Guiding with Empty Spaces:
How Subtle Changes in Space Affect Player Wayfinding

Thesis Presented
by
Josiah Lou Veloso
to
The Department of Art and Design

In Partial Fulfillment of the Requirements for the Degree of Master of Science in Game Science and Design

Northeastern University
Boston, Massachusetts
December, 2019

Advisor: Celia Pearce
# Table of Contents

ACKNOWLEDGEMENTS .................................................................................................................. 4
ABSTRACT ......................................................................................................................................... 5
INTRODUCTION ................................................................................................................................. 6
ARCHITECTURE ............................................................................................................................... 9
   Ma – a Non-Western Concept to Architecture .............................................................................. 9
   Preventing Unfriendly Spaces ....................................................................................................... 11
   Navigating with Landmarks ........................................................................................................... 14
   Architectural Properties summarized ........................................................................................... 17
   Functional Aesthetics Designed for Tendencies ............................................................................ 19
   Linking Currently Existing Game Spaces ....................................................................................... 20
   Movement ....................................................................................................................................... 22
VIRTUAL ENVIRONMENTS ............................................................................................................. 23
USER INTERFACE ............................................................................................................................ 26
METHODOLOGY ............................................................................................................................... 27
   Tools/assets and methodology ....................................................................................................... 28
   Attractors/The 15 Fundamental Properties .................................................................................... 29
DESIGN ITERATIONS ....................................................................................................................... 38
   Iteration 1 ....................................................................................................................................... 38
   Iteration 2 ....................................................................................................................................... 39
   Iteration 3 ....................................................................................................................................... 42
   Iteration 4 ....................................................................................................................................... 44
   Iteration 5 (Final Iteration) ............................................................................................................ 47
      Variant A .................................................................................................................................... 47
      User Data (Variant A) ................................................................................................................... 50
      Common Areas of Interest (Based off figure 31) ....................................................................... 53
         A. The Long Road ...................................................................................................................... 53
         B. The Farm ............................................................................................................................... 53
         C. Noticing the valley near the southwest fence at town (landmark within periphery) ........... 54
         D. Noticing the Tower 1 Landmark upon approaching the valley ........................................ 54
         E. Noticing the Observatory Landmark .................................................................................... 55
         F. Noticing a checkpoint of the observatory town from the lone light at the west ............... 55
G. Wayfinding at low visibility using Large dead trees – then spotting the third landmark ... 56

An observation from an incomplete playtest ................................................................. 56

Variant B ...................................................................................................................... 57

User Data (Variant B) .................................................................................................. 58

CONCLUSIONS AND REFLECTIONS ........................................................................ 60

BIBLIOGRAPHY .......................................................................................................... 64

Primary Sources .......................................................................................................... 64

Secondary Sources ...................................................................................................... 66

External Picture Sources .............................................................................................. 67

Data Collection + Game Builds .................................................................................. 68

APPENDIX .................................................................................................................. 69
ACKNOWLEDGEMENTS

First, I must thank all the professionals of Fiverr and the users in Unreal that allowed me to use their assets and blueprints for my project, my project literally would not exist as a playable and testable state without their help:

Within Fiverr.com I thank J. Fink “Filmfinken” for initial rendering and landscape generation, Manny Lopez “mannyzie” for most of the custom buildings and low poly assets AND some map planning, Nizar Ilman “nizar86” for the lovely comics illustrations, and “Vintriano” for rigging my vehicle for actual movement! As for blueprint use, I thank Jorge M. of “Coqui Games” for modular roads, Lukas Orihel for modular fences and walls, and Marc Fabricius for the free blueprint “EarthTimeOfDay_BP” for very easy adjustment of the background atmosphere, humidity and day cycle! As much as my messages were brief, your contributions were significant to my work and I am extremely thankful.

Of course, much excessive love to my mom (Cristina Veloso) and sister (Jonina Veloso) for simply being there when I called and messaged at strange hours. I would call more if the UAE did not ban free online video calls for their own vague and nonspecific reasons. I am sorry Lolo that I did not graduate in time for you to see the US, my time with you was brief but you taught me the importance of ambition and opportunity. Without my family as support and inspiration I don’t know what kind of drive I would have.

Thank you, Clarence, for your nigh limitless positivity and being a great role model to constantly learning and evolving yourself. I thank you Aymen, for checking occasionally if I had a pulse related to me specifically drinking coffee or not drinking coffee. Jafer.

Thank you to my class cohort - helping me with testing things and giving me a good direction with suggestions from my initial proposal. Alex for giving me a direction to test my ideas. Alissa, furthering the unquestionable superiority of heatmaps. And Lynn for making good points about hints. Varun. I would list more of you but that would be weird and strangely specific, you know who you are. I admired that wave of energy in class and the wake it left to push me. Cheesy as it is, I need to mention that in my sandwich of acknowledgements.

Thank you, Professor Chris Barney not only for your help - but also sharing that story with player behavior and shiny things during your thesis. For better or worse this made me paranoid with how I placed my lighting and my many, many blocking barriers in my design.

The writing center for helping minimize my broken English I have been speaking with most of my life. The thorough editor and tutor Tim Charles for correcting my paper when I cannot go to the writing center.

I of course thank my advisors Prof. Celia Pierce and Prof. Harteveld for taking your time to quickly read through my admittedly large thesis several times within short notice and giving critical, needed advice.

I thank that strange DungeonWorld- group that happened around the summer, I really would have liked if we finished that campaign but that funnily enough actually gave me an idea of what to expect in player behavior in a seemingly controlled environment. A hilarious mess. But hey that’s the point.

The world is a large place, its experiences can be pleasing, sad, subtle or grand – most people would prefer to admit it is within their control. It’s random and it really isn’t. Strive to be an honest, positive person – love the small things, start with a small goal. It can change for the better, clear the mind, builds overtime and can eventually give consistency in this large seemingly random world. You’ll never know who you really inspire in turn.
ABSTRACT

How do you guide a player in an expansive space without complete reliance on a map? This question requires game designers to be meticulous in their expertise of the architecture of game design. But what kind of details are valid? To explore this question, I designed an open game level that incorporated elements and details based on the work of noted architectural scholars Christopher Alexander, Kevin Lynch and Jane Jacobs, as well as game scholars who have applied these principles to game design.

My focus was on the most noticeable element commonly associated with wayfinding, the Landmark – this will be applied to a digital game. To this end, I have recorded common areas of attention and time towards the actual goal in an open level; however, this open level will not have a readily perceivable endpoint. Considering this challenge to the users, I have used architectural principals and connected similar ideas from virtual environments and UI to facilitate and minimize stress while wayfinding and navigating through the environment. During the process of game design, I have looked at common guides from architecture and computer interactivity, in an effort to identify common traits to refine and gain better insight to level design practice. From this project, I hoped to prove that even subtle principles drawn from real-world architecture and other subjects can be broadly applied to the design of digital game spaces. My findings are currently inconclusive due to the low number of users tested. However, I believe I made a base for further testing.
INTRODUCTION

Effective game design takes inspiration from an amalgamation of other media; however, there are some practical subjects that are required to form the base of my intended design. I have focused on how an environment is designed and how players interact with it. In architecture – there are some common issues that are found and must be addressed when planning an area, such as how game users interact in their environment, as has been discussed in texts such as Video Game Spaces by Michael Nitsche (2008) and An Architectural Approach to level Design by Christopher Totten (2014). Both commonly follow the lines of real-world architecture and computer interaction concepts.

Making wayfinding effective in games involves answering questions about when and how it works, when a distance is too long, and how assets efficient support wayfinding. I ask these questions to investigate how subtle changes in physical level design would generally affect player behavior towards a goal, noting how sensitive new players navigate and react in an unfamiliar environment. I will be compiling aspects from various sources from design philosophies in architecture, interface design, and computer interaction that help in harmony with 3D virtual level design towards wayfinding. My research has been inspired by beginner player areas such as those designed in Guild Wars by ArenaNet that have large areas to navigate (shown in the screenshots below at Figure 1). Large areas that are beginner-friendly to navigate thanks to clear design choices. Based on the approaches in architecture, interface design and computer interaction, my actual design will mostly concentrate how I will form empty spaces (which I will attribute as negative spaces) and positive spaces (highly noticeable objects in the background in the form of landmarks). The design will look at how these spaces interact with each other and how subtle changes between them may affect player wayfinding towards an unseen goal.
Figure 1: (Bottom Image) **Nodes** (Kamadan and Sunspear Great Hall at the top right of the map of stars symbolizing towns/cities) which are the areas to navigate between and a **Joint** (The area between the nodes - The Plains of Jarin). These elements will be elaborated later.
(Cont’d) (Top image) Sunspear Great Hall is a node usually seen as a target destination – it’s presence **contrasts** with the environment and can be easily found at a distance. (Note if players have not visited the destination it would take a 3-5 minute run to get here) Images are from *Guild Wars 1* owned by ArenaNet (2006) taken from fan sites.

My eventual methodology will link if aspects of navigation and wayfinding, taken from the subjects of architecture, virtual environments and UI are going to support my hypothesis of whether simply adding landmarks will be effective to guide users. Designed levels will be in the form of two levels of specific variations. This will further be confirmed using statistical analyses comparing the presence of independent variables from the variations. Independent variables would be the presence of landmarks (variation A with landmarks, variation B without landmarks). Controlled variables would be supporting elements helping wayfinding not directly related to the independent variables. Dependent variables will be the comparing the complete times of individual observations with the complete time of the average of variation B.

I have compared and took note of overlying principles from studies in architecture, virtual environments and user interfaces of what would make a less stressful environment when wayfinding. Ultimately, the design will concentrate on the effectiveness of landmarks and navigation. However, there is other variables that could affect the user’s attention away or towards landmarks. I must to take them into account as well to shape my design to optimally make an effective analysis. Landmarks are not the only means to facilitate navigation however these elements must be considered in order to support landmarks in the final design.
ARCHITECTURE

Before there were computer generated worlds, there was traditional architecture. Christopher Alexander is one author who correlated user experience (the citizens living in designed architecture) through more intimate classifications. Game designers have drawn on Christopher Alexander’s categories and elements from architecture and found parallels in them in level design. Game designers such as Will Wright, creator of SimCity, noted in an interview (Iconeye 2008) and Jesse Schell, founder of Schell Games, both took inspiration from Alexander’s applications in architecture and urbanization and incorporated them to their respective games, Indeed, Schell applied it beyond physical spaces in level design and even narrative (Schell, 2018).

I was attracted by Alexander’s reference of Asian style architecture in the use of spaces which he calls a Zen view in A Pattern Language, as in using empty spaces to guide attention to interesting viewing angles (1977, p.642). His reference seemed to be part of the Asian architecture ideology of Ma, which is a way of harmonizing a balance of spaces and objects to make attention grabbing views. This is important because it shows how spaces are universally recognized. I will discuss Ma’s importance from its notably non-materialistic centered ideology and compare it to western architecture. In addition, I will link western and eastern influences and find common or notable ideas of how each perspective views wayfinding and spaces.

Ma – a Non-Western Concept to Architecture

For my experiment I will be investigating the potential use of Ma – the shaping of paths and spaces to bring attention to the object, in harmony with spaces and paths. Ma applies to multiple meanings from literal emptiness, pauses or even extending to the metaphorical gaps
(Fiadotau 2018, p.102-103). This can be applied to not only architecture but also in literature, drama, film, and even religion, helping to give meaning and emphasize context to the non-empty literal space and concepts (Nitschke, 2018; *my emphasis*). Ironically, despite being relatively present in Japanese games, not much westernized writing is associated with *Ma*, but it is fundamentally embedded in Japanese cultural and architectural philosophies. “It’s not how we think… in the western tradition, it’s not just the negative space help[ing] define the foreground rather it’s the negative space being in one continuous piece with the image itself” (ExtraCredits, 2018). ExtraCredits is a public Youtube channel dedicated to level design and cultural video essays, they have also noticed how *Ma* affected game design. Direct use of these techniques forms the 3D transitioning overworlds in the *Legend of Zelda* video game series. An example is the usage of colors and the surrounding forests of *Zelda: Breath of the Wild* emphasizes its several hubs and architecture. Director Satoru Tanizawa in an interview revealed that *Breath of the Wild’s* distances were based on aspects of Kyoto, a historically notable city, from one tourist attraction to another (Webster, 2017). In his research on religion and games *Methods For Studying Video Games And Religion*, Fiadotau notes of the obscurity of this design aspect to the West and briefly implies and compares its similarities to the Western concept of phenomenology in architecture (2017, p.102). I will not be going into detail with phenomenology in architecture, other than the fact it shares with *Ma* the psychological and symbolic aspects of subjective experiences in spaces (Wapner et al, 2000). *Ma* originated from the Shinto belief in Japan, and it has also been likened by the Chinese beliefs towards *Zen* or *mu* (Fiadotau, 2018, p.106-107).

Inspired by *Ma* - I have considered on my design how any empty space (the sky and ground) interacted with the populated environment guiding player attention. This applied to the various landmarks that have a strong skyline and the better lit roads that give guidance to players.
amidst dark morning’s surroundings (as shown in the pictures based on iteration 3). Negative space, from Christopher Alexander’s vocabulary is the language I used interchangeably to represent this idea – fitting similarly to *Ma*.

*Figure 2: Distant castles, structures and the mountain harmonizing with the surrounding vegetation and skyline in the distance. Giving attention to said locations. Ma is the vegetation (Cont’d) and the sky. Taken from a non-commercial use Zelda: Breath Of The Wild (Nintendo 2017) screenshot.*

**Preventing Unfriendly Spaces**

Architecture extending to entire town designs was at times flawed – mirroring the actual map design issues in games - an aesthetic was in hindsight limiting practicality. An example of this was provided Christopher Totten in *An Architectural Approach to Game Design*. He noted how renowned architect Le Corbusier tended to design his commissioned cities. “Like many of Le Corbusier’s theoretical plans, Chandigarh separated different functions into their own districts, with blocks for parkland, industrial areas and government facilities. Initially, the city was largely empty… Even recently, however visitors have commented that the city is sparsely populated with pedestrians” (Morshed, 2008 as noted by Totten). Neatly organized town plans were normal for modern architecture did not necessarily translate to a thriving populous city.
Eminent urban studies scholar Jane Jacobs — in opposition to the developing ideas of the planned communities idealized by “modern architecture” — realized its faults and came up with some rules to avoid its pitfalls. Based on her social science research on urban environments, she proposed four generators of density:

1. Multi Use districts that encourage constant use by people.
2. Short blocks to allow easy access to amenities and exploration.
3. Buildings of varying age so as to vary economic factors.

The purpose was to promote diversity and harmony with existing buildings and communities existing rather take inspiration from the designs of suggested by modern architecture. Incorporating these architectural ideas into game design, Christopher Totten translates these rules, gearing towards multiplayer games as:

1. Multiuse game spaces (social, fighting, shopping etc.).
2. Close functional places close to one another.
3. Spaces for different player types and factions.

Consideration of factors and lessons from architecture fosters a more dynamic environment for players. Not only does it give more to do within a convenient distance, but it allows players to meet others more often. This kind of planning prevents monotony and a stale experience which is a reaction against Le Corbusier’s tendency to over organize and over theorize planning areas (as noted by Morshed). This is still applicable to my design even as a
single player game, as not only do I translate these lessons as needing enough distance balancing for a vehicle game, but games should at least foster some stimulation and engagement (I am expecting one person to play the game quickly without feeling it is tedious). Lessons two and four would apply directly to distances to the objective, while lessons one and three can apply to unique interactions beyond the usual gameplay. One modern example is the use of “Lion’s Arch” (Figure 3) in the base game of Guild Wars 2, where holiday-specific events happen in the player dense city, usually near the city center - not only attracting players but also breaking the usual daily grind by providing unique stimulus. I would attempt to provide consistent stimulus by distancing my hints appropriately by providing specially designed comics which provide a break and an entertaining diversion from gameplay to veer players towards the goal.

Figure 3: The town of Lion’s Arch in Guild Wars 2 (ArenaNet, 2012) hosted holiday events within the already regularly bustling player hub. A clear use of multiuse game spaces by lessons from Jane Jacobs.
**Navigating with Landmarks**

Before Christopher Alexander, classifying elements of better designed architecture was the province of Kevin Lynch, who was one of the first architects to openly classify traits of a city to a simplified form in his book - *Image of the City* (1960). This is where the most central parts of my overall design begin. First are landmarks, notable points of interest which help guide navigation. As Lynch mentions, landmarks on their own (unless incredibly large or very singular in space) are weak and easy to miss unless actively searched for by a newcomer. However, sequential landmarks which appear in sight of each other tend to be much more effective because there are no wide spaces which are functionally and emotionally supportive towards navigation (Lynch 1990, p.83). Concerning differentiating landmarks Lynch quoted:

“A landmark is not necessarily a large object, it may be a doorknob as well as a dome. Its location is crucial: if large or tall, the spatial setting must allow it to be seen; if small, there are certain zones that receive more perceptual attention than others: floor surfaces, or nearby facades at, or slightly below, eye-level... A landmark is yet stronger if visible over an extended range of time or distance, more useful if the direction of view can be distinguished.” (1990, p.101).

Universally whether large or small – an effective landmark should remain distinguishable and noticeable no matter what time of day and at all distances. Lynch’s perception towards landmarks was also further supported by later works as mentioned by the journal *Human Wayfinding* at an excerpt written by Harvey Miller “At the urban scale, Evans et al. (1982) extended the research of Appleyard (1969) and argued that distinctive architectural elements at key points along routes in a city can aid in the legibility of that environment” (1992, p.141). It is like the quirkily named concept of the *architectural weenie* which I will discuss later. Another
aspect of my design is considering nodes which Lynch states are “conceptual anchor points” (1990, p.102). Lynch notes how nodes are recognized:

“The first prerequisite for such perceptual support is the achievement of identity by the singular and continuous quality of the walls, floor, detail, lighting, vegetation, topography, or skyline…The essence of this type of element is that it be a distinct, unforgettable place, not to be confused with any other…The node is more defined if it has a sharp, closed boundary, and does not trail off uncertainly (sic) on every side; more remarkable if, provided with one or two objects which are foci of attention…there are many techniques for the expression and definition of such a space: transparencies, overlappings, light modulation, perspective, surface gradients, closure, articulation, patterns of motion and sound” (1990, p.102).

A group of objects sharing many traits (ex. Buildings) or entities (ex. lights) that have a noticeable boundary are what makes a node, one example in a city would be recognizing what would make a single district recognizable. As an example, Beacon hill’s upper-class styled architecture grouped on a hill is a node (Lynch 1990, p.104). This was also introduced in the earlier pages of Lynch in *The Image of the City* (1990, p.50-55). In between nodes are “paths” – areas that connect each node. Before a path there has to be noticeable “joints” that transition between them “The joint between path and node must be visible and expressive, as it is in the case of intersecting…The traveler must see how he enters the node, where the break occurs, and how he goes outward.” (Lynch 1990, p.102).

Going back to the Beacon Hill example alluding to Lynch’s mention – *a joint* is where the upper-class style architecture and the hill ends, it is the street parallel to the park (the next *node*) and the hill – this is Beacon Street. The *nodes* are Beacon Hill and The Park. The *paths* are
the sidewalks and connecting streets that are being used to navigate Beacon Street as loosely illustrated below (figure 4).

(Cont’d) Figure 4: Edited from Google Maps (2019) Beacon Street acts as a JOINT that connects the NODES - The Park and Beacon Hill.

Lynch also notes how the landscape can attract attention just by the existence of being so unique to the surroundings “there are visual qualities in some landscape features which make them the inevitable subjects of attention, despite the selective power of the eye” (1990, p.134). Concluding “Therefore, while noting the flexibility of human perception, it must be added that outer physical shape has an equally important role. There are environments which invite or reject attention, which facilitate or resist organization or differentiation. This is analogous to the ease or difficulty with which the adaptable human brain can memorize associated or unassociated material.” (1990, p.136) – landscape at the periphery of visual attention are a factor when navigating. As noted in Toward a Ludic Architecture by Steffen Walz, Lynch’s specific overview of architectural elements discussed so far are supported in game design, (2010, p.214). These compiled observations will unconsciously be considered at varying degrees while navigating. The background landscape references Ma or negative space.
From these lessons, I would like to observe the effect that landmarks have on new players transitioning between nodes, while taking note of the attention to the background landscape (which I will refer to as negative space).

**Architectural Properties summarized**

Applying all the lessons on architecture so far common patterns come to place in the form of fundamental properties – as defined by Christopher Alexander in yet another one of his more well-known more relatively recent works. Beginning its formulation at Chapter 5 of *The Phenomenon of Life: Book 1* Christopher Alexander lists 15 properties of what makes recognizable, less stressful spaces which Nikos Salingaros summarizes in his book *Unified Architectural Theory* (2015):

1. **Levels of scale:** “Repeating components of the same size and similar shape define one scale. Levels of scale have to be spaced closely enough in size (magnification) for coherence, but not too close to blur the distinction between nearby scales.” – recognizable sizes of objects/areas within an overall space.

2. **Strong Centers:** “Strong centers are formed when a substantial region of space is tied together coherently. It is useful to distinguish two types of centers — “defined”, and “implied” — that overlap and interact. A “defined” center has something in the middle to focus attention. An “implied” center has a boundary that focuses attention on its empty interior.” - A notable property very relevant to my design as it will be used in conjunction with landmarks.

3. **Thick Boundaries:** “A thick boundary is an “implied” center. According to the scaling hierarchy, a thick boundary arises as the next scale smaller than what is being bound.” – these are essentially effectively recognizable joints as discussed earlier.
4. Alternating repetition: “… repetition, reinforces each component through alternation.” – repetition helps the mind process observations more easily; however it should not be used on its own.

5. Positive Space: “…Convexity plays a major role in defining an object or a space, whether this is an area or a volume… We strongly feel a threat from objects sticking out…” – objects that stick out of empty space, like landmarks.

6. Good Shape: “…when symmetries reduce the information overload… satisfying the brain’s innate need to compact information. Shapes that are not easily represented strain mental computation, hence they induce anxiety.” – recognizable shapes are easily memorable.

7. Local Symmetries: Symmetries that happen at every section no matter what level of scale within the design. More effective when designed as a hierarchy working with each other.

8. Deep interlock and ambiguity: visible transitions between recognizable spaces that are recognized as one whole. Essentially spaces that blend and group together within a node.

9. Contrast: Specifically sized spaces that give attention to oppositely sized smaller/compact or larger/open spaces around an area. This can even be applied to recognizing distinct diverging kinds of shapes and colors.

10. Gradients: noticeable transitions – it can even apply to colors to even material types.

11. Roughness: deliberate irregularity/non-symmetry to break away monotony.

12. Echoes: “There are two types of echoes in design. First, translational symmetry: similar forms found on the same scale but at a distance. Second, scaling symmetry: similar forms existing magnified at different scales.” – Sameness between spaces and/or objects.
13. The void/negative space: Literal open, empty space - likely the largest. Balances the more filled up spaces, this would help facilitate less “information overload” - could potentially get attention in areas of high detail. Note this is one property, which will interact and support positive space and strong centers is very relevant to my design as part to test intuitive wayfinding for navigation. This also potentially alludes to Ma. In which case would mutually give attention to the detailed objects next to them.

14. Simplicity and inner calm: A minimalist quality/space that exudes a sense of humbling calm because of its subtle simplicity compared to the potential surroundings. A small gazebo in a park.

15. Not-separateness: Doubling as also a goal of blending all properties at a macro level – you would likely say at its most effective when you would say one part of it – a space to even an individual material or object definitely belongs to the entirety of it all. I do not practice artistry so I could objectively tell this is likely going to be the most difficult with my effort alone.

    These properties are crucial to my design to recognize what elements would facilitate navigation. This will in turn likely make a distinct, less stressful space to a newcomer. Directly affecting wayfinding.

**Functional Aesthetics Designed for Tendencies**

    High places – one of the main architectural points of my thesis is of course part of Christopher Alexander’s guide *A Pattern Language* “The instinct to climb a high place… seems to be a fundamental human instinct… These high places have two separate and complementary functions. They give people a place to climb up to, from which they can look down upon their world. And they give people a place which they can see from far away and orient themselves toward, when they are on the ground.” (1977, p.315). Alexander suggests this property should be
built occasionally. It will be a major aspect of my design I will concentrate on. People interacting with paths and goals have some tendencies which I summarize from Christopher Alexander’s views (1977, p.586-587):

1. People tend to walk straight lines (efficiently) towards their goals.

2. The longer the path is – the more people tend to curve/deviate their path going towards the goal.

3. People realistically take intermediate paths between landmarks the longer the goal is but tend to not change the direction too extremely.

I highlight landmarks as that will essentially be what the intermediate desired “goals” of my designed architecture are. I can assume users will likely move erratically the larger the area is, possibly more if landmarks are not in sight. I will have applied all these similar attributes to my game not only for the sake of the design purpose but also for quality of life for the player so that they would likely not get too bogged down or lost, for a sizable level made for a vehicle. I will then test their effectiveness by removing them.

**Linking Currently Existing Game Spaces**

Noted in *Remediation on the High Seas: A Pirates of the Caribbean Odyssey*, “The Designers employed the technique called the ‘weenie’ a term invented by Walt Disney himself to indicate a visible landmark that draws visitors to a certain geographical area” (Schweizer & Pearce, 2006). This technique (the architectural weenie), will allude to my design as this I feel is the most western/recognizable concept contrasting *Ma*, both combine spaces and objects (aka the location) to attract participants. The “architectural weenie” emphasizes the object as the center of attention relying on its presence alone to draw that attention. *Ma* uses the surrounding empty
space to compliment attention to a central object. This technique was notably used in Pirates of the Caribbean Online:

“… the use of attention drawing weenies, which had in turn been borrowed from the parks, to guide players to quest locations. When a player is given a quest, a beam of sunlight in the distance points to a visible landmark that the player must go to complete the quest. Additionally, the movement of non-player-character-controlled boats also leads players to sail to desired destinations, avoiding the “lost at sea” problem that had been an issue with the DisneyQuest attraction.” (Schweizer & Pearce, 2006).

The lost at sea issue bought up in that study was implied to point out the potentially ineffective wayfinding from the expansive space from the DisneyQuest ride with the navigation being fully controlled by the player - who would in turn get lost in the virtual world.

Having actual lights to guide players sufficiently helped navigation, however it also helped that the movement mechanics simplified navigation which will be discussed after this section. A game that puts these principles to use (alongside landmarks) is Journey by Thatgamecompany LLC (2012), whose lead designer is, incidentally, from China. Who may have the idea of Zen or Mu (the nearest equivalents to Ma) within his repertoire in architectural level design. A distant, shining mountain at the very beginning of the game draws attention and motivates movement towards the empty sands that surround it.

In his book Video Game Spaces, Michael Nitsche refers to the same concept in the game Black and White. “These light beams not only provide help for spatial orientation, but they also indicate past and future activities” (2008, p.214). Colors also have a similar effect as noted in an interview from IGN to Johannes Soderqvist - Dice’s art director for Mirror’s Edge (Thomsen,
I make the distinction that the use of *weenies* is the closest western idea of the usage of space and objects/locations of attraction with emphasis on the *objects/locations as the centerpiece of wayfinding*. Lights and colors serve as supporting elements which also bring attention as well, with that in mind I must be careful in how I apply them. I would classify these aspects as part of positive spaces in my eventual design.

**Movement**

Beyond the placement and literal design of structures, I’ll be considering movement – the actual velocity of the intended user and the more subtle details to further polish navigability for my intended design. In a dissertation by Bobby Schweizer *Videogame cities in motion*, he presents the idea of “motilities”:

“Motility refers to the player’s interaction with a space as embodied by movement mechanics. The player of GRAND THEFT AUTO IV (Rockstar North, 2008) can control a pedestrian, an automobile, a helicopter, and a speedboat while the player of BURNOUT PARADISE (Criterion Games, 2008) takes on a variety of cars. As a result, GRAND THEFT AUTO IV’s Liberty City needs to accommodate all these kinds of motilities while BURNOUT’s Paradise City’s design needs focus on only one.” (2014, p.175).

In other words, whatever kind of mobility if available – walking, running, driving and flying—should be accounted for as a prerequisite for sculpting a game level. For instance, large levels might be good for vehicles but for some players may be inconvenient with only walking/running. Physical scope of a level would be a factor of connecting predicted player expectations and movement as well. Considering space from the expected movement is nothing new as mentioned yet again in *Toward a Ludic Architecture*:
“In the Chartre d’Athènes directed at future architecture and urban planning students, Le Corbusier explains that “Architecture is volume and movement” (Le Corbusier 1962:28). In other words, we wander through architecture, and this modality of movement determines how architecture is experienced. Movement places the visitor into positions and involves him or her in processes, guides views, enforces velocity, and presents or conceals parts of the whole.” (Walz, 2010, p.32).

Despite Le Corbusier’s biases (as discussed by Morshed previously) his views at the time were shared by many by the intuitive nature of including movement in architectural design. Considering previous sources discussed, the speed of the users (in my case which will be a vehicle) must also be accounted for when designing the overall map. I am aiming for a relatively short experience, so the space will have to be adjusted appropriately for a relatively fast vehicle as I apply architectural aspects to the project which may affect user attention to the overall map.

VIRTUAL ENVIRONMENTS

One paper has classified interactions in a virtual environment, The effects of movement of attractors and pictorial content of rewards on users’ behavi[or] in virtual environments: an empirical study in the framework of perceptual opportunities (Fencott, Ling, Shaik, & Shafiullah, 2002). Notably with less direct influences from architectural design, it compiles studies from general interactivity. There are notable similarities in how the studies treat attention and aspects of navigation, which connects to lessons in architecture to lessons in general interactivity and thereby computer interactivity. These interactions are classified as perceptual opportunities, in which they are repeatedly distilled further into more fundamental categories.
They maintain that these opportunities provide presence, implying these traits attract visual attention:

1. **Sureties** – defined as expected supportive spaces that mostly appeal to the unconscious mind, supports attention just like how Lynch saw how landscape affected pathfinding and navigation.

2. **Surprises** – any attribute that provides stimulus which in turn enhances attention. These attributes will be examined much further. Taken inspiration from Whitelock et al. (1996).

3. **Shocks** – issues that could cause a break in attention.

   Distilled further the study goes into more categories within “surprises”. These categories are attractors – a category that is central to my study, connectors and rewards. The paper likewise centers itself on the observation of attractors – perceptual opportunities that purposely draw attention to areas of interest. In a previous paper Fencott categorized several attractors (1999)– which are relevant to my design:

1. **Mystery Objects**: unusual (in shape and general contrast) and/or partially obscured objects. Which could include lone static lights and distant landmarks in the case of my study.

2. **Composite Objects**: groupings of objects at a distance that could serve as one attractor. Depending on how I group certain objects, density and frequency of the space near said objects could be an attractor instead. (Similarly describing nodes as noted by Lynch)

3. **Awesome Objects**: comparatively large and highly noticeable objects; the valley in the middle of the island and the man-made landmarks in my study are some examples.

4. **Alien Objects**: relatively unusual objects in terms of context – it can be argued the landmarks that jut out on the general skyline of my design is this.
Outside of the subject of landmarks, the focus of my project, there are other visual and audio factors that would affect attention as well. Inanimate objects aren’t paid as much attention to compared to animate objects (Dunn 1996; Tremoulet and Feldman, 2000). From this suggestion, movement is a very strong attractor – and is minimized to only the player object in the project the attempt to control scope from analyzing user behavior. Another study referred from the paper by Ito et al. (1998) also suggest rounded objects provoke less attention/neurological responses to the brain than jagged/sharp objects – so particular attention must be made in actual shaping of individual objects (an allusion to good shape of the 15 fundamental properties by Christopher Alexander). Sensational objects – non-visual attractors are minimized to only the music – specifically chosen characteristically to be “active yet laid back” in an attempt to calm potential players, which could potentially be a crutch in terms of potentially a player’s taste (might dislike the music so much that they could leave).

Connectors are interfaces and levels of planning that allow the user to adjust themselves to the environment (physically and mentally). This would in my case be the use of landmarks as intermediate goals to reach and orient themselves as they navigate the level. Actual interfaces – like UI and text comments (in context to my study) would be purposely minimized appropriately to lessen noise so that the user would concentrate on the surroundings. Rewards are the ultimate goal which users plan their navigation for, better rewards not only make for supporting attention but doubles in practicality for the user to voluntarily remain for the whole study “Rewards should be designed to deliver the memorable experiences of the VE as well as ensuring that visitors linger appropriately from time to time as they move around the world” (2002, p.127). The rewards in my study would be the small narrative in the form of comic pages. “Triples” – a successful combination of attractors, connectors and reward are an effective way to achieve
attention. Attention specifically coming from visual attractors would affect the navigation of the player, the focus of my design. I will link these attractors synonymous to the 15 fundamental architectural properties by Christopher Alexander.

**USER INTERFACE**

Mentioned in *Video Game Spaces*, Michael Nitsche read several papers by Ben Schneiderman, known for his research in interface design and summarized in three rules that could be applied to video game design:

1. continuous representation of the object of interest
2. physical actions or labeled button presses instead of complex syntax; and
3. rapid incremental reversible operations whose impact of the object is immediately visible. (Schneiderman in Laurel 1993, 8; also Schneiderman 1998, 229)” (2008, p.37-28).

Objects or interfaces being tested must be simplified and the center of attention and any changes/interactions into them can be easily seen and undone. Further emphasizing the need for me to simplify the game in terms of complexity/distance while keeping player engagement. This notion was also similarly noted by Norman Brosterman at an earlier date during his research towards “user centered design” as mentioned in *Toward a ludic architecture* by Stephen Walz (2010, p.43-44). Observations towards optimal simplicity and information load in interface design connects to lessons learned in architectural design. From these lessons my game design must minimize UI to facilitate user attention to their surroundings. I will at the same time have to show in my visual analysis (which will be detailed in Iterations 4-5) a consistent and distinguishable way to record user data. These lessons are not limited to game design but also to how I would track and present my own data collected.
METHODOLOGY

In accordance with the principles of architecture and interactivity (lessons in virtual environments and user interface) I will apply in a short and relatively simple 3D game of a third person-controlled vehicle (with a freelook camera) in the form of a delivery truck. I will only take note of one variable – landmarks, one version with and another version without. Furthermore, I will be taking into consideration the supporting elements that facilitate the potential use of landmarks for players.

I have included concepts derived from architectural wayfinding with information load and interface studies (ex. a simple consistent design that is likely to produce less stress as noted by Christopher Alexander’s observations to good shapes and the void/negative space in the background section) that are similar to the way that virtual environments are observed (ex. perceptual opportunities by Fencott). From these lessons I have determined that for this project it is better practice to reduce UI and the amount of complexity in order to literally facilitate attention to specific aspects of the design towards landmarks, while at the same time practicing consistent usage of architectural patterns in a large area suitable for a vehicle.

The simplified game design enables the user to not only pay more attention to the surroundings within the game but also reduce stress to stimulate the user to finish the game, as well as balance the need for practical and complete data collection, collect sizable data points (physically in the game world and within appropriate time intervals), and recognize trends. The simplicity enhances the user’s experience and allows a more limited direction of what could have garnered attention towards landmarks. This is reminiscent of prototyping and the early stage development of many games.
My design will test whether players in a comparatively large open environment will be able to navigate and orient themselves more quicker towards the hidden goal with noticeable landmarks as opposed to none at all. These will be supporting elements already present (negative spaces, contrasts of limited colors, lighting and other architectural elements in the game) - I am also planning to dub sound as well, to stimulate relaxed gameplay. All of this must preferably be performed with unique users who have little to no knowledge of the environment designed in the first place – akin to first-time users. This will reveal any weaknesses or strengths in my design regardless of skill level of the potential user.

**Tools/assets and methodology**

I will be using the game engine *Unreal Engine* (version 4.18) and using *RStudio* and various libraries within to analyze data. I will have made a heightmap (commissioned/designed alongside a third party from fiverr.com and reviewed by me) which doubles as use in land generation in Unreal and will be used as an overview in player navigation. Player navigation will be tracked in Unreal with a modified program I made to work alongside Unreal’s blueprint system (which I chose to use for quick changes and prototyping). This player navigation will be processed through RStudio and tracked using said heightmap. Specific modifications from RStudio/visualizations will be made using Adobe Illustrator adjusted over time with data being collected per Iteration. Initially I was using video records to note of trends alongside RStudio tracking but I found this impractical to store overtime from the first two iterations which was when I simply decided to use tracking via RStudio. Assets were made with Assetforge (some filler buildings and the main vehicle) but most architecture/vegetation was also made by a third party. Certain blueprints that help with quality of life will be used as well (wall construction and weather/sky lighting) all stable at UE 4.18.
Iterations will generally be based improving on asset completion, directing attention (such as limiting to only black and white colors in iteration 3), data recording, and controlling player movement over time. All recorded users are unique and anonymous. To collect the data on the behavior of less erratic players that I have encountered during iteration 5, these players are stay in one spot and never move the world rotation at any direction, despite having no framerate issues. Therefore, I will only focus on users who have completed the game and looked through all factors of ~360 degrees (shown at figure 23 used at iterations 4-5).

My design aesthetic was inspired by the Philippine islands, specifically a location similar to the rugged, yet well preserved area of Kagayan Lake in Palawan. The Filipino culture implied from the comics is based from the island of Siquijor, the Island of Witches.

![Figure 5: Kagayan Lake, Palawan.](image)

**Attractors/The 15 Fundamental Properties**

These screenshots are based off Iteration 3, these elements/properties are crucial in order to understand what could garner a user’s attention which would in turn help in wayfinding:
1. **Levels of scale** - The mountains and the buildings. There are clearly differing sizes between manmade and the natural environment.

2. **Strong Centre** - The town centre and fountain at an intersection in the town.

![Levels of scale (left). Strong Centre (right) – the fountain](figure6.png)

3. **Boundaries** - The trees and walls/fences are applied through the level blocking the player/vehicle.

![Boundaries](figure7.png)

4. **Alternating repetition** - Philippine mangroves and alternating tropical palm trees are a common sight, I attempted this in the hope to make a natural looking environment.
5. Positive Space - Positive spaces function as the lights and the objects I have applied in my game in the attempt to guide user attention to closer objects and outline distant architectural weenies/landmarks that stick out of the landscape.

6. Negative Space (inner void) - refers to the shadows and areas not illuminated by light in this very early tropical morning of my design. This would also apply to the sky as well. This could potentially be the nearest concept to *Ma* discussed earlier.
Figure 9: Positive space as shown by distant landmarks and nearby better lit objects, and negative space are shown by the dark areas and sky. (Removed the speedometer at iteration 4)

7. Good Shape/Contrast - the towers placed in the distance are highly noticeable from afar especially in contrast in the early dawn light. The contrast (towards colors) is minimized as well due to the colors being only black and white, this classification is combined (Note this is technically two of the 15 fundamentals) as the contrast that will be more relevant also refers to the unique shape and size relative to the environment.
Figure 10: Good shapes (the distant tower) and contrast (the colors). Very prevalent in The Long Road (described at Iteration 5).

8. Local Symmetry - applied to certain buildings, in this case applied to the mayor’s offices.

Figure 11: Local Symmetry – noticeable colors and shape per building

9. Deep Interlock - some of my colonial style buildings appear different upon closer inspection in terms of theme and supporting structure in the village.
10. Graded Variation - some buildings have variations in size despite being the same asset. I wanted to show how buildings implied were originally built at different periods; however, this is only more obvious in the editor or on close inspection.

11. Roughness - Road and ground textures give the scenery a slightly more realistic feel.
12. Echoes - My “colonial” style buildings follow those found in Filipino-Hispanic architecture. Generally, there is a contrast between the modern architecture and the Filipino-Hispanic architecture in this implied tourist-friendly island.

13. Inner Calm - I have included occasional Filipino-style gazebos, installing them at places outside implied populated areas, and these serve as public rest-stops to pedestrians. They are not usable by the vehicle movement but if noticed – implies a sense of a laid-back culture.

![Figure 15: Inner Calm](image)

14. Not Separateness – Not separateness implies a sense of unity and belonging between all objects involved within a space, from color scheme, to sculpted style and material (in this case common to a Philippine island). I have struggled to create this sense of not separateness, and it is thoroughly obvious in editor mode where assets can be seen clearly. Some buildings were made by other applications (asset forge objects vs my usual commissioned objects) in the attempt to make a reasonable town space. I believe my
colonial-style buildings have achieved a sense of non-separateness. However, this might potentially add to shocks – breaks in attention (as noted by perceptual opportunities).

Figure 16: Not Separateness (the lack of it in some objects) – this center building has darker colors and an inappropriate metropolitan style of intensity compared to the other buildings.

I will consider all these attractors but ultimately, I will be looking at the effect of one variable – which is the unusually tall mysterious landmark in the form of the tower (as shown below at figure 17). These landmarks also work as high places (which instinctively attracts according to Christopher Alexander) and an attractor (from categories of mystery, alien, composite, and awesome from the surroundings it resides by) by its unique presence in the game space. My hypothesis was that by removing one element from the level would subtly affect user navigation and wayfinding. The other landmarks serve as intermediate points to guide players towards a goal not obvious at the starting area node.
Figure 17: The Landmark, the tower, the architectural weenie

My design will have five major nodes which will be populated with objects and architecture. Node A will be the starting area and will be open enough for the player to get acclimated to the movement. Node B would be the main town (SouthWest town), which will be the testing area of the first landmark(s) – one of which is located at a blocked area of node C. Technically the valley is a node – however it will only be for the first three pilot tests at my iterations. Depending on how well development goes – nodes E and D (D being the absolute goal in the design for the user) will be made to further reinforce the way a player would navigate in unfamiliar terrain. Paths or joints between each node would be the “Valley” – the negative space between nodes B and E, and “The Long Road” the negative space between nodes A and B. These paths will be elaborated at Iteration 5 in figure 26.
DESIGN ITERATIONS

Each iteration is based on incrementally improving assets to support as attractors and refining how I have analyzed the data between all users. All users are unique.

Iteration 1

This iteration was to test the general reaction of users traversing the open environment. During the pilot test at this iteration, I realized two things at the time pertaining to movement mechanics and color: five users recorded (one recording file corrupted). At the time, I was not familiar with other architectural concepts beyond the architectural weenie. This was probably also due to the incomplete state of the project at the time; however, players were more concentrated on the movement mechanics. The fact that the car was easy to handle and could
move quickly enabled them play with the vehicle rather than follow any kind of goal. However, after getting used to the movements most subjects went straight for the tower upon noticing it and did not notice the alternate goal, which would be the actual goal in future iterations – a valley next to the “town.” The valley was designed to be conspicuous (confirming it was hidden well enough); however, this was due to colors and elevation not being too obvious (one user collided on elevated ground towards the valley).

Figure 19: A user speeding towards the lone "architectural weenie" - the tower at the distance.

**Iteration 2**

At this Iteration I wanted to see if simply adding colors would vastly change player behavior. Having conducted another pilot test – this time with a clearer level with more defined colored paths. Specific behavior was noted, namely that players were still distracted by speed and movement, as in previous tests. 10 players were recorded, and despite coloring the landscape and paths in between the “nodes” – only two players out of the ten noticed and navigated towards the valley.
Upon planning my map over time, I considered two additional ideas as I was designing in the second Iteration. Firstly, is considering variables beyond architectural elements. This is using supporting elements alongside landmarks and other physically placed attributes for wayfinding, this is referring to hints. This is important as there is a possibility that players might ignore certain guiding elements in the background. On that tangent, guiding the player according to player types is a completely different subject and is beyond the scope of determining which player types would be more susceptible to the “physical spaces” in the design. As noted in the conclusion of a paper by a fellow colleague Yu Xiao, *Utolypse: How Interactive Visual Hints Help Players Solve In Game Puzzles*, “By constantly using interactive hints to enhance the player's memory of a specific hint, it can not only reduce the need of space in the UI design for storing hints, but also allow the player to focus more on the game itself” (2018, p.24). Secondly, I decided to add a small narrative to the game which would double to give a clue of where to go and added more detailed assets at Iteration 3.

![Image](image.jpg)

*Figure 20: Still the same issues but now it's colored.*
Figure 21: A small narrative that will serve as a reason for users to explore – serving as a mini reward and helping on giving hints in game of where to go. This was commissioned and illustrated by “nizar86” for use in-game.

I have also noted of the limited effect of color which could affect a user’s navigation. As noted in Schewizer’s paper Videogame Cities in Motion, commenting on an interview with art director towards the game Mirror’s Edge, he said, “A combination of wayfinding and aesthetic choices help link the different areas of the city together through the hyper-athletic body of Faith, the dissident message courie.” (2014, p.51). Movement supported by appropriate and highly noticeable colors helps players intuitively choose paths to navigate. It was at this time I also concluded that different colors could also potentially distract a player’s attention as well – so I
decided on a limited black and white color palette as well as reduce the number of things (ex. fundamental properties related to contrast) players can see on screen to potentially distract.

**Iteration 3**

This iteration examines if my completed design, now actively applying some aspects of the 15 fundamental properties from completed assets, made players act more consistently when navigating. This iteration has refined movement is appropriate to a sizable delivery truck; assets are populated on the map, their quality has improved (no longer relying on greyboxing), and the data collection via R has been further developed. 5 users have been recorded.

![Figure 22: This user left mid game. The truck flipped over. Map made from world direction/rotation from south (0 origin - y coordinate) north.](image)

I noticed there was plenty of user retention issues – caused by the loud/active environment this test took place in, which resulted in users leaving in mid-game for a variety of reasons. This was when I realized during this stage of development, I should expand more
resources into the atmosphere; I after all will be sending this game to users overseas where my presence will likely not affect the user’s gameplay. A greater stimulus must be introduced to counteract the variable conditions of the external environment for the sake of more complete data collection. Therefore, an interesting game would entice users to complete it. There were other reasons why users weren’t able to finish. Unplanned shocks (referring to Fencott’s study) occurred where the truck turned over, when the teleport point of recovery was too far from where the user flipped, and then left the game. I will have to develop a dynamic teleport point (when flipped in an emergency) to move the truck appropriately (the node where the user flipped) to make it through the major nodes. I was in the process of developing my data collection and noted the player location well, but not the world player rotation (where the user was generally looking at absolute rotations). Unfortunately local rotation was being recorded (rotation relative to the truck), rather than absolute rotation to the world – however this helped. Despite the issues, I did notice that users tended to act specifically when moving with the vehicle (as noted from the local rotation data collection).

Users tended to look forward relative to the direction in which the truck was moving, there was no mouse movement. I have noted similar behavior written at the time from a colleague Alissa Sisson’s paper VISUAL ATTENTION PATTERNS IN VIDEO GAMES. She explains: “In the scenarios when the player had a weapon, typically a firearm, the player tended to view the rest of the game space down the gun barrel by moving the sites with the game controller. The result was a nearly singular focal point, even when visually exploring the world. However in scenarios where players did not have a weapon, their visual pattern changed so that eyes physically moved across the screen much more.” (2019, p.20-21). I have noted that players would unconsciously use the default view of the truck (third person view pointing forward) as a
focal point to view the surroundings rather than use the mouse (which you can freelook in at 360 degrees) while moving.

**Iteration 4**

This purpose of this iteration was for the development towards data analysis. Noting the view angle I have set by default, I have appropriately set factored sections of the absolute rotation of where the player was generally facing in the map as shown below (figure 23). My reasoning is that not all players would look at the exact direction center of where users focus but also at the periphery of the screen. I have also removed the speedometer – to absolutely make sure the players’ eyes are on their surroundings. I however applied a “help” button as an option at a non-intrusive area at the bottom of the screen (shown first at the iteration 5, figure 32). I only used one player at this time in this test – this was more to see if using diverging colored dots to denote rotation was preferable to using symbols in a potentially dense navigation track. These rotations, as recorded on the map, will be used in a future iteration to prove if users visually saw landmarks and other attractors at a certain direction. Knowledge of asset placement and landscape is used in conjunction to this, the map is large, but I have purposely used distinctive assets per direction at fixed distances. This will facilitate the fixed recording interval.
Figure 23: The map and symbolic dot colors of absolute general rotation of where the player was facing made into factors. Blues/dark greens toward the northeast, lighter greens toward the southeast, oranges and yellows to the southwest, dark orange and reds to the northwest.
Figure 24: Dot colors are differentiated at the dense areas at this visualization. Especially with the diverging colors selected.

I also noted that if I added animate objects – it would be more difficult to track what people could possibly be looking at from the potential number of attractors in a given direction, alluding to my background on movement (as referred from Fencott’s study). My conclusion, at
this point, would be to list what attractants would be present at notable rotations common to players overtime – noting the direction of the landmarks as well.

**Iteration 5 (Final Iteration)**

*Figure 25: Here is the live map with landmarks PRESENT (circled in red, southwest landmark represented by red arrow). This figure is based on the zoom and orientation of my map recordings, from user data between the variants, on which I will base my analysis.*

My design is finalized with two variants of the same level. Independent variables are the presence of landmarks, controlled variables are “notable constants” (Figure 26) – spaces following the 15 Fundamentals to consistently guide players to the destination, and the dependent variables would be the individual times between users *relative to the average complete time of Variant B*. Variant A is the version of the level with the landmark assets, and Variant B is the version of the level without the landmark assets. There will be notable constants
in the form of the designed spaces between them that may or may not attract attention and also potentially help in wayfinding, this might serve as an alternative to landmarks (as shown in figure 26 below, referring to the 15 Fundamentals by Christopher Alexander). The large dead trees pointed out in figure 26 are purposely hidden by the darkness and terrain until a player sees them around the corner of the area. This was an attempt to help the player navigate and finish the game as he/she approaches and finds a wide path next to these trees. The hint comics are in the same places between the variants A and B; hint comic 1 will be changed between the variants— one panel will have the Tower 2 (shown in figure 25) in the background which may imply importance to the goal. The observatory town (shown in figure 26) has an explicit hint in the form of hint comic 2 of where the goal would be, so that players would likely head towards its direction.

I have added a mechanic in the game which will help un-flip the car and teleport it at a reasonable checkpoint nearby, and it has a delay and a tight constraint to activate to prevent accidental key presses. A control help UI reminder is placed directly at the bottom of the truck to prevent a distracting periphery. If there is teleporting during a recording moment (of every 5 seconds when gameplay starts), the map legend will report an NA. The Long Road, The Valley and the area next to the large dead trees and the sparse lighting between the intersection towards hint comic 1, and lighting towards hint comic 2 are where Ma or negative space concepts are being tested directly within the island landmass.
Figure 26: Notable constants between variants.

Figure 27: No landmark in hint comic 1 between variants. This takes place at a bordering fence blocking the whole area towards tower 2 (SouthWest Tower 2 Fence/Gate in figure 26).
**Variant A**

I will be displaying pictures and descriptions while taking note of landmarks within common coordinates/rotations relevant at the constants (as shown in figure 26). The constants (excluding the hint comics) happen to be attractors. Another observation to note is the fact that players always make a loop in the town and do not explore the locale any further upon noticing the valley (there is the potential that they might avoid interaction with hint comic 1). Despite the users going through the town– the users in this variant are by average (slightly) faster at completing the level. Which I calculated is approximately ~**19.57 minutes**. Three out of the five users completed the level, although one of the incomplete users had notable data. Users are all based off anonymous naming convention from the RMD files. Users who have completed the game in this variant are T1A, T5A and T9A. The one notable user who didn’t complete the game is T4AI.

User Data (Variant A)
(Cont’d) Figure 28: User T1A. Name based off csv files read in RMD. Finished in ~15.8 minutes.

Figure 29: User T5A. Finished in 27.2 minutes. Longest time within variant A.
Figure 30: User T9A. Finished in ~15.7 minutes, the “NA” recorded implies car crash and teleportation to checkpoint upon recording at that moment. User T9A did not look directly at the farm and sped the long road.

Common areas of interest are observed between all the users that were recorded in Variant A, taken from constants at figure 26. Common rotational directions are noted based on the completed user data collected from notable common factors, these are based off isolated world rotation (WRotation) factors (explained later at the Appendix and figure 44).

Figure 31: Common Areas of Interest. Red arrows are showing notable common rotations.
Common Areas of Interest (Based off figure 31)

A. The Long Road

Figure 32: Landmarks within sight at 180-225 degrees (yellow dots) globally.

B. The Farm

Figure 33: Small glances being recorded towards the farm (blue dots at The Long Road).
C. **Noticing the valley near the southwest fence at town (landmark within periphery)**

*Figure 34: Reaching the southwest fence (even without touching the hint comic 1) players are drawn towards the valley upon when looking at this angle. These are the red dots at \( y=\sim 100K \).*

D. **Noticing the Tower 1 Landmark upon approaching the valley**

*Figure 35: Zero-degree angle of rotation is common within the valley.*
E. Noticing the Observatory Landmark

Figure 36: Continuing the zero-degree rotation in the valley.

F. Noticing a checkpoint of the observatory town from the lone light at the west

Figure 37: All players who approached this light/hint went towards the direction of the goal.
G. Wayfinding at low visibility using Large dead trees – then spotting the third landmark

Figure 38: The large dead trees near the final goal. Noted by the red and green dots at the area.

An observation from an incomplete playtest

Figure 39: User T4AI. Finished in 19.3 minutes with very low framerate. The valley was noticed much earlier (shown by the orange areas at The Long Road), the player also kept the camera towards the distant landmark of tower 2 (WRotation 180-225) noted from the yellow dots, just like ‘A’ from the common area of interest from the complete users, before quitting.
**Variant B**

Two out of the three players noticed the valley first and went towards that area, despite it being in the opposite direction of the goal – on average they took slightly longer to complete the level. Three out of four users have completed the level, those users (based off my anonymous csv to RMD naming convention) are T2B, T6B and T7B.

Despite having no explicit landmarks, I noticed similar rotation behavior at The Long Road, the valley, and the large dead trees areas (based from figure 26). Noticeably users at The Long Road looked towards the mountains more frequently. I will note these areas are large, empty, and relatively featureless because of the need to make general assets occupying space nearby more prevalent. This follows the concept of *Ma* and *negative spaces*. Note the one player (T7B) that went in town (figure 42) and took a longer time leaving that vicinity compared to the Variant A users, who was observed by the dense dots populating the town. I did not include screenshots because the land is similar other than to add that it has no landmarks, and the behaviors of users in this Variant are much more apparent in the map recordings. From the two out of three recordings, the users (T2B and T6B) did not to navigate further into the Southwest Town – which in this case had no landmark. Variant B users took approximately ~21.53 minutes average complete time. This time would have been used to further prove if my design was effective from the independent variables present (or not present in this case), expanded further in the Appendix.
Figure 40: User T2B. Finished in ~19.8 minutes, note crash and teleportation after the valley next to the observatory area as noted by the record of NA and the wide gap of movement at $Y=200K$.

Figure 41: User T6B. Finished in ~15.9 minutes, the fastest out of Variant B.
Figure 42: User T7B. Finished in 28.9 minutes, note the density of movement in town (implying the player drove slowly) and the fact the player went through the valley twice. Longest time of Variant B.
CONCLUSIONS AND REFLECTIONS

Variant A

Variant B

Figure 43: All users from variant A (above). Figures 40-41 aka users T2B (left) and T6B (right) from variant B (below). Distinct shapes unique to their variant from specifically if they moved to the Southwest Town node at Unreal map coordinates X > 200K, Y < 150K.
In this small test, on average Variant A users who had landmarks in their game finished the level faster. Unfortunately, due to the small number of players tested, I could not make any statistical confirmations to determine whether my hypothesis is true, let alone calculate statistical reliability (a confusion matrix and a Fisher’s exact test as will be discussed in the Appendix section). To a very small degree there was some success with context to the user movement over time, and there were noticeable patterns between Variants A and B. Despite most of the users in Variant B going the opposite direction towards the goal, it did not necessarily mean they would complete it much quicker than Variant A. The fastest of them in Variant B did not advance in a decisive direction towards in the north area beyond the valley. This was obvious from the lack of movement towards the Southwest Town (shown in Figure 43 above). However, consistent movement and rotation between the variants commonly happened in the areas testing negative spaces (Shown much better at figures 44-46 at the Appendix). A landmark’s effect in this very small test group was apparent, and movement in purposely built negative spaces was consistent between all the users.

Aside from the limitations encountered, I still believe the data collection methodology was still optimal to test for general tracking, to confirm whether landmarks and negative spaces helped in wayfinding, and to assess whether it had a noticeable effect. Due to the fixed recording interval – it was easy to see if the users were moving quickly in certain open spaces, this is from the larger noticeable gaps between recorded points. The users in both variations consistently acted similarly in negative spaces (which were constants), especially north of the valley, and the lack of presence of a landmark seemingly did not stimulate two out of the three users into fully entering the southwest town node at variant B (shown in figure 43 – based off figures 40 and 41). This is unlike variant A which had a landmark in that direction, which resulted in all the users
traveling in that direction and making a loop at the southwest town. This is more obvious by looking at all the recorded observations (figure 43) where the navigation between each variant follows a similar shape to their variant.

In this small test group – my hypothesis is inconclusive, as I know this could lead to extreme bias from the small number of users collected. I would not know that this group coincidentally played within expectations; this would better be confirmed with at least 15 to 20 users per variant. Suitable for a Fisher test to statistically confirm if this was the case. It is enough as a pilot test which would benefit with continuation (introduced hypothetically in a preferable state at the Appendix). This would only be the beginning to a more formal experiment, as strong empirical evidence taken from statistics based on more collected data will confirm, if a subtle detail such as placing landmarks, will make significant changes to user movement and thereby show better completion times.

The design in digital form is in a complete state, applying principles of design from Architecture and Interactivity (Computer and UI). To further prove if the principles were effective is through statistical data, this will show distinctively if the presence of landmarks leads to better complete times. This will be done through an Exact Fisher’s Test which will compare tallied distributions (details given at the Appendix). The results by minimum will confirm if based off the independent variable (Landmarks or not) the categories are by current chances leading to differing results/distributions, proving that the independent variable lead to differing results. This will also depend on the accuracy of the predictions (true positives and negatives).

The subjects taken outside game design did in general help with how I observed users and improved my overall design at each iteration. Based on details that attract user attention and observations from my current design, from common principals in architecture, virtual
environments and UI, show that differentiation to a specific object or element (also relative to their surroundings) is key to facilitating a less stressful environment and therefore allows better wayfinding. Simplicity means consistency not only to the user, limiting variables that could attract attention (whether it be assets per rotational direction, or details such as color) allows a designer to point out what the user has possibly experienced and effectively control user movement. Intimate knowledge and planning of asset placement which in turn would lead to understanding the user’s perspective at any given moment is key to pointing out and controlling a user’s experience. More complex concepts, such as adding more game mechanics or adding a level of deeper analysis to users can then be developed on top in confidence.
BIBLIOGRAPHY

Primary Sources


Extra Credits. (July 18, 2018). Ma, The Space Between - Uncluttered Game Design - Extra Credits. (00:00:30-00:00:49)


People Make Games. (August 29, 2019). Why the sound of a gun had to be nerfed in *Wolfenstein: Enemy Territory*. (00:00:45-00:03:10)


**Secondary Sources**


**External Picture Sources**

**Picture labeled for non-commercial use – Nintendo owns Zelda: Breath Of The Wild and any resource derived from it. I own none of these resources.**


**Pictures taken from fansites – ArenaNet owns Guild Wars and Guild Wars 2 and any resource derived from it, I own none of these resources. I agree on all terms on https://www.guildwars2.com/en/legal/guild-wars-2-content-terms-of-use/.**

GW2 Lion’s Arch Wintersday Final Stop. (2012). Retrieved from

User: Mozoziz/Pictures. (2009). Retrieved from

Guild Wars: Nightfall Screenshots. (2007). Retrieved from

Philippines – Kagayan Lake, Palawan (Labeled for reuse with modification)

Wikimedia Commons. (2018). Retrieved from
https://commons.wikimedia.org/wiki/File:Kayangan_Lake,_Coron,_Palawan.jpg

Data Collection + Game Builds

Iterations 1-2 (Videos)

https://www.dropbox.com/sh/05u0upvr34ecgav/AADopenw3I4sNfRHdGDs5ffaa?dl=0

Iterations 3-5 (Raw data and RMD file *will not run unless put in the same file*)

https://www.dropbox.com/sh/3uq4wbmpadttdd5f/AACB8-YEQ6x_n_Yr79ulhwvFa?dl=0

[Game Build – original bad frame rate + slightly fixed framerate versions]

https://www.dropbox.com/sh/p65npdtufc1s2y3/AAABLz-vrjSIINJZ4LrA4IPOCa?dl=0

[Variant A + Variant B (fixed versions)]

https://www.dropbox.com/sh/cf0guc5w22srdecl/AACCFEnYVyND1E1edRcLyeDqa?dl=0

https://www.dropbox.com/sh/ofiwos726e022q6/AABrv_e6ey9NGmYD21iqf0F5a?dl=0
APPENDIX

In this hypothetical scenario I would at least take 30 players to complete the game split equally between variants with or without landmarks (exactly like in Iteration 5), I would have made individual density maps dependent on world rotational direction and (coded and factored as WRotations) taken from all users separated by each variation. The ‘dense’ areas would note user attention in the specific space, I will make a density map per rotation only for all users in variant A. Variant B does not need a density map per rotation as its use is for comparative purposes, namely to prove variant A will have likely faster completing users thanks to the landmarks.

As attempted in Iteration 5, I will mostly consider the constants and the landmarks (as described in figures 25-26), having personally designed the map – I will also take into account transitional rotations (rotations being done midway to a final/prolonged rotation) and likely vehicle movement (rotation being mostly controlled by default view of the vehicle therefore from the design of the paths/negative spaces). All areas refer to figure 31 and the “Common Areas of Interest” in Iteration 5. This will make more reliable trends based on statistics thanks to the number of users, which in turn expands the data, confirming whether landmarks are effective in consistently guiding players through each node (figure 18) to an eventual goal. The starting area node (which is the area under of $X < 150K$) will be ignored as that area is to setup familiarity to the controls of the game, which I expect there would not be an immediate landmark or explicit goal to head towards as a new player.

From the extra number of users who successfully completed the game, I believe there would be unusual behavior from the paths they have chosen. This would lead to a large amount
of data to process. But from the rotational density plots we would be able to see consistent areas of attention, relative to landmarks and other attention-grabbing areas.

**VARIANT A examining world rotations between 180-225 degrees (Southwest)**

![Image](image.png)

*Figure 44: This plot is based off ALL users of variant A that had noticeable consistent rotations made apparent from the density at area A and area F. My eventual goal would be a version with (Cont'd) at least 30 users from the two variants. I used this method to isolate and find common world rotations at common areas of interest.*
VARIANT A examining world rotations between 0-45 degrees (North)

Figure 45: Ignoring the starting area node (X<150K) glances were dense during areas B, D and point E.

VARIANT A examining world rotations between 315-359 degrees (Leftward - North)

Figure 46: There are very few moments where you would look northward towards the left the only moment expected to look in that rotation is during points C and G.
The visualizations above only serve to confirm if the common areas of interest, in summary areas knowingly utilizing attractors following the 15 fundamental properties are effective. Thus, would show how consistently they support landmarks. Supporting those visualizations would have resulted in a confusion matrix; this confusion matrix with be the hypothesis of would variant B – the version of the game without landmarks have users who by average likely complete the game longer than variant A – the version with landmarks. This is done after gathering the target number of users and averaging out each variant. From the average time completed in variant B, all individual complete times between the variants will be examined and users will be tallied accordingly to a confusion matrix.

**Confusion Matrix examining preferable number of users to Variant B’s Average Time**

<table>
<thead>
<tr>
<th>(Above) Actual / (Below) Reference</th>
<th>Variant A (Is below average to variant B’s level complete time)</th>
<th>Variant B (Is equal or above variant B’s average level complete time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant A</td>
<td>Majority</td>
<td>Low</td>
</tr>
<tr>
<td>Variant B</td>
<td>Low</td>
<td>Majority</td>
</tr>
</tbody>
</table>

Table 1: True positives and true negatives from all the combined users must equal above 90 percent for my hypothesis to have credence to be true. The tally will then be applied to a Fisher’s Test.

The preferred number of users tallied would have a large majority of users be put in their expected places (true positives and true negatives). From most users tallied as a true positive or negative, that number should at least exceed over 85-95 percent. If it is beyond 90 percent, it
would confirm that there is truth to my hypothesis. If the tally is lower yet still above 85 percent it would mean that I would need more users to further confirm my hypothesis. However, if it is consistently under 90 percent that would mean I my game design is partially flawed and aspects of it needs to be reworked. There will be repeat testing until a sizable number of users to fulfill above 90 percent true positives and negatives.

Depending on the amount of false positives and negatives, it would mean that there were specific issues design flaws. If there are a noticeable number of false positives, this means the tally is below the amount of preferable true positives, and means variant A individuals completing the level have timings above or equal to the average of users in variant B. That result would mean my hypothesis is flawed and I either must redo my whole level design, confirming my original hypothesis again or my hypothesis regarding landmarks is false. If there are a noticeable number of false negatives, meaning the tally is below the amount of preferable true negatives, variant B individuals would have a noticeably lower completion times below the average of the variant B average time. This in turn would mean the variant A design was consistent, while the variant B users who navigate the map and attributed varying success to completely different issues with the map. In this case the overall hypothesis would be false; however, that would still mean landmarks do affect users in a specific way, requiring a reworked design and closer towards the original hypothesis. From these issues, I have chosen Fisher’s exact test, which would imply that there is a statistical difference from each independent observation overall. Below is an example of a complete tally with the following example of Fisher’s exact test made as previously mentioned.
Example Tally/Confusion Table

<table>
<thead>
<tr>
<th>(Above) Actual</th>
<th>Variant A</th>
<th>Variant B</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>(Is below average to variant B’s level complete time)</td>
<td>(Is equal or above variant B’s average level complete time)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(Below) Reference/Expected</th>
<th>Variant A</th>
<th>Variant B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant A</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Variant B</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 2: Two users in Variant B were faster than the average of Variant B. And two users in Variant A were slower than the average of Variant B. Leading to an accuracy of ~87%.

Fisher’s Exact test (If Variants A and B were consistently below or equal/above Variant B’s average time)

<table>
<thead>
<tr>
<th></th>
<th>Below</th>
<th>Equal/Above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant A</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Variant B</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>

```r
ContTable <- matrix(c(13, 2, 2, 13), nrow = 2,
                     dimnames = list(Expected = c("Variant A", "Variant B"),
                                      Actual = c("Below", "Equal/Above")))
fisher.test(ContTable) # Extremely high statistical significance between variants A and variants B
```

Fisher’s Exact Test for count data

data:  ContTable
p-value = 0.0001451
alternative hypothesis: true odds ratio is not equal to 1
95 percent confidence interval: 3.92059 562.861006
sample estimates:
odds ratio 34.12385

Table 3: Fisher’s Exact test notes by the p-value if Variants A and B are statistically significantly different from each other. Comparing if distribution is the same between categories. In this case I would reject the null hypothesis. Even if the values were not above 90%
(Cont’d) accuracy this result (in this example) lends credence that the design did lead to statistically differing and significant results. Implying landmarks affected the level.

I would confirm using Fisher’s Exact test and p-value that follows. The expression in question is would be a minimum of confidence interval of 90 for 30 observations minimum. A value above p value of .10 minimum will further confirm if the values taken from the accuracy are significant and are likely not coincidental. In the best outcome, a confidence interval of 95 with a p-value of .05 will be used. This would help confirm whether to reject the null hypothesis (depending on the tally of false negatives and false positives as explained above) if my experiment led to any kind of trend of statistically significant behavior. Thus, tests of my landmarks may have led to differing behaviors between the variants. This proves that if my experiment, especially if the accuracy is lacking (calculated from true positives and true negatives over total observations), and thereby is flawed due similarities in the distribution between tallies of the variants (noted by the p-value taken by Fisher’s exact test) relative to expected true positives and negatives, or needs a direction to improve to get better results.

Unless there was a sizable number of users to confirm my hypothesis, I would not be able to find out if my overall level design that (concentrates on landmarks) has any justification. To a lesser extent, testing if some aspect (in the virtual design or analysis) regarding each variant’s users is affected by landmarks or not need to be redone, this will depend on the number of false positives and negatives. My experiment relies significantly on the perception of individual users navigating the environment, and some users may or may not be as used to navigating a 3D environment quickly, I am expecting either a highly noticeable trend to be confirmed or otherwise my hypothesis, whether landmarks affect player navigation, to be otherwise false and to be rejected.