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## Exploring the intersection of wayfinding and presence in video games

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# Abstract

This thesis project aims to contribute knowledge to the field of user experience design in games by examining the relationship between presence and wayfinding in games in order to determine how one might design wayfinding systems that simultaneously facilitate player navigation and create a sense of presence. Based on examining and comparing existing literature on wayfinding and presence in games, and by analyzing existing games that accomplish the aforementioned dual purpose, I formulate a set of hypothetical design principles for presence-creating wayfinding design. The validity of these principles is then put to test by creating and testing a digital prototype where participants are tasked with navigating a virtual space. The testing of the practical application of these principles reveals them to be largely viable, demonstrating the viability of designing wayfinding solutions for games that simultaneously facilitate presence.

**Keywords:** Presence, Wayfinding, Navigation, Diegesis, Immersion, Games, Spatiality, Spatial cognition, Cognitive mapping, Mental mapping.

# Acknowledgments

I would like to thank my supervisor Simon Niedenthal for his guidance and support during this project. I also want to thank the participants who helped playtest my prototype.

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# 1 Introduction

## 1.1 Context

An important but elusive quality of video games is that of presence, frequently also known as immersion. In the context of games, presence is generally meant to signify the phenomenon of the player having a sense of not merely observing and controlling the game but actually inhabiting the game world and ceasing to be aware of the surrounding physical world. Being present in a game is widely viewed as a desirable experience by players, a deeper sense of presence is equated with a greater enjoyment of the gaming experience in general (Cairns, Cox, & Nordin, 2014; Jennet, et al., 2008; Brown & Cairns, 2004).

Creating a sense of presence is dependent on the player accepting the game as a viable alternate reality. This occurs through a process where the player observes and interacts with the game world and forms a mental model of the world based on these observations and interactions. If the world is sufficiently rich in sensory data and coherently follows its own esthetic, narrative and systemic logic, which is to say that it adheres to expectations of the player's mental model, the player's mind and senses will favor the world of the game over the their physical surroundings (Wirth, et al., 2007; Witmer & Singer, 1998).

Wayfinding is a term used to describe the process through which humans orient themselves in environments in order to successfully navigate through them. Wayfinding is at its core a process where a person forms a cognitive map of an environment and uses that map to navigate environments. This cognitive map consists of a hierarchy of objects based on their spatial and causal relationships to each other, established by navigating environments and detecting recurring relationships between different objects. A cognitive map allows one to not only navigate previously visited locations, but also to make qualified assumptions as to how navigate new ones based on previous experience (Bond, 2020). Wayfinding can be regarded as the cognitive half of navigation, the executive half being locomotion (Champion, 2005).

A significant amount of research has been conducted on presence and wayfinding in games as separate phenomena, but very few researchers have attempted to explore connections between the two despite the fact that they are both deeply rooted in spatial cognition. This intersection thus presents itself as a potentially rich and largely unexplored field of inquiry.

## 1.2 Aim

The aim of this project is to explore connections between immersion and wayfinding in games and, based on these findings, attempt to design and prototype a game containing wayfinding design that guides the player through the game world while simultaneously creating a sense of presence.

## 1.3 Research questions

This thesis project began as an investigation of how to best design wayfinding systems for games. Further reading however hinted at intriguing connections between wayfinding and the phenomenon of presence, leading me to the following research questions:

- What is are the connections between presence and wayfinding in the context of video games?
- How might a designer, based on these connections, design wayfinding solutions that successfully guide the player through the game world while simultaneously facilitating presence?

## 1.4 Delimitations

The focus of this thesis is presence and wayfinding in games and how they intersect and interact, and how to design wayfinding solutions that create presence in games. As will be discussed at length in this thesis, that objects be coherent within the context of the game world is key for presence. For this reason, it does not delve into great detail when discussing the design of wayfinding objects whose specific nature means that they run a high risk of being perceived as incoherent by the player, for example signs and color-coded paths. As literature on wayfinding design tends to overwhelmingly focus on such objects, much of the literature on wayfinding design for physical spaces was deemed not applicable to this project.

This thesis also does not concern itself with presence in non-interactive media or completely linear gaming experiences, as it is not possible or necessary to design wayfinding for experiences where the player is not afforded navigational agency.

Exploring how different perspectives and forms of locomotion might affect the player's experience of both presence and wayfinding in games would likely be a valuable pursuit, but as such an investigation would require the design, creation and testing of a vast number of prototypes it falls outside the scope of feasibility for a bachelor's thesis project.

Finally, as the prototype created during the course of this project consists of a screen-based game this thesis does not explore presence or wayfinding in virtual reality games. This is not because the topic of this thesis is not potentially relevant for virtual reality, but due to a lack of access to the necessary equipment prototyping for that medium would not have been possible.

## 1.5 Wider relevance

Beyond their implications for the design of virtual game worlds, the findings of this project could conceivably also be of value for designers creating physical spaces where guiding participants through the space while maintaining a sense of presence in the fiction of the space is paramount, such as escape rooms, haunted houses at theme parks or live-action roleplaying games. This thesis could furthermore be of value for designing virtual reality experiences that share the need for presence-creating wayfinding.

## 1.6 Structure

This thesis consists of the following sections:

**Part 2** introduces and defines the key terms used in this thesis. It first presents an overview of the phenomenon of presence in games. It then proceeds to give an introduction to the concept of wayfinding as an activity and as a part of design practice in games.

**Part 3** analyses existing works that can be argued to succeed at presence-creating wayfinding.

**Part 4** discusses how the requirements for presence and wayfinding in games converge and diverge and, based on these findings and the analysis of existing work in part 3, hypothesizes a set of design principles for presence-creating wayfinding.

**Part 5** describes the methods employed to prototype and test the hypothetical design principles outlined in part 3.

**Part 6** describes the design, creation and playtesting of the prototype.

**Part 7** reflects on the outcome of the design process and playtesting.

**Part 8** provides a summary of the project and its knowledge contribution.

# 2 Theory

## 2.1 Presence in games

### 2.1.1 Defining presence

In the context of video games, the term presence is used to describe the phenomenon of the player feeling like they are “in the game”. Players enter a state where they lose track of time, cease to be aware of their physical surroundings, and become totally absorbed by the world of the game (Wiebel & Wissmath, 2011). Players describe being present in a game as a “Zen-like state where you just know what to do and your mind just seems to carry on with the story”, “you stop thinking about the fact that you’re playing a computer game and you’re just in a computer”, “you feel like you’re there” and “everything else is irrelevant” (Brown & Cairns, 2004). As technology has advanced and allowed for ever increasing levels of audiovisual fidelity and more complex game worlds, presence has become an increasingly important field of study (Tamborini & Skalski, 2006).

In short, being present in a game is the sensation of feeling like one is inhabiting the world of the game while simultaneously being unaware of the surrounding physical world. Designers, players and critics tend to view presence as an inherently positive attribute in games, the level of presence is seen as corresponding directly to the quality of the gaming experience in general (Cairns, Cox, & Nordin, 2014; Jennet, et al., 2008; Brown & Cairns, 2004). However, players seek to experience presence in games not necessarily only because they consider such experiences inherently more enjoyable or engaging. Presence-creating games that explore unpleasant themes such as horror, anxiety or grief are viewed as safe and controlled environments where players can confront and overcome their fears. Presence-creating gaming experiences thus present a potential for therapeutic use beyond entertainment (Tamborini & Skalski, 2006).

Clearly defining presence is complicated by the fact that researchers and other writers in the field of games tend to use many different terms to describe the same phenomenon. In both academic papers and the games press the terms immersion, presence, spatial presence, and spatial immersion are frequently used interchangeably. It is not uncommon for a paper on presence to reference a paper on immersion, or vice versa. Other writers present immersion as a precursor to presence (Brown & Cairns, 2004) or as a component of it (Witmer & Singer, 1998). Therefore, one cannot assume that a writer shares one’s definition of the terminology. This unfortunate situation necessitates a careful reading of each text to establish

its relevance. While immersion appears to be the most commonly used term based on the frequency of use in papers researched during this project, this thesis will consequently use presence for the sake of clarity and accuracy as I judge it to be the more specific and less frequently misused term.

The concept of presence in games in some respects maps closely to the notion of flow in the field of psychology, which is the experience of being absorbed by an activity to such an extent that one stops paying attention to the outside world, loses all sense of time and is completely focused on executing the specific activity. Flow and presence thus share the traits of time distortion and focusing the senses on a single task to the detriment of outside stimulus. However, flow is also closely associated with executing an activity to the utmost of one's ability with a sense of great ease, of being in an "optimal state". Flow is thus an inherently extreme state, a sense of total absorption and concentration while operating at a high level (Csikszentmihalyi, 1990). Presence in games is on the other hand not necessarily an intense or extreme experience, nor is it tied to the player being challenged or playing the game at the maximum of their ability. A player who is captivated by the non-challenging activity of casually walking through an esthetically pleasing virtual landscape might experience a deep sense of presence but cannot be said to be in a state of flow as their ability to play the game is not being put to test at that moment (Wirth, et al., 2007). Flow as a concept presupposes that an activity can be poorly executed, presence can be achieved during trivial non-challenging activities or even while doing nothing in particular. Being challenged can facilitate presence by requiring the player to focus on the game, but it is not a prerequisite. The other significant difference between flow and presence is that presence in games is inherently spatial, the player achieves a sense of actually being present in the game world. A person in a state of flow will cease to pay attention to the outside world, but they do not necessarily feel like they are instead present in another one (Jennet, et al., 2008; Wiebel & Wissmath, 2011).

### 2.1.2 Creating presence

Brown & Cairns (2004) argue that presence is created in three stages: engagement, engrossment and total immersion. A player that is merely engaged in the playing of a game has decided to invest their time, attention and effort into the activity of learning and playing the game. The engaged player is still aware of time and their surroundings, but playing the game is their current main focus. An engrossed player has reached a stage where they are still aware of the outside world but have become emotionally invested in the game and have ceased to actively think about how to play and control the game. This requires that the player is actually enjoying the game, and that it is designed in such a way as to be easy to control and learn. A player who is totally immersed has reached a state of presence and is no longer aware of

their surroundings or the fact that they are playing a game. While valuable in that it clearly outlines the initial obstacles that might prevent a player from reaching a state of presence, this model focuses heavily on physical controls, motivation and learning on the part of the player while not going into great depth when describing the qualities that game worlds should possess in order to create presence.

Presenting a model more focused on unpacking the presence-creating characteristics of worlds in games and other media, Wirth et al. (2007) propose a two-stage model for how a state of presence is achieved (Figure 1):

1. The first stage consists of the player forming a mental model of the game world by observing and interacting with it. To facilitate presence, the game world must fulfill several criteria in order to act as the foundation for a rich mental model. Firstly, it needs to be rich in sensory data that attracts the player's attention. The player will hopefully approach the game with a high degree of attention, but it must be maintained by the game. In the context of games, this sensory data will mainly be visual and auditory, and to a lesser extent haptic if supported by the game's hardware controller. This sensory data must furthermore be coherent and consistent. If the game takes place in a real-world setting it must strive to fulfill and not contradict the player's expectations of such a space, and if it instead takes place in an environment not based on reality it must clearly define and adhere to its internal esthetic and systemic logic. Interactions with and the causal and spatial relationships between objects and actors within the game world must be predictable. A game world does not need to adhere to the laws governing physical reality, but it must have its own set of laws that are followed strictly and clearly presented to the player. The player's experience of the game should furthermore be unbroken, meaning that it should not be interrupted by for example intrusive user interface elements. Finally, there is a need for narrative richness. This narrative does not have to be verbose or ever-present in the play experience, but there needs to exist some kind of fictional context that explains what the game world is about and what the player's role within it is.
2. In the second stage the player chooses or does not choose to feel like they are inhabiting the world of the game rather than the real world, a kind of total shift of perceptive focus. This is however generally not a conscious process; it is rather the case that the player's mind gradually and imperceptibly starts to prioritize sensory data from the world of the game over that from physical reality. The outcome of this second stage is determined by whether the player's mind accepts the mental model generated during the first stage as a viable alternate reality, which in turn depends on how successfully it fulfills the

> criteria outlined in the previous stage. How successfully it matches the criteria is decided by the player constantly and unconsciously creating hypotheses and then checking their validity. Such a hypothesis is based on previous experience of interacting with and observing the game world, and from physical reality if the game world bears a resemblance to it. If the game world is found lacking in coherence and internal logic it will not be perceived as a viable alternate reality, and the player will not enter a state of presence.

According to this model, creating and maintaining presence is a never-ending negotiation between the player and the game world, an infinite loop of inquiry and result that will collapse and must be rebuilt if it fails even once. Designers must therefore strive to create worlds that constantly promote presence.

Witmer & Singer (1998) and Tamborini & Skalski (2006) are in agreement with both of the above-mentioned models, arguing that both external and in-game factors are key for creating and maintaining presence.

When discussing how to present information to the player in a way that creates presence, much has been written on the phenomenon of diegesis. Diegetic game elements are presented as existing within the game world and are treated as being visible to the player and other actors in the game. Conversely, game elements that are presented as an overlay on top of the player's view of the game world are non-diegetic, meaning that they do not exist within the fiction of the game and are treated as being visible only to the player. Diegesis in games is most commonly discussed in the context of user interface design (Russell, 2011). Removing non-diegetic user interface elements and instead presenting the information they contained using diegetic means has been shown to create a deeper sense of presence in some instances (Iacovides, Cox, Kennedy, Cairns, & Jennett, 2015). However, some game designers appear to view diegesis as a shortcut for creating presence, believing that simply minimizing the amount of non-diegetic user interface elements is a guaranteed path to presence (Tach, 2013). While diegesis can contribute to creating presence and non-diegetic elements can conversely risk inhibiting presence, it is a relatively minor factor when compared to esthetic, narrative and systemic coherence (Fagerholt & Lorentzon, 2009). Diegetic user interfaces in games furthermore tend to communicate relatively non-complex information, such as the amount of ammunition left in a weapon. As communicating navigation is a vastly more complex task, the design practices for diegetic user interfaces are not necessarily directly applicable to or relevant for presence-creating wayfinding design.

## 2.2 Wayfinding

The term wayfinding denotes the process by which a person interprets and orients themselves within an environment in order to successfully navigate between locations. Wayfinding as a phenomenon is ancient. For example, ancient Polynesians would travel great distances over the open ocean and successfully reach small islands by interpreting the sea, the sky, and the flight patterns of birds (Bond, 2020). In a modern design context, the term was first popularized by Lynch (1960) to discuss how to plan urban environments in order to facilitate navigation. The term was later expanded by Arthur & Passini (1992) and Gibson (2009) to also include architecture and signage. Wayfinding as a design practice for physical spaces is especially important in dense urban areas and other large public spaces that constantly offer a vast array of navigation options, such as transit hubs and shopping malls.

The act of wayfinding occurs through a process that involves sensory input, cognition and memory. The mind processes sensory information and uses it to create an environmental image based on previous experience of similar environments. If one is able to correlate an environment to one previously experienced one can use that experience to project the environmental image outwards beyond what is immediately visible and make qualified assumptions about what might be there, for example knowing that following a river downstream will eventually lead to an ocean or lake. A sufficient level of familiarity with a type of environment can even allow one to successfully navigate environments that at first glance offer next to nothing in the way of navigational clues, for example traversing the open ocean and successfully reaching land by following the flight path of birds. Thus, while often not a conscious process the act of wayfinding is in fact an acquired skill that is to a high degree shaped by a person's unique life experience and the types of environments that they are most accustomed to navigating (Lynch, 1960).

### 2.2.1 Spatial cognition and wayfinding knowledge

The type of knowledge required to successfully navigate a space is known as a cognitive map. However, a cognitive map should not be assumed to be merely a mental version of a regular map. Rather than a direct representation of an environment, it is a hierarchical organization of objects based on their relationships to each other. A cognitive map allows one to not only navigate previously visited environments, but also to plan new routes in unfamiliar environments as long as they contain familiar spatial information. To be able to be incorporated into a cognitive map objects must be distinguishable from their surroundings, both visually and in the sense that they are perceived as having a specific meaning and function. They must furthermore be structured in an understandable way, which is to say that their spatial and causal relationships to other objects must be learnable and predictable (Elvins,

1997). How this knowledge is recorded and retained by the brain is a complex process that science currently has only a limited understanding of. Neuroscientists conducting experiments with rats in labyrinths have discovered that the brain contains specialized cells that deal with spatiality and navigation. There are cells that determine which direction one is facing and others that activate when one approaches an edge or a wall. Of greatest relevance for the subject of wayfinding are place cells. When a rat first enters and starts exploring a new space, a unique combination of these cells is activated. If the same space is revisited at a later time, the same exact combination of cells will again activate. Researchers have however yet to discover where in the brain this information is stored, and there is no apparent correlation between the layout of a space and the unique set of space cells it activates (Bond, 2020).

In order to construct a cognitive map of a given environment, Lynch (1960) proposes that a person must go through a series of steps where they acquire and combine three distinct and interdependent types of spatial knowledge (Figure 2):

1. **Landmark knowledge** concerns spatial knowledge about locations that stand out within the environment, for example tall mountains, prominent buildings or road signs. The mind classifies certain locations as landmarks in order to create structure and filter out non-essential spatial information. An environment devoid of discernable landmark features is exceedingly difficult to navigate, it is for example not just the complexity of their paths but their uniformity that makes labyrinths so challenging to successfully traverse. The types of locations selected as landmarks tend to be visually imposing, visible from a distance and familiar to the person viewing them, meaning that they are able to classify the landmark as a specific type of object separate from its surroundings. Landmarks serve as navigational points of reference and checkpoints along routes, failure to encounter an expected landmark will generally cause the wayfinder to abort their current route and attempt to find a new one to follow (Sorrows & Hirtle, 1999).
2. **Route knowledge***,* also known as procedural knowledge, is the knowledge of the steps needed to successfully traverse the environment and reach a given destination. Route knowledge is generated by establishing spatial connections and causal relationships between different types of landmarks. For example, if a person is injured and lost in the woods encounters a set of train tracks, they can be reasonably confident that following these tracks will eventually lead to them a train station. They can further assume that the train station will be located in or near a town, which is in turn likely to contain a hospital. This is of course assuming that they have

previous experience of the relationships between train tracks, stations, towns and hospitals.

3. **Survey knowledge** describes large scale topological information. This type of knowledge is geocentric, meaning that it assumes a top-down perspective as opposed to the egocentric first-person perspective. Survey knowledge can be acquired either by studying an actual map or by moving through an environment and gaining a sufficient amount of knowledge in order to be able to establish spatial relationships between many different landmarks, how to transition between different routes and make qualified assumptions about not yet visited locations based on this knowledge. (Darken & Sibert, 1996).

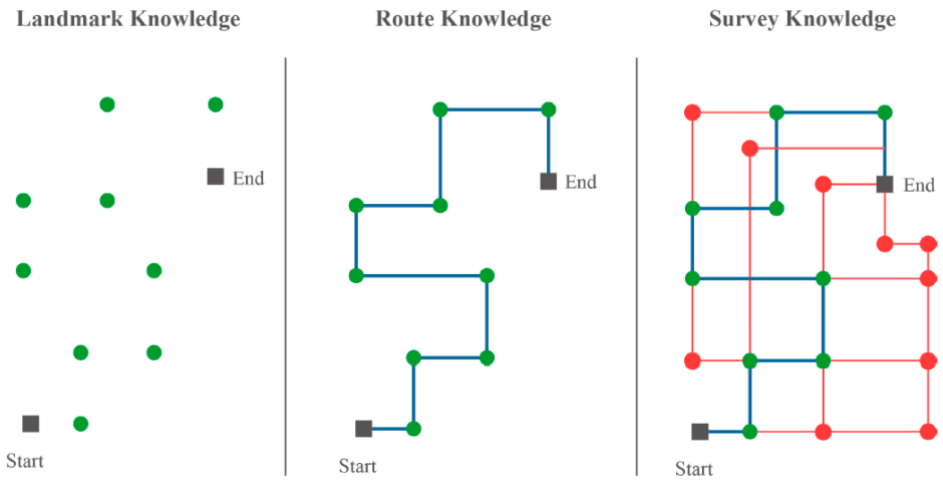


*Figure 1. Visual representation of landmark, route and survey knowledge (Quesnot & Roche, 2015).*

The process of successfully going through these steps and building a cognitive map can be described as a form of map-making, albeit one that is very different from regular cartography. This raises the question of what role navigational tools such as maps might play in facilitating wayfinding. Having access to an actual map of an area can function as a shortcut that allows a person to bypass the initial two stages of establishing landmark and route knowledge and rapidly acquire a high degree of detailed survey knowledge of a previously unknown environment. However, due to the fact that no map is able to depict an area with a one to one level of detail and stay up to date with changes in the environment there is a hard limit to the level of survey knowledge one can acquire from studying a map. This limit is dependent on both the fidelity of the map and the map-reading ability of the individual, map-reading being a separate but related skill to wayfinding. Conversely, there appears to be no limit to the level of detail of survey knowledge that can be acquired by going through the albeit much slower process of actually

navigating and learning an environment using the above mentioned three-step process. Furthermore, the survey knowledge acquired with the assistance of a map is not identical to that gained by navigating a space. Map-based survey knowledge allows one to better judge the distances and directions between landmarks whereas traversal-based survey knowledge is superior for route planning and determining travel time. These findings suggest that maps and other navigational tools cannot supplant traversal-based learning as a source of survey knowledge but rather act as a complement, they provide useful information but this information must still be interpreted by the wayfinder in the context of the sensory data generated by the environment (Thorndyke & Hayes-Roth, 1980).

It is difficult to draw definite conclusions as to the nature of spatial cognition in games, as game worlds tend to vary wildly from each other in terms of perspective, esthetic and fidelity in ways that physical spaces do not. These factors have a profound impact on how the player's mind experiences the space, the exact nature of which is difficult to anticipate (Anagnostopoulou-Politou & Al-Sayed, 2016). An experiment where one group of participants were driven on a tour of an unfamiliar area and another group were shown a video recording of the same route revealed that those who had viewed the filmed tour acquired a higher degree of landmark and survey knowledge but also displayed inferior procedural knowledge compared to the group who had undertaken the physical tour (Goldin & Thorndyke, 1982). While interesting, findings based on the non-interactive medium of film cannot be assumed to be true for gaming experiences. One study also revealed that spatial knowledge acquired through playing games is applicable to physical reality, suggesting that games or other non-ludic virtual experiences might serve as a form of training for wayfinding in the physical world (Spence & Feng, 2010).

### 2.2.2 Navigation

Wayfinding can be viewed as the cognitive part of navigation, the other being locomotion. According to Lidwell, Holden & Butler (2010), the act of navigation can be broken down into four stages:

- ***Orientation*** is the act of determining one's current location, this is done by attempting to locate nearby familiar landmarks.
- ***Route decision*** is the selection of a specific route, determined by one's desired destination and the routes available at a given location.
- ***Route monitoring.*** It is imperative to constantly check whether the desired route is being followed correctly. This is usually accomplished by examining the environment for expected landmarks, if a visible path is not available.

- ***Destination recognition.*** Concluding that a destination has been reached is again generally done by encountering an expected landmark associated with the destination.

The way people navigate spaces also differs greatly between individuals. Some carefully plan their entire route before departing, whereas others set off after only planning how to reach their first target landmark, creating new route plans as they progress. While appearing more flexible, this second approach has been shown to result in lower navigational success (Spiers & Maguire, 2008).

### 2.2.3 Designing for wayfinding in games

The craft of designing game worlds is known as level design. However, as navigation in games with large open worlds tends to rely on user interface elements rather than observing and interacting with the environment, handbooks on level design researched during the course of this project tended to not discuss wayfinding and thus proved to be of little relevance. While there has been conducted a fair amount of academic research on wayfinding in games, this knowledge does not appear to have transferred to the profession of game design in a noticeable way. A few game designers, such as Chung (2015) and Anderson & Rodkin (2015), do however discuss wayfinding design but largely without using the established vocabulary of the field.

Lynch (1960) proposes that environments can be broken down into a set of key categories of wayfinding objects. These form the foundational components of wayfinding design:

- **Paths** are the channels that afford movement within an environment. Examples of paths are streets and transit lines.
- **Edges** are boundaries that define the scope of possible movement, for example shorelines and walls.
- **Districts** are large areas that are defined by having one or several distinguishing characteristics that are not present in adjacent areas, such as a unique architectural style or a specific type of activity that occurs in the area.
- **Nodes** or **Connectors** are locations that connect many different paths and thus afford a wide range of movement options, for example transit hubs and crossroads.
- **Landmarks** are as established by Sorrows & Hirtle (1999) the foundational reference points upon which the cognitive process of acquiring route and survey knowledge are based, they are therefore also a key design element when designing wayfinding solutions. Landmarks are usually static objects such as buildings or mountains. Dynamic landmarks are however possible provided that they follow

predictable and learnable patterns, e.g. determining one's direction by observing the position of the sun.

Arthur & Passini (1992) emphasize the importance of employing these objects consistently and according to some overarching principle, for example the grid system found in many North American cities. This once again underlines the value of coherence and predictability for successful wayfinding. For wayfinding design for virtual spaces Darken & Sibert (1996) agree with this and add that such an organizational principle should be hierarchical, which is to say designing the space with cognitive mapping in mind.

One study compared the efficacy of wayfinding using paths versus landmarks in games. This study revealed that wayfinding using only landmarks was highly reliable, players would move towards the nearest and most prominent object visible. Path-based wayfinding was however discovered to be less reliable; players would frequently not discover or accidentally leave the path unless its visibility was bolstered by adjacent landmarks. This underscores the foundational nature of landmarks in wayfinding design (Moura & Bertram, 2014).

# 3 Existing work

The overwhelming majority of games that afford the player navigational agency in large open worlds use conventional user-interface based navigation solutions, such as detailed maps that at all times display both the player's location and the location of nearby objects of interest. While it is fully possible that such games can create a sense of presence, they cannot be said to require the player to engage in wayfinding in any meaningful way as both designers and players become dependent on the user interface and cease to think of the game world as a source of navigational data (Chung, 2015). While rare, games that contain presence-creating wayfinding do exist and the following section unpacks two prominent examples.

## 3.1 Firewatch

Firewatch (Campo Santo, 2016) is a narrative exploration game that takes place in a large forest environment. The narrative is progressed by visiting specific locations in the game world, which in turn prompts the player to navigate to new locations. While the narrative of the game is linear, its

progress is completely dependent on the player successfully and independently navigating the game world while receiving limited guidance.

At the start of the game, the player is provided with a map of the game world and a compass (Figure 2). This encourages the player to navigate in much the same way as a real-life hiker would when traversing the wilderness. In order to ascertain the correct route towards a given destination, the player must first identify their target location on the map, then locate themselves on the map by identifying visible landmarks and finally combine knowledge provided by the map with their previous experience of the terrain to plot a route towards the target. The map provides a topographical view of the game world and names several prominent locations, but it omits many key landmarks and is frequently unreliable. Routes that appear viable based on the map will sometimes turn out to be impassable, and other passable routes do not appear on the map and must be discovered in person by the player. This kind of intentionally unreliable map arguably promotes presence, as highly accurate maps have been shown to drive players to ignore the game world and focus solely on the map (Vembar, et al., 2004). In time, the player's survey knowledge of the game world becomes more detailed and accurate than that provided by the map. The map is never rendered completely irrelevant, but it does become relegated to a role where it is mainly consulted for purposes of establishing where a new and not previously visited destination is located in relation to familiar locations instead of being repeatedly consulted during route traversal. This clearly illustrates how cognitive maps gradually but unavoidably surpass and supersede printed maps, as described by Thorndyke & Hayes-Roth (1980). Firewatch is thus a game heavily dependent on wayfinding, cognitive mapping and executing route plans are arguably the main activities of the game apart from engaging with the narrative. The game was designed with wayfinding and presence in mind, the designers intended for the player to build a deep relationship with the game world by requiring them to constantly observe and interact with it (Anderson & Rodkin, 2015).

In terms of the designing the game world to facilitate wayfinding, Firewatch makes extensive use of paths, edges, nodes and landmarks. The game world consists of a set of nodes in the form of medium-sized open areas, these are usually connected to multiple paths and frequently highlighted by prominent landmarks such as distinct rock formations. These paths are generally quite narrow and sectioned off by edges in the form of cliff faces or dense underbrush. Thus, the world of Firewatch can be likened to a set of rooms connected by corridors. Such an approach to game world design might at first glance appear antithetical to creating the feeling of being in a vast open forest, thus potentially inhibiting a sense of presence. As established by Wirth et al. (2007), presence-creating game worlds must be coherent and believable.

However, this issue is largely circumvented by the fact that the constrained nature of the navigational possibility space is cleverly disguised by the esthetics of the game world. This demonstrates that it is possible to use wayfinding objects that would usually not be present in the type of environment that a game takes place in without compromising presence, provided that they remain coherent with respect to the rest of the game world.

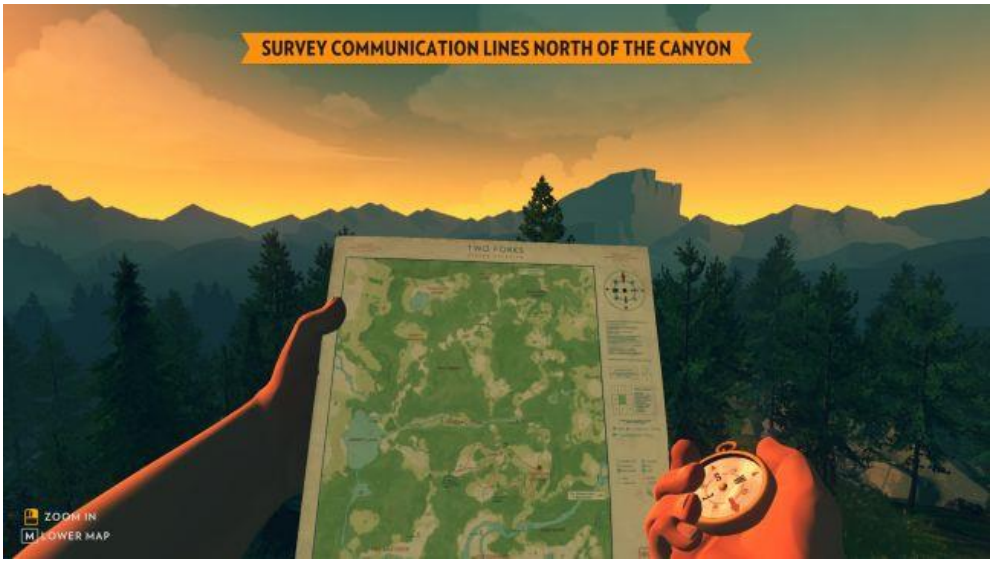


*Figure 2. Map, compass, and game world in Firewatch (Campo Santo, 2016).*

## 3.2 Eidolon

In Eidolon (Ice Water Games, 2014) the player is tasked with navigating a vast wilderness in a fantastical far future setting, following a vague and mysterious narrative. Much like Firewatch, Eidolon contains a linear narrative that is progressed through freeform exploration. Whereas Firewatch attempts to simulate the real-world experience of navigating the wilderness using a map and compass, Eidolon contains no map or other real-world wayfinding tools and instead affords the player a unique wayfinding object in the form of a bird of prey (Figure 3). This bird will intermittently attract the player's attention by emitting a loud screech and then proceeds to fly in the general direction of next location that the player is intended to navigate to. The player is never explicitly informed that this is the main navigational device of the game, discovering this key fact instead becomes the first and arguably most important challenge of the game. While such an outlandish wayfinding object without analog in the physical world might be perceived as highly incoherent, it is not in the context of Eidolon's narrative and setting.

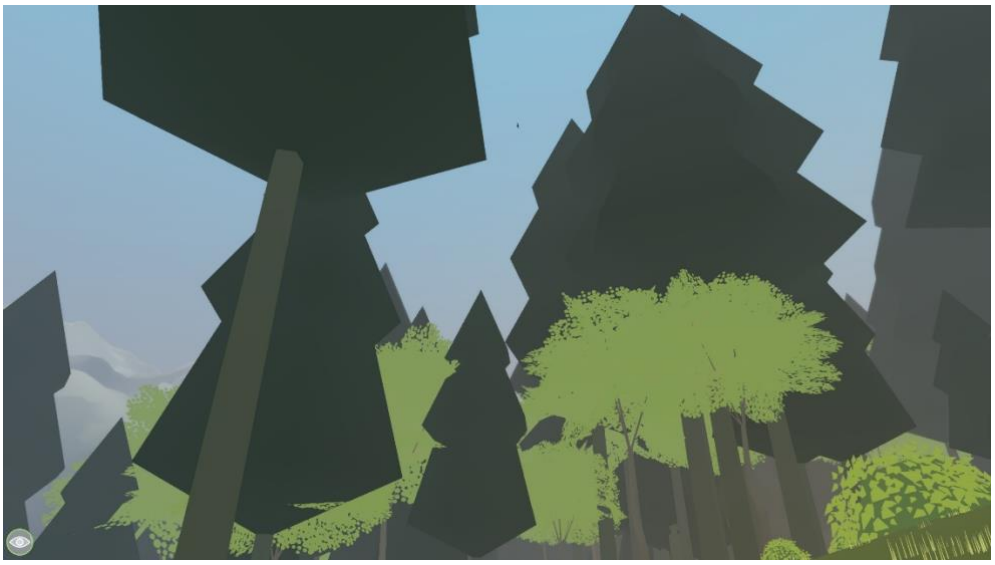

*Figure 3. Barely visible wayfinding bird in Eidolon (Ice Water Games, 2014).*

The bird is often so distant from the player that it appears as merely a small black dot in the sky. It is furthermore frequently obscured by trees, fog, or other natural obstacles. Thus, even after its wayfinding function has been deduced, merely locating and keeping track of the bird remains a constant challenge. A further level of challenge is added by the fact that the bird can fly and the player cannot, it is thus still left up to the player to successfully plan and execute routes across the wilderness in the direction indicated. This frequently results in the player being forced to take long detours to get around cliffs, lakes, and other obstacles, often losing track of the bird for long periods of time. This type of wayfinding aid is also highly ambiguous. Not only must the player first discover its function, but even after that revelation the player is still only made aware of the general direction of the object or event that will progress the narrative. What might await the player at the destination, how far away it is, and how to successfully traverse the game world to reach it remains unclear and is left up to the player to discover. This demonstrates how it is possible for a designer to guide the player towards a specific destination while simultaneously still requiring that they engage in wayfinding.

The world of Eidolon is, unlike that of Firewatch, just as open as it appears to be. While the game world does contain many obstacles, it is consistent with the level of openness one would expect from a forest. Where Firewatch employs paths, nodes and edges to constrain and guide the player, Eidolon instead contains many districts with distinct visual identities that allow the player to successfully locate themselves in the world despite its openness.

# 4 Theorizing presence–creating wayfinding

The process through which players form a mental model of a game world in order to reach a state of presence (Wirth, et al., 2007; Wiebel & Wissmath, 2011) shares many features with the process of cognitive mapping, which is the foundation of successful wayfinding (Elvins, 1997). Both processes are based on the player forming and attempting to verify hypotheses about the world. For presence to be experienced, the game world must be consistent and coherent with respect to its fictional context. For wayfinding to be possible, objects in the environment must be coherent in the sense that their relationships to each other must be learnable and predictable. If the world is experienced as incoherent, the player risks simultaneously losing any sense of presence and losing their way in the game world. Therefore, presence and wayfinding share the same need for game worlds to be coherent. Furthermore, game worlds must be rich in sensory data for the player to experience a sense of presence. This requirement goes hand in hand with wayfinding objects' need to be visually distinct from their surroundings.

All game worlds are planned and designed spaces, pieces of virtual architecture disguised in different esthetic languages. The fact that a game might be set in a forest or desert does not mean that its creation followed the complex and semi-random natural processes that lead to the creation of such environments in the real world. A game designer might take inspiration from such real-world environments for reference purposes, but it is still an esthetic layer on top of a carefully crafted space designed for a specific purpose. Therefore, it is possible to treat all game worlds as belonging to the category of architectural spaces no matter what kind of environment they ostensibly take place in and thus apply the methods of wayfinding design to them. There is however a tension inherent to this fact in that designers of game worlds that are intended to create a sense of presence must be wary of applying wayfinding design in a way that is too obvious or heavy-handed. If a player feels that the space was designed specifically for them in order to guide them towards specific locations within it the game world will cease to be perceived as a viable alternate reality (Bidwell, Lemmon, Roturu, & Lueg, 2007).

Literature on the craft of designing for wayfinding in real-world environments tends to assume that a designer is working within the context of complex public spaces such as transit hubs and urban centers. For this reason it will often focus on signage, color coding, and other intentionally obvious wayfinding devices made to stand out in places rich in sensory data

and highlight paths, nodes and other key wayfinding objects (Gibson, 2009; Arthur & Passini, 1992). If a game happens to take place inside an airport and the designer wishes to guide the player towards a certain gate this might not present a problem and these design principles could be perfectly applicable as they are. However, many games take place in environments where such obvious wayfinding objects would conflict with the setting and esthetic of the game, thus being incoherent and potentially reducing presence. This does not necessarily mean that well-established best practices from designing wayfinding solutions for real-world environments are completely inapplicable to the design of game worlds, but rather that they must be made to be coherent within the context of the game world (Bidwell, Lemmon, Roturu, & Lueg, 2007). This need for coherence must furthermore be balanced against the need for wayfinding objects to be visually distinct from their surroundings (Elvins, 1997), necessitating a careful balancing act between coherence and distinctiveness.

The map in Firewatch and the bird in Eidolon can best be classified as interactive wayfinding tools. While the map in is a familiar real-world object and the bird has no direct analog in wayfinding design for physical spaces, they are both coherent within their respective contexts. These tools are furthermore diegetic, which has been shown to enhance presence. A key characteristic of these tools is that while they direct the player towards a specific destination, they do not present a ready-made route and leave it up to the player to successfully navigate to the destination. Interactive wayfinding tools thus present a solution to the problem of how to guide the players towards specific locations in game worlds without inhibiting presence.

In conclusion, I hypothesize that wayfinding objects in game worlds should designed according the following principles in order to facilitate both presence and wayfinding:

- **Wayfinding objects must be coherent.** Landmarks, paths, and other elements of the game world that are intended to function as wayfinding objects must appear as esthetically, narratively and systemically coherent within the context of the game to not risk inhibiting and instead creating presence. Coherence is as established furthermore key for successful wayfinding; one cannot build a cognitive map of and successfully navigate an environment where the relationships between objects cannot be anticipated.
- **Wayfinding objects should be rich in sensory data.** Sensory richness is as previously mentioned important for creating and maintaining a sense of presence, and wayfinding objects need to stand

out from their surroundings in order to be registered as such by the player.

- **Interactive wayfinding tools should be diegetic and require the player to engage with the world.** Maps and other interactive wayfinding tools that indicate a specific destination are not necessarily detrimental to presence, given that they both fulfill the above-mentioned requirement of coherence and are made intentionally vague. For the purposes of presence-creating wayfinding, these types of tools should strive to indicate a destination while simultaneously not providing such a high degree of navigational data that observing and interacting with the game world becomes unnecessary for successfully reaching a destination. They should furthermore be diegetic. As discussed, diegesis has been shown to not be the presence-creating panacea that some believe, but a non-diegetic approach is nonetheless more likely to inhibit presence and is thus generally inadvisable.

# 5 Methods

## 5.1 Prototyping

Validating the design principles outlined in part 4 necessitated that they be applied in practice and put to test, thus requiring the project to enter the prototyping phase. As all literature on wayfinding in games assumes a three-dimensional game world of reasonably high fidelity and a rich sensory experience is required for presence to be achieved, the prototype was required to fulfill these criteria.

Generally, a game design process begins by creating paper prototypes. These can be rapidly created and disposed of and allow designers to iterate on gameplay design without being slowed down by the arduous process of creating playable digital prototypes (Fullerton, 2014). However, given the deeply spatial and sensory nature of this project, paper prototypes were deemed to not be able to approximate the intended final experience in any meaningful way. This necessitated proceeding directly to digital prototyping.

I elected to create the prototype in the Unreal game engine. This tool was primarily chosen because I have a significant degree of familiarity with it, allowing for rapid iteration and reducing the risk of the prototyping process being hindered by technical issues and having to learn new skills. Unreal furthermore offers a high degree of visual fidelity and many built in-features

that greatly aid in prototyping. Using a game engine for prototyping is however not without downsides, the most significant being distribution in a remote testing situation. Whereas a web-based prototype is easily accessible via hyperlink, a prototype built in a game engine must be downloaded and installed on the participant's computer, creating additional work for the participant and possibly leading to various technical issues that are beyond the capabilities of the designer to effectively address. However, based on the needs of the prototype and my skillset I judged that it was the best choice.

## 5.2 Playtesting

Due to the Covid-19 pandemic of 2020 and the resultant social distancing requirements, all user testing methods that necessitate designer and player to be present in the same physical space were deemed not feasible during this project. Observational studies, which is to say when a designer carries out user testing by directly observing a play session, is one of the most effective and widely used tools for user testing in game development. This method allows the designer to observe not just the game as it is played in real-time, but also the mood and reactions of the participant (Mirza-Babaei, Mosajee, & Drenikow, 2016). This key method not being available during this project was a significant complicating factor that I was forced to work around to the extent possible.

Due to these extraordinary circumstances I concluded that the most feasible means of conducting playtesting was to distribute the prototype over the internet and afterwards request that participants fill out an online survey detailing their experience. While this approach allows for rapid distribution to a large number of participants, it also presents potential issues compared to in-person observational studies, beyond the impossibility of observing play sessions in real time. In a remote playtesting situation, it is not possible for the designer to guarantee a consistent experience for participants as they play on different computers in different environments that may contain various distracting elements. When evaluating presence in an audiovisual experience, this might raise questions regarding the validity of testing results (Steed, et al., 2020). It also not possible to verify that participants actually played the game in the way they describe, or if they for example repeated the experience multiple times or played with the assistance of a second person.

### 5.2.1 Participant selection

One significant complicating factor of remote playtesting of a 3D game of moderately high visual fidelity is that participants must have access to reasonably powerful computers. Writing on the subject of testing virtual reality experiences during Covid-19, Steed et al. (2020) propose that designers should seek to recruit participants who have the necessary

equipment at home. Combined with the requirement for participants to be genuinely interested in playing the game and being comfortable with the physical controls for presence to be achievable (Brown & Cairns, 2004), this resulted in a fairly small pool of potential participants. Also, participants for the testing of the final prototype should furthermore ideally not be personally acquainted with the designer in order to generate honest results (Fullerton, 2014).

To reach participants fitting this profile, I reached out in public spaces on social media and contacted suitable participants privately. While this unfortunately meant that I was likely to be acquainted with at least some of the participants, the completely anonymous nature of the survey made it impossible to link a specific participant to a specific answer.

## Privacy, ethics and consent

The prototype itself is not connected to the internet, does not contain any analytical tools, and gathers no personal or gameplay data whatsoever during play. While such automated data-gathering methods might be contemplated as a substitute for in-person observation of play sessions, they also pose numerous ethical challenges. The great advantage of an approach that is completely reliant on a post-session survey and devoid of analytics tools is that participants are technically not participating in the study until they fill out the survey. If they merely download and play the prototype, they are only doing just that. The survey furthermore never asks testers to share their names, e-mail addresses or any other type of personal data that might be used to identify them. As the survey is anonymous and the prototype is distributed as a publicly available download it was not possible for me to identify participants. In order to be in compliance with the European Union's General Data Protection Regulation (GDPR), it is best practice to only gather data that can be used to identify a participant if absolutely essential and only ask questions that are key for the subject of one's study. While GDPR does not require explicit consent when gathering anonymous data, I nonetheless opted to begin the survey by asking participants to consent to participating in an academic study to eliminate any possible confusion as to the purpose of the survey (Troeth & Kucharczyk, 2018).

A user testing method that initially appeared promising for circumventing the impossibility of conducting observational studies during the Covid-19 outbreak was remote screen sharing using video conferencing software, as it would have allowed me to simultaneously observe the participant and their play session in real time. This method unfortunately posed several significant ethical issues that prevented its use: I might accidentally be exposed to highly personal data such as e-mail or chat notifications during the testing session,

and I would also be offered a view into the participant's home where I might view or overhear sensitive personal information. This would be especially problematic if sessions were to be recorded for future reference. Furthermore, there would be no way for me to guarantee the security, privacy and GDPR compliance of third-party video conferencing software (Steed, et al., 2020).

### 5.2.2 Survey

The anonymous online survey contains a mix of yes/no, scored and free text questions, concerning both wayfinding and presence.

Whereas determining how and whether a player reached their target destination is a relatively straightforward matter of asking participants to describe their routes, why they chose them and what the outcome was (Bidwell, Lemmon, Roturu, & Lueg, 2007; Moura & Bertram, 2014), determining the degree to which they felt present in the game world is more complex due to the subjective nature of such experiences. As measuring presence objectively is not possible one is forced to rely on interpreting the subjective reports of participants. While there exists a great deal of literature on presence in games, there has been much less written on how to accurately measure it. However, Witmer & Singer (1998) have developed a detailed questionnaire for measuring presence in virtual experiences from which I selected a set of key questions based on their relevance given the added context of wayfinding.

In a remote testing situation, it is beyond the power of a designer to ensure that no external stimuli interfere with the play session. For this reason, I chose to begin the questionnaire by asking the participant if something interrupted their play session, allowing me to take this into account when analyzing their responses. To take issues regarding the physical controls as a source of reduced presence into account, participants were also asked how difficult they found the game to control.

# 6 Prototyping

## 6.1 Lighthouse

### 6.1.1 Narrative and gameplay

The player takes on the role of a newly arrived lighthouse keeper on a small island and is tasked with finding and activating a lighthouse before nightfall.

This fictional context was chosen in order to fulfill the requirement of narrative richness for creating presence, as outlined by Wirth et. al. (2007), but also to give participants a clear goal that can be achieved or not achieved. When wayfinding in the real world, we generally approach environments having already established a goal for ourselves. In a game world, the goal must however instead be explicitly presented to the player as they take on the needs and motivations of a fictional character unfamiliar to the player. There are furthermore vague indications that something mysterious and sinister is taking place on the island. With limited time and resources, I resorted to hinting towards a narrative in the hope of intriguing the player, attempting to create the greatest possible narrative richness with the least amount of effort. As demonstrated by Eidolon (Ice Water Games, 2014), an intentionally vague narrative also serves to widen the scope of what players will accept as coherent, allowing

The player's main method of engaging with the game world is by moving and looking. There is furthermore one interactive object that the player can pick up and equip.

The prototype is time limited. A perfectly planned and executed route from start to finish, along the shortest route possible, takes approximately three minutes to traverse. Based on this I opted to limit the experience to fifteen minutes. This gives the player sufficient time to explore and engage in cognitive mapping while simultaneously not giving them so much time that they would become bored or frustrated and quit the experience, which might impact their survey responses. Because the experience is time limited, it also became necessary to mark the passage of time. The earliest timed version of the prototype did not indicate the time remaining in any way, resulting in play sessions that ended abruptly and without any warning. Instead of a visible on-screen timer, which would risk constantly reminding the participant that they are playing a game and thus inhibiting presence, the passage of time is indicated by the color of the ambient light shifting from daylight towards sunset and finally night.

### 6.1.2 The player perspective

The player experiences the game world from a first-person perspective, meaning that the virtual camera view is rendered from the viewpoint of the player character, generally assumed to be an adult human, as opposed to a third-person perspective where the virtual camera is pointed at the player character. This particular perspective was chosen for several reasons:

- It approximates the perspective of a real-world human which is also the assumed perspective of all literature on real-world wayfinding and most literature on wayfinding in games. Furthermore, players feel a

greater sense of presence in the game world while playing from this perspective (Denisova & Cairns, 2015), hopefully reducing the risk of the nature of the player character affecting testing results relating to presence. There is however obviously still a not insignificant difference in experience between being physically present in a real space and viewing a virtual space through the eyes of a player character, but the first-person perspective comes closest to bridging that gap. the issue of how applicable that literature might be on wayfinding in game worlds. Testing the same wayfinding mechanisms from multiple common game perspectives and examining the validity of existing knowledge on wayfinding in games on these shifting perspectives would doubtlessly be valuable and interesting, but such a project would be a thesis-sized undertaking by itself and thus unfortunately falls outside the scope of this project.

- It is a very common type of player perspective with well-established conventions for how it is physically controlled using a gamepad or mouse and keyboard, hopefully minimizing the potential for the controls to inhibit presence.
- As the prototype is viewed from the perspective of the player character there was no need to create, program and animate a visible player character. Throughout the project I strove to minimize the amount of time and effort I had to invest towards designing and creating aspects of the prototype that were not directly related to exploring the subject of this thesis.

### 6.1.3 The game world

The game world consists of a small island, containing several wayfinding objects, surrounded by ocean. In order for the efficiency and reliability of the wayfinding objects to be falsifiable, it had to be possible for the player to get lost. Therefore, the game world could not be too small. Weighing this requirement against the need for a world small enough that I could design and build it rapidly, an island seemed the obvious choice. I also reasoned that an island would be more conducive to presence than many other possible settings. All game worlds have fixed bounds beyond which the player cannot move, these might be perceived as highly incoherent if encountered. An island is however defined by the very fact that it is a landmass with fixed bounds, thus circumventing this potential issue.

The player's view of the game world is to a significant degree obscured by a dense fog. This was partially an esthetic choice as fog is a useful tool for creating a rich ambiance (Perron, 2012) which in turn will hopefully promote presence, but also a practical one. As it is necessary for the player to be able to get lost while navigating the game world it would need to be reasonably large and complex, posing a significant challenge in terms of both the time

and effort required to build the game world and the time it would take participants to complete a play session. A long play time and generally slow pace might risk resulting in a higher number of participants aborting their sessions out of frustration, boredom or external time constraints. However, employing a dense fog allowed me to greatly reduce the scale of the game world while still keeping most of it obscured from the player at any given time. Reducing both the size of the world and the player's visibility of it thus enabled me to compress the entire experience, allowing for a smaller environment with shorter routes and a resultant reduced playtime without compromising the design goals of the prototype.

Features of the game world intended to create a rich sensory experience include dense vegetation that moves in the wind and an array of looping ambient sounds.

### 6.1.4 Wayfinding objects

The game world contains wayfinding objects of the following types: paths, edges, landmarks and one interactive tool. As districts would have required a large world containing multiple areas with unique visual identities, they unfortunately fell outside the scope of what was possible to prototype given the limited time and resources available. Likewise, including nodes would have demanded a complex environment with numerous intersecting paths. All of these objects were designed according to the principles outlined in part 4, with additional guidance from the general knowledge on wayfinding design for games outlined in part 2.2.3.


*Figure 4. Top-down view of the world of Lighthouse, with landmarks annotated for clarity.*

The player begins the experience at a landmark in the form of a boat dock, where they are also presented with the fictional context of the game by a text prompt.

The most prominent single wayfinding object in the environment is the edge in the form of a shoreline (Figure 5). This is also the easiest means of successfully completing the game, as it merely requires the player to follow the shoreline in either direction until they reach the lighthouse. While at first glance easily fulfilling the requirements for coherence, this object in fact runs a significant risk of presenting as highly incoherent. This is due to the fact that the player cannot swim in or even enter the water, as the entire shoreline is surrounded by a network of invisible walls that prevent the player from straying outside the bounds of the game world. Presence-creating wayfinding using this object is thus completely dependent on the player not attempting to enter the water. I strove to discourage such behaviour by giving the water a hostile and foreboding appearance. This object is furthermore rich in

sensory data and is clearly distinct from the rest of the environment, as it is both animated and emits a loud noise. As the shoreline is quite uniform in appearance and it is important for players to be able to monitor their progress along a route (Lidwell, Holden, & Butler, 2010), several distinct rock formations were placed along the shoreline to act as route monitoring landmarks.

*Figure 5. Docks, ocean and shoreline in Lighthouse.*

As the player leaves the dock a radio tower becomes visible in the distance. This radio tower (Figure 6) is in turn connected to a path in the form of power lines, following these will eventually lead to another landmark in the form of a house. Entering this house allows the player to pick up and equip a portable radio direction finder that allows them to pinpoint the direction of radio signals emitted by the towers. The radio direction finder thus acts as a kind of auditory multipolar compass. It is furthermore diegetic, as it exists as an object within the game world. Much like the bird in Eidolon (Ice Water Games, 2014), the radio direction finder indicates a direction to move towards without informing the player of the specific route required, thus requiring continuing engagement with the game world.

*Figure 6. Radio tower, power lines, and radio direction finder in Lighthouse.*

There are two radio towers on the island, and they are both connected to different power lines that lead to buildings, one being the aforementioned house and the other being the lighthouse itself. This design had several purposes. Firstly, it was to discover whether participants would, after picking up the radio direction finder, immediately grasp that one signal emitted from the tower they had just passed and proceed directly in the direction of the other signal. In order for survey responses to reflect this result, a shortcut to the second tower, in the form of a bridge placed so that it was unlikely to be discovered by other means, was added to the game world. Secondly, I wanted to discover if they would cognitively map this relatively complex relationship between four different wayfinding objects and conclude that the second radio signal might to lead them to another building, possibly being the lighthouse. By virtue of their height and distinctive shapes, all of these objects stand out clearly in the environment. The power lines form a continuous path and are individually randomized in size and rotation, making them somewhat distinct from each other and allowing for effective route monitoring. The fact that they both start at radio towers and end at buildings furthermore facilitates destination recognition.

Whereas power lines and buildings should not risk appearing as incoherent on an island, the two radio towers and the radio direction finder stretch at the limits of believability when compared to real-world expectations of such a space. However, taking inspiration from Eidolon (Ice Water Games, 2014), I believed that the intentionally ambiguous narrative would expand the

player's sense of what might be experienced as coherent to also include these objects.

### 6.1.5 Playtesting results

Before describing the playtesting results, I must address the fact that the final group of participants did not reach the size that I would have preferred. Despite multiple recruitment efforts, both by contacting suitable participants privately and by reaching out to a wider group, only five people completed the survey. Comparing this number to the fact that the prototype was downloaded and presumably played a total of 41 times speaks to the challenging nature of participant recruitment for remote playtesting. However, given that literature on playtesting tends to assume an in-person situation and thus provides very little guidance for remote testing, forcing me to improvise to the best of my ability, I still consider this result acceptable.

Three out of five participants reached the lighthouse in time, and none aborted the experience before succeeding or failing.

Regarding the level of presence experienced, no one described the game as being difficult to control, ruling out control issues as a potential source of reduced presence. However, several participants reported being interrupted by external stimuli. Despite this, all participants reported moderate to high sensory engagement and being highly engaged by moving around in the game world. Asked to what extent they were aware of their physical surroundings while playing, responses were evenly distributed across almost the entire range of possible answers from completely unaware to moderately aware. There was however no discernable correlation between the reported level of awareness of their surroundings and being interrupted by external stimuli. Furthermore, participants who reported a high level of awareness all gave answers indicating that they had otherwise experienced a high degree of presence. While all participants reported perceiving incoherent elements in the game world, several of these were due to technical issues and only one was directly related to wayfinding. This participant found it incoherent that the boat dock, which is to say the starting location of the game, was located far from the lighthouse with no direct visible path between them, reasoning that there should exist a path between the two most important locations on the island. No participants reported that they attempted to enter or swim in the ocean, and none mentioned the invisible walls surrounding the island.

Two participants initially ignored the first radio tower, despite its visual prominence at the starting location, and instead decided to follow the

shoreline around the island. They made this decision based on their existing wayfinding knowledge of the relationship between shorelines and lighthouses, correctly reasoning that lighthouses tend to be located along shorelines. As they also knew they were on an island, the shoreline thus being guaranteed to form a circular path, they further reasoned that they could simply move along the shore in either direction.

No participants indicated that they had, at least on a conscious level, fully mapped the relationship between radio towers, power lines and buildings and used this to immediately find the lighthouse. However, they all reported using the radio direction finder to locate the towers and the majority of those who reached the lighthouse did so by following the power lines. Also, no participants reported moving directly towards the second tower after locating the radio direction finder.

Multiple participants further described being confused by the radio towers and power lines, instead of correctly identifying them as different instances of the same types of objects they assumed that they had somehow doubled back and encountered the same landmarks twice.

Two participants described the game world as hostile and frightening, despite the absence of combat-oriented gameplay or any other kind of actual threat. They ascribed this to the dense fog, raging sea and generally bleak atmosphere.

# 7 Discussion

## 7.1 Reflection

Answers indicate that all participants experienced a moderate to high degree of presence. However, the fact that there was no discernable correlation between being interrupted by external stimuli and the depth of presence reported in other questions runs contrary to existing models for creating presence. Both Wirth et al. (2007) and Witmer & Singer (1998) argue that external stimuli is highly detrimental to creating presence. Rather than disproving established knowledge, it is fully possible that this unexpected result stemmed from the specific way the questions in the survey were expressed. It is also possible that participants experienced a generally high degree of presence except for the moments when they were interrupted, and that their answers are reflective of their total experiences.

The fact that all participants reported experiencing presence and only one described any wayfinding object as incoherent, or rather felt that another type of wayfinding object should have been present, strongly suggests that the design principles proposed in part 4 are viable as far as presence is concerned. Whether the wayfinding objects actively contributed to creating presence or merely did not detract from presence created by the surrounding environment and general audiovisual experience is however difficult to judge. However, as not inhibiting presence is for all intents and purposes the same as maintaining it the wayfinding objects can nonetheless be described as successful in this respect.

That no participants described the radio direction finder as incoherent and that they all grasped its purpose is also interesting, as it is arguably the strangest and least fictionally justified wayfinding object in the game. It is possible that the richness of the experience of detecting and navigating according to the radio signals led players to not question its presence in the world.

The fact that several participants walked along the shoreline for extended periods of time without attempting to enter the ocean or coming into contact with the inarguably incoherent invisible walls surrounding the island is highly illuminating, suggesting that my attempt to deter them from doing so by making the ocean appear as unappealing as possible was successful. As previously exemplified by the successfully disguised edges in Firewatch (Campo Santo, 2016), this indicates that the esthetic quality of sensory data can have a significant impact on player behaviour and thus navigation.

Whether a relatively low success rate should be viewed as an issue largely depends on the design goals of the individual game. In a game such as Lighthouse, wayfinding is the player's main activity and it can therefore be argued that navigation should reasonably challenging to make the experience richer and more engaging. However, in a game where the purpose of wayfinding is mainly to guide the player towards other types of ludic or narrative events intended as the core of the experience a low success rate might be seen as a problem that detracts from the design goals of the game. When a game world is designed for wayfinding, and the player is not afforded any other navigational assistance, wayfinding inevitable becomes a large part of the experience and is possibly detrimental to other elements of the game.

Based on analyzing the playtesting results, I conclude that all three design principles for presence-creating wayfinding have been shown to be effective,

with one significant exception. While all of the wayfinding objects in the prototype proved to be coherent for the purposes of creating presence, only the shoreline but not the elaborate radio-based system proved to be so for the purposes of wayfinding.

Whereas several participants successfully navigated the environment using the radio towers, power lines and buildings, no one clearly described grasping the recurring pattern between these objects. While not reported as incoherent, this experiment must be regarded as only partially successful. This result might suggest that such a complex pattern would require additional repetition before being successfully cognitively mapped. Another possible contributing factor might have been that instances of these objects do not vary in their appearance, in fact being perceived as the same object by several participants. The fact that several participants initially ignored these objects in favor of simply following the shoreline also indicates that players will favor preexisting cognitive maps over having to establish new ones. Whether players will already possess wayfinding knowledge about a specific type of object is however very difficult to predict, as that depends to a great extent on their individual life experiences (Bond, 2020).

## 7.2 Future work

In a situation such as a thesis project or when creating a small independent game, one is designing and building a game world with very limited time and resources. The pursuit of coherence and sensory richness proved to make the prototyping process slow and arduous. It would therefore be of great value to uncover exactly which types and qualities of sensory data are key for creating presence and giving the game world an impression of coherence. As exemplified by Firewatch (Campo Santo, 2016) and the fact that I succeeded in preventing participants from experiencing the incoherence of the invisible walls surrounding the island, the right type of sensory data can disguise deeply incoherent design compromises in the game world. Had I possessed this type of knowledge, I might have been able to design a generally lower-fidelity prototype that remained coherent and thus capable of creating presence.

As experimenting with districts and nodes fell outside the scope of what was possible to prototype during this project due to the workload reasons outlined above, any continuation of the line of inquiry establish in this thesis should also include these key wayfinding objects.

# 8 Conclusion

This thesis project adds knowledge to the field of user experience design in games by combining the two hitherto separate fields of wayfinding and presence, uncovering connections between them and using that knowledge to formulate a set of design principles for presence-creating wayfinding. Designing, prototyping and playtesting a game containing wayfinding objects based on these design principles revealed them to be largely viable in practice. The outcome of this project furthermore reveals how attributes of game worlds, in this case coherence and sensory richness, can contribute to multiple desired player experiences simultaneously.

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# Appendices

## 1. Lighthouse prototype executable

The Lighthouse prototype is available as a downloadable executable for Windows and Mac OS at https://bakelite.itch.io/lighthouse.

## 2. Lighthouse prototype source code

The source code for the prototype is available at https://bitbucket.org/johan_hellgren/lighthouse/src/master/. It has been stripped of most audio and art assets to reduce the file size of the project. As the prototype was created in the Unreal game engine the project can only be opened in the Unreal Editor, which is available as a free download at https://www.unrealengine.com/.