory, wayfinding, cognitive mapping, brain scanning

INTRODUCTION

In their use of media and techniques designed to enhance engagement and immersion in digitally created content, computer games are a form of virtual environment. When we design and critique games, we are typically focusing on the design and criticism of space that is defined by the activity that takes 'place' within it. Hence, in order to better understand games, we need to understand their creation of place and how it is perceived by the players [4].

PLACE

Place is an elastic term both readily understood, and difficult to pin down. Place is particular, unique, elusive, dynamic, and memorably related to other places, peoples, and to events (tasks and happenings). Place may have a cultural and personal significance as well as a social history

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shaped by how it helped, hindered, and was modified by humans. Place may also act as a decipherable record of human interaction (a 'history').

Unfortunately, architecture (as a built place) has too often been viewed as an art-form that relies on its aesthetic value in terms of being an immovable and immutable object. For example, in the nineteenth century, empathy theorists viewed architecture as little more than sculptural objects that we can create associations for [15].

A few years ago, the philosopher Anthony Savile attacked Richard Foster's work for the same reason: treating the essence of architecture as sculptural form [17]. Architecture also involves interior spaces, the linking of spaces (e.g., from inner to outer and the converse), and the placing or locating, using and imagining of symbolic objects (as well as the self and other people) in order to create a *significant* sense of place.

How Place is Learnt by Movement through Space

The philosopher Schelling suggested that architecture could be viewed as clothing, which implied that rather than merely acting as a clumsy mass, architecture covers modifies and directs our imagined and real movement. We are, after all, kinetic sculpture [14].

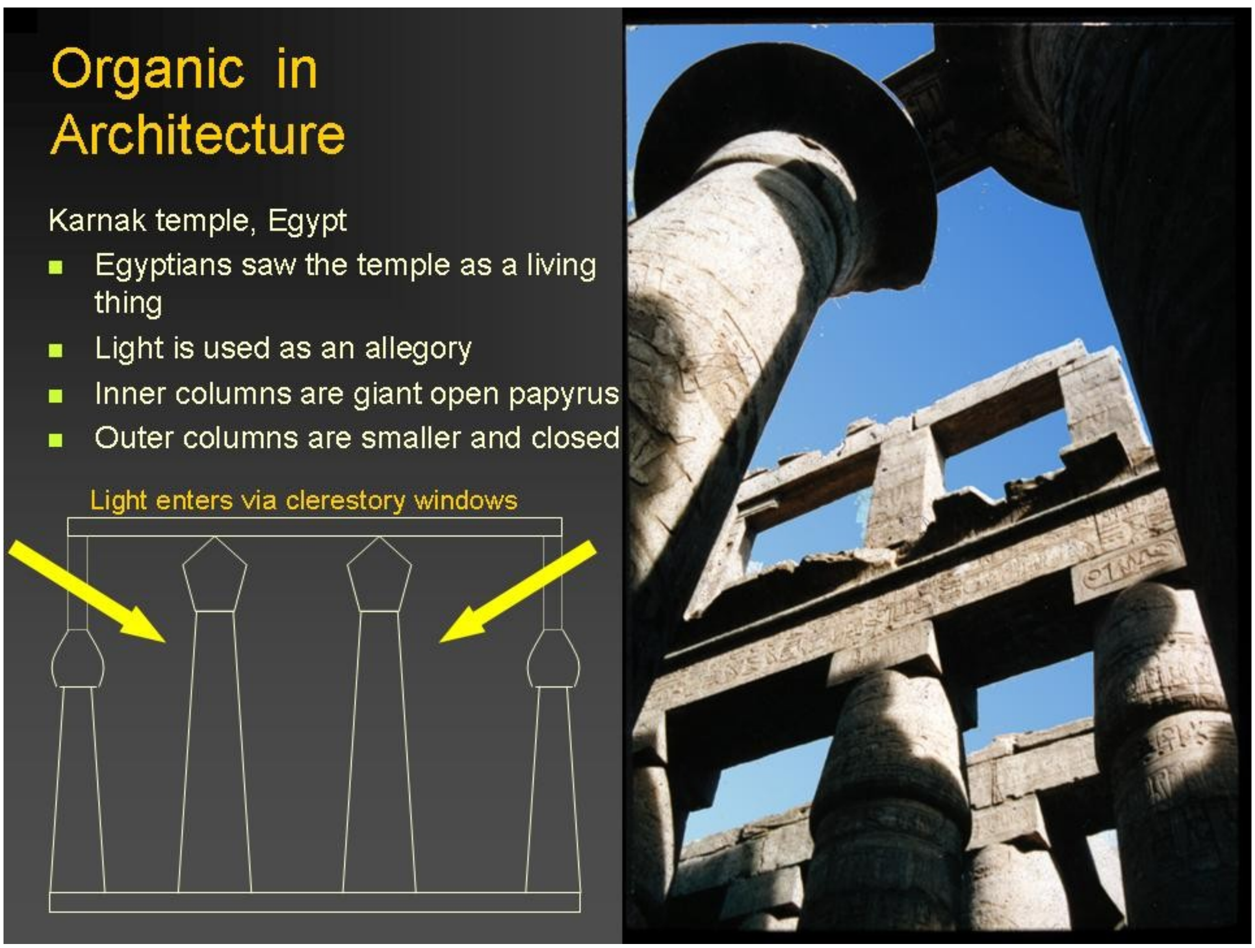

Figure 1.1: Diagram and Photo of Allegorical Architecture

For example, in the temple at Karnak, the movement through the temple itself is an allegory of life (Figure 1.1). As one moves through the temple, light streams through the clerestory windows onto the large columns (shown to the left in the photo) with open buds, as if the columns are flowering in the light. By contrast, the small side columns that stand in the dark (to the right in the photo) have closed buds. The allegory of light and dark and life and death are here played out in stone. Game designers also use similar themes of phototropia (attraction to light), in their designs.

Allegories also exist in modern architecture (for example, the Adam and Eve theme spatially configured to the direction of the user in Stockholm City Library, designed by E. G. Asplund). Church designers built tiny entry halls so that the main space seemed to be much bigger and impressive than it actually was. Architects have used allegories and perceptual affordances to help inform navigate and orient people for thousands of years.

I mention the above in response to Henry Jenkins' suggestion that we approach the design of games as 'narrative architecture" [8]. I believe he coined the term in order to appraise the value of computer games in regards to conventional narrative media. Yet three-dimensional computer games already follow place-making affordances of architecture in a way traditional narrative forms of entertainment do not.

The importance of the threshold as interstitial space in the experiencing of movement through space has also not been addressed in his article [6]. I agree with Jenkins that games can learn a great deal about atmosphere from studying amusement park design [3]. However, amusement park rides are actually more related to films than games are. As the amusement park rail system is passive and directed by an external force, its design does not fully address the proprioceptive opportunities (relating to perception of movement and other sensations within one's own body) of computer games.

Navigation

A sense of place relates to how we individually believe we would, should or have navigated through a space. Navigation may be defined as locomotion and wayfinding [12]. Rather than seeing wayfinding as a process, Elvins seems to see wayfinding as a type of ability: "the ability to find a way to a particular location in an expedient manner and to recognize the destination when reached", i.e. navigating with spatial knowledge and a destination in mind [5].

Other academics have suggested that there is more to navigation than locomotion and wayfinding: Raubal and Egenhofer emphasize the distinction between "...practical space (i.e., acting in space) and conceptual space (i.e., representing space)" [16]. They refer to Johnson's belief that wayfinding is developed by habits and social practices [9] along with image schemata, "recurring mental patterns that help people to structure space so that they know what to do with it" [16].

Lynch created a descriptive theory of place-making elements at urban scale. Many researchers have used his writings as a prescriptive theory of what to include in the creation of real or virtual places. Yet while Lynch's ideas of the city allow us to visualise how it works, his theory does not necessarily tell us that his five elements are always required and always understood in the same way by different people. "The crucial thing missing from the traditional geographies is the failure to appreciate how environments are conceived by people as opposed to simply perceived by people" [1]. Recently, virtual environment researchers have suggested that their inability to substantiate Lynch's theories of navigation and place-making is due to the highly variable navigation tools each person tends to use.

OBSERVATIONS

Why is navigation so important to the design of virtual environments? In 2004 I ran a series of evaluations on cultural understanding acquired via three different modes of interaction in a virtual heritage environment (Figure 1.2). Each mode used a subset of the buildings on the site but I did not foresee that this change in content would affect the results. I was wrong, both task performance and understanding (information retrieval and extrapolation), were severely affected by which cluster of buildings participants were asked to navigate.

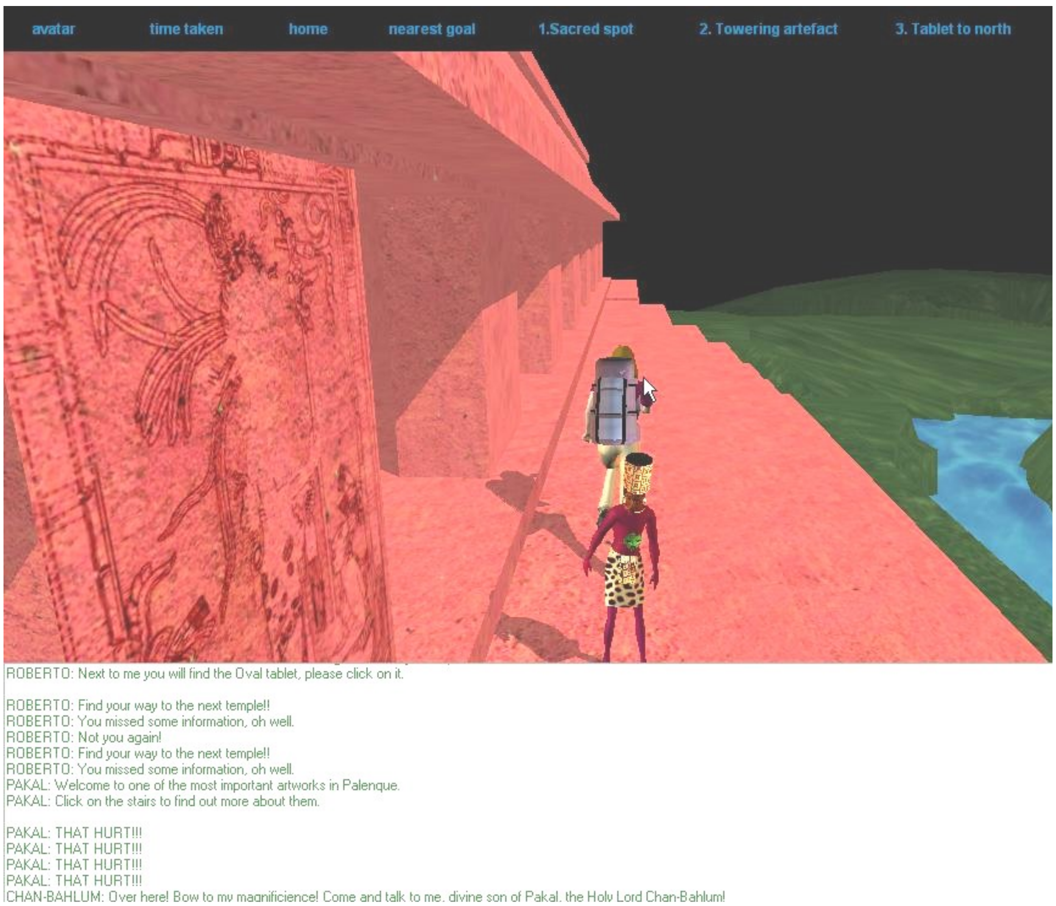

Figure 1.2: Mayan virtual heritage project that inspired the hypothesis

On closer inspection I realized that the ability to gain a visual overview of the entire site without having to continually look around affected the cognitive loading, enjoyment, and understanding of the participants. I have since found research that corroborates my observation [15]. People do not glance around in a virtual environment as much as they do in real-life, and hence navigation and positioning of major landmarks and navigational goals is a crucial component of virtual environment design.

On the other hand, psychology students have suggested to me that computer games can help improve not just hand-eye coordination, but also spatial memory. They related that when they started playing three-dimensional ‘shooter’ games, they noticed a definite increase in their spatial memory i.e. their ability to recall what will appear next when moving from one spatial 'cell' to another in a first person shooter game. They said this ability was transferable across to new games, and hence their spatial memory and related skills was not developed solely through repetition of the same environment.

I had a similar observation, based on my own experiences of interactive fiction. A recent example, last year I played a demo of the game “Future Boy!” [19]. It uses textual commands (such as “N” for north), textual instructions (to paraphrase, “there is no door to the north”), and two-dimensional pre-rendered pictures, to create an ‘interactive fiction’ style mystery-adventure game.

What irritates me when I play interactive fiction (such as “Future Boy!”) is that I don't remember the position of the spaces I have been to. I select the option to reverse direction only to be reminded that there is no door behind me. I have forgotten that I entered via a side door, because the N E W S system of organizing rooms has no meaning to me. The answer seems obvious; most people do not understand maps or pictures as readily as a three-dimensional immersive medium. Usually only spatial designers such as architects and spatial scientists (such as those trained in geography or geomatics), appear to have this ability to visualize in three dimensions from two dimensional media. Yet I have trained as an architect, and can read and visualize in three dimensions from maps, blueprints and house plans, and I even wrote/designed D and D style games in the early 1980s, so why can’t I remember which walls behind me had doors in “Future Boy!”?

Perhaps it is because the directional information is all textual, not even two-dimensional. My suspicion is that I need to have some feeling for being able to move through the space, in order to remember which room belongs where. I don't believe that when people read, for example, the maps in the book series “The Lord of the Rings”, or view the films, that they know spatially where each realm is in relation to each other. They would need to actively partake in the Lord of the Rings as a three-dimensional environment, (such as a computer game), to develop true spatial cognition.

Episodic Versus Sequential Mapping

I am convinced that we use different parts of our mind when we interactively navigate through a three-dimensional virtual environment as opposed to visualizing from a film or from a book or even from interactive fiction games (two dimensional pictures where people 'navigate' by typing in N E S or W, a bit like the game “Myst” or “Future Boy!”).

I argue that our spatial understanding differs between computer games and viewing films or reading books. When we view films, we are shown episodic flashes of place, place sets the scene rather than dictates our own decision making process. Since we are guided through changes in setting, our cognitive mapping is not necessary. A camera may race us through opening doors and adjoining spaces, but we never rest on or in a threshold (even if the scene is framed) because our bodies are not required to even recognize what a threshold is. A film is a virtual form of two-dimensional eternal space, but we only recall it episodically.

There are often maps in books, but they too do not trigger the cognitive mapping process, because all that is required is route knowledge, not embodied wayfinding. As most people struggle to visualize the actual environment from the two-dimensional representation of it, they cannot ‘place’ themselves in the map. And this lack of embodiment means that even if they are shown pictures in the book that relate to the map, given that they cannot look around and move through the scene, they do not develop a sequential cognitive mapping of the represented place.

Unlike the picture space of films, the three-dimensional space of games is far closer to ‘place’. We also have more cognitive overloading in a game, as we are actively wayfinding, rather than passively experiencing the cinematic display of space. For three-dimensional adventure/ shooter games rely on evoking not just engaging our perception, but also our sense of embodiment and embeddedness.

Inside a game, as embodied avatars, we become aware of what we can fit inside of and move between. We are also more ‘vulnerable’ to unseen dangers. For example, in order to attack and scare us, the film-bound monster has to be within the visual ‘frame’, unlike a game monster, which can sneak up on us. In a game we may need to select the right outpost in order to see out, that is easily defensible (stands out from the surrounds), that hides us from prying eyes, and protects our ‘back’. In terms of embeddedness, a game often allows us to interact with and personalize the surrounds. We have to actively make sense of our ‘surrounds’, and engage our wayfinding abilities.

I hypothesize that we can track this relation of interaction and spatial presence through scanning the brain and recording brain activity of the players. I don't know how accurately this brain scanning will be or how revealing. But it may help the design of virtual environments (and computer games) with better spatial presence, improve navigation, or even help improve designer's spatial memory (one could have games that teach them how to read from plans by testing them in virtual environments). Secondly, I suggest that we can track how the brain learns to use spatial cues through continual navigation through dark and panicky computer game environments like Doom etc.

MONKEY BRAINS AND COGNITIVE MAPPING

In fact, Billinghurst and Weghorst have previously evaluated engagement by qualitative and quantitative measurement of “sketch maps” [2]. Their research indicates that accuracy in sketching the virtual environment after the experience is directly related to engagement in the virtual environment.

Research in this area relies on the notion of cognitive maps and mapping. There is confusion in the literature over whether a cognitive map is the process by which people store navigational knowledge, or whether it is the instantaneous product of cognitive mapping, i.e. a cognitive map is formed in the mind on demand from cognitive mapping processes. Lagoudakis, for example, seems to define a cognitive map as the former [11]; but Soini defines it as the latter, “a product of this [cognitive mapping] process at any point in time” [8].

Medical research indicates that Soini is more likely to be correct; cognitive maps are created on demand as their elements are retrieved from different parts of the brain on demand. In fact, research suggests “…space is represented in the mind not once but multiple times” [20].

Cognitive maps appear to be highly individual. Neural research by scientists on monkeys indicates that we remember locations in terms of salience (behavioral significance) not by what is actually there [7]. Thus, the way we access these cognitive maps is typically not just via quantitative estimates and measurements but also in relation to personal attachments and perceptions [20].

APPLYING THESE THEORIES TO GAMES AND OTHER MEDIA

I believe that we are using different parts of our brain more or less actively when visualizing about a spatial scene, watching a scene, or trying to actively wayfind 'inside' a three-dimensional virtual space. I believe that I can use brain scanning technology to evaluate brain states of participants in a virtual environment or game, which may show differences in the cognitive mapping process. I have spoken to various researchers in Australia and the United States about possible scientific evidence behind the above hypothesis.

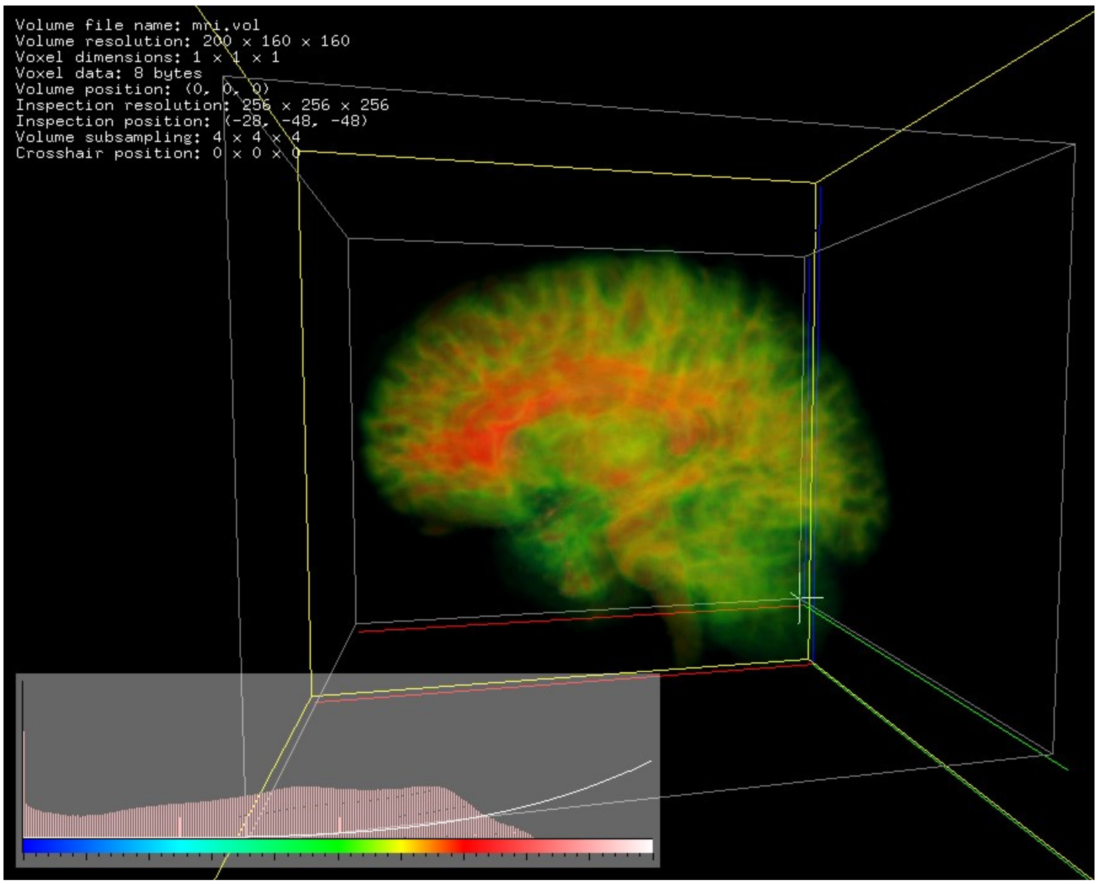

Figure 1.3: magnetic resonance imaging

The researchers suggested that there are three potentially useful methods. These use fMSI, SSVP, and EEG. fMSI (functional magnetic resonance imaging, also known as MRI) is an expensive method that measures blood flow, one theory being that increased blood flow occurs in areas of high activity (Figure 1.3).

Steady State Visually Evoked Potential (SSVP) records basic water density and thus creates a static image. The EEG test is a method that records the electrical activity of the brain by via electrodes attached to the scalp. Typically EEG tests involve presenting a number of carefully aligned events to which the "patient" is supposed to make a decision involving cognition. Each has advantages and disadvantages, and results may not be clear-cut.

How would we test the hypothesis? So far, research into comparative learning between media has struggled with selecting media that are equivalent in learning content [10]. For my experimental design I have three admittedly ambitious aims. Firstly, to provide some empirical evidence that our brains spatial functions are differently 'activated' when navigating virtual environment or game space to cinematic space, reading a book with elaborate maps, or interactive fiction space. Secondly, to provide evidence for using hybrid two-dimensional / three-dimensional map systems for better visualization information. Thirdly, to see if there are individual differences in spatial cognition, and to see if the three-dimensional environment helps develop these skills (useful for architecture and three-dimensional multimedia students).

A potential design would be to select participants without 'shooter' game playing experience or a specialist background in three-dimensional visualization. Half the group will play a three-dimensional game version of an interactive book (i.e. two-dimensional pictures and text) and the other half will read the interactive book. We could evaluate changes in brain function using an EEG tracking system. We could also swap the two groups around to observe any sequencing effect. Unfortunately it is difficult to find a suitable game or virtual environment that has an equivalent film or book text narrative that takes approximately the same amount of time to complete. Further, we really should use three groups, one reads the book, one plays the game, and one group watches the film.

CONCLUSION

If this experimental design is successful, we may be able to not merely say three-dimensional games have special properties not easily and immediately explained by conventional narrative theory; we may also be able to improve the spatial presence of digital environments, and perhaps even improve the spatial recognition and navigation capabilities of users. The significance of successful results would indicate whether our spatial recall from three-dimensional games differs from that in film and literature, and it may help researchers and educationalists to use these computer games to improve the spatial memory of students, spatial designers, or virtual travelers.

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