Atmospheric Sound Design in Games: Pacing, Engagement, and Environmental Storytelling

Callum Collins

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Abstract

Atmospheric Sound Design in Games: Pacing, Engagement, and Environmental Storytelling seeks to demonstrate that game pacing is a key factor in determining player investment in high-agency narrative elements, such as environmental storytelling, and that pacing can be manipulated through both level design and atmospheric sound design. This research seeks to further game sound research by producing artefacts that will serve as case studies for other designers and researchers. These artefacts will take the form of game prototypes which will explore game sound design and discover what techniques and tools effectively realise the potential of sound as a narrative device and engage the player in the narrative of a game world. The making processes of this research will follow an iterative design methodology, using the methods of conceptualisation, prototyping and evaluation. The case studies *Flower*, *Darkwood* and *Limbo* will form the basis of ideation for the prototypes and serve as a reference during iteration and development. These case studies will be used to analyse how sound can be incorporated into a game design process, to further understand its connection to level design and pacing.

Table of Contents

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed: Date: 11/07/22

List of Figures

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Introduction

Video game levels are often thought of as visual containers for gameplay,[1] but there are more elements to game levels that players may not realise. An often underutilised and overlooked area of level design is its connection to game sound design, specifically the effect that atmosphere design has on the player.[2]

While atmospheric sound design is not an unexplored area in game design research, its connections to level design and gameplay pacing have not been fully investigated. Sound design for games differs from linear media such as film, as games are dynamic systems, and while designers can predict what players will do, they cannot design for every possible outcome.[3] Therefore, to explore this non-linear design environment, this research will consider games like *Flower*, *Darkwood* and *Limbo* to analyse how sound can be incorporated into a game design process, to further understand its connection to level design and pacing. By uncovering these connections and understanding the effect of atmospheric sound design on a player, this research proposes that it can be used to further the engagement of players with high-agency narrative devices like environmental storytelling.

Research Question:

How can atmospheric sound design be used throughout the game design process to influence gameplay pacing, to foster deeper player engagement with a narrative constructed using environmental storytelling.

1. Torill Elvira Mortensen, "Real Game Worlds: The Emotional Reality Of Fictional Worlds", *Mediekultur: Journal Of Media And Communication Research* 34, no. 64 (2018): doi:10.7146/mediekultur.v34i64.97015, 79.
2. Christopher W Totten, *An Architectural Approach to Level Design*, 2014, 368.
3. Karen Collins, *Game Sound: An Introduction to the History, Theory, and Practice of Video Game Music and Sound Design* (Cambridge, Mass: MIT Press, 2008), 89.

Contextual Review

Summary of Body Sections

This literature review is separated into two parts; the first will contain definitions for key contexts within game studies and this research. The second part will explain how these contexts relate to the research.

Narrative Definition for Games

Before this research can begin, the core aspects of the field of inquiry need to be defined. The first of these is game narrative and how to design it.

There are several definitions of narrative in the field of game design. One definition is that "narrative consists of the text or the discourse produced by the act of narration."[4] This definition assumes that narrative is the part of the story that the designer delineates to the player. Another definition is that narrative is the sum of all the actions of play and the designer's narration. "[Narrative] is the totality of the experience; something that happens when all elements are taken together: Gameplay, dialogue, notes, setting, graphics."[5] This research will use the latter definition when referring to a game's narrative. This research will focus on atmospheric and environmental narrative, created using environmental storytelling and atmospheric sound design; both terms will be defined in the following sections.

Level Design

Level design is not simply a way to translate game rules into a construct for play[6]; it is the act of combining gameplay and gamespace.[7] These gamespaces, which can also be thought of as game worlds, are often deeply complex and encourage the player to explore and manipulate.[8] The various designed aspects of the environment constantly relay information to the player, making the player an active participant in the game's narrative.[9]
Through level design, the designer can express their narrative further using environmental storytelling.

Game Worlds and Environmental Storytelling

Game worlds are the designed spaces of play. These virtual environments are "designed and planned, and the activities within are bound by rules, affordances and limitations."[10] In this sense, we can think of games as containers for elements of play, and as previously stated, narrative is the totality of these elements. Environmental storytelling is the narrative drawn from the player's observations and experiences in the game world, which designers have carefully constructed. It relies on the player to be an active participant in the story as it "exists in the space between the scripted story and the story created by gameplay."[11] This means it is not the most effective tool for constructing narrative as players can misinterpret or simply ignore it. However, its connection to level design makes it appropriate for this research since atmospheric sound design also depends on the game level.

Atmospheric Sound Design

Sound designer and researcher Budhaditya Chattopadhyay defines atmospheric[12] sound design as sounds that are present in a location, such as birds, wind, electrical hums, and office clatters. Chattopadhyay continues to state that to the sound artist and practitioners, ambient sound injects life and substance to both the cinematic world and the story world.[13] This concept illustrates an overlap with environmental storytelling; the sound designer and the level designer both attempt to immerse the viewer in the world they are creating.

4. Ernest Adams, *Fundamentals of Game Design, Third edition.*, Voices that matter (Berkeley, CA: New Riders, 2014), 383.
5. Thomas, "4-Layers, A Narrative Design Approach," In *The Games Of Madness*, April 29, 2014, accessed June 30, 2022, https://frictionalgames.blogspot.com/2014/04/4-layers-narrative-design-approach.html.
6. Rudolf Kremers, *Level Design: Concept, Theory, and Practice*, 2009, 18.
7. Totten, *An Architectural Approach to Level Design*, xxiv.
8. Ian Graham Ronald Shaw and Barney Warf, "Worlds of Affect: Virtual Geographies of Video Games," *Environment and Planning A: Economy and Space* 41, no. 6 (2009): 1332–1343, accessed September 19, 2021, http://journals.sagepub.com/doi/10.1068/a41284, 1.
9. Fern, "Environmental Storytelling - How to Use a Game Level Design to Tell a Story," Blog, *Environmental Storytelling - How to Use a Game Level Design to Tell a Story*, May 30, 2020, accessed September 21, 2021, https://fable-and-fern.com/2020/05/30/environmental-storytelling-how-to-use-a-games-environment-to-tell-a-story/
10. Mortensen, "Real Game Worlds", 79.
11. Steve Gaynor, "AAA Level Design in a Day Bootcamp: Techniques for In-Level Storytelling," GDC Vault, last modified 2013, accessed April 15, 2022, https://www.gdcvault.com/play/1017639/AAA-Level-Design-in-a.
12. Budhaditya Chattopadhyay, "Reconstructing Atmospheres: Ambient Sound in Film and Media Production," *Communication and the Public* 2, no. 4 (2017): 352–364, accessed May 21, 2022, http://journals.sagepub.com/doi/10.1177/2057047317742171. He refers to atmospheric sound as ambient sound.
13. Ibid, 354.

Ludic and Narrative Game Sounds

In games, audio designer Denis Zlobin suggests that sounds can be organised into ludic and narrative sounds. It is important to note that "most sounds in any game have both ludic and narrative functions; a ludic sound is not necessarily 'anti-narrative' and vice versa."[14]

Narrative sounds draw us into a world or narrative, while ludic sounds provide the player with information to help them achieve or motivate.[15] An example of this would be in *Mario;*[16] when the player jumps, it is a ludic sound that informs the player the action has been completed. Narrative sounds can range from dialogue audio to the soundscape for a particular level.

Denis Zlobin also suggests that: "everything in the game belongs to a narrative but not necessarily supports the narrative design. The narrative value reflects how well the sound aligns with the narrative design."[17]

By focusing on a narrative atmosphere (something that, like environmental storytelling, does not interfere with player freedom), the designer can focus their sounds on the narrative side. Foley sounds[18], which would normally fall into the ludic category, can be intertwined with the atmosphere design, giving the sounds narrative value.

What is Important for this Research

This research seeks to demonstrate that game pacing is a key factor in determining player investment in high-agency narrative elements, such as environmental storytelling, and that pacing can be manipulated through both level design and atmospheric sound design.

Game Worlds and Environmental Storytelling

Scripted interactions such as cutscenes (when the player is taken out of the interactive environment and a film or animation video appears)[19] and triggered dialogue sequences (when text appears on screen and the player must conclude the sequence before returning to the game) trade player freedom in favour of certainty that the narrative will be delivered and understood by the player. By using environmental storytelling, designers can deliver narrative elements to the players without interrupting the players' control over the game; players who are only interested in the physical gameplay will not be impeded or frustrated with excessive narrative sequences.[20] Through these small vignettes, a game world can begin to take shape, and the player can deduce the history and culture of the world. This cannot be done by placing a single object in a game world; it is all of the environmental properties of the playspace interpreted as a meaningful whole.[21] For example, a player may find themselves in a cave that has a campfire, a tent and a note. Depending on how these objects are represented, the tent could be tattered and the fire still smouldering, the player can ideate on what happened in the cave. However, environmental storytelling is not a complete narrative delivery method as it requires the player to engage with it and cannot be used to express exposition or dialogue between characters. It is strictly tied to the narrative of the game world.

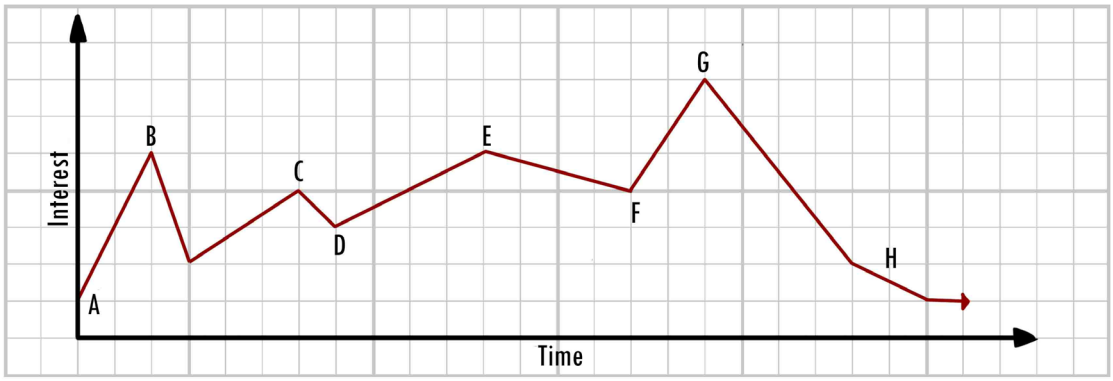
For players who want to engage with the game's narrative, environmental storytelling asks the player to take an active role and use deductive reasoning to form their own interpretation of the narrative being presented to them. This active participation creates a more memorable experience and builds player investment.[22] However, this creates the problem of how does a designer encourage the player to engage with this form of narrative delivery? This research explores the idea that atmospheric sound design can influence the players pacing through a level, encouraging the player to move through dense narrative zones slowly, improving the likelihood of engagement with environmental storytelling.

14. Denis Zlobin, "Ludic and Narrative Sound in Games," *UX Collective*, last modified February 15, 2021, accessed September 27, 2021, https://uxdesign.cc/ludic-and-narrative-sound-in-games-3fc52dbbfee1.
15. Ibid
16. Yukio Kaneoka, *Super Mario Bros.* (Nintendo, Atari., 1983).
17. Zlobin, "Ludic and Narrative Sound in Games."
18. Foley is a technique for creating common sounds and is named after Jack Foley who established the technique. It involves creating sounds like footsteps, clothes rustling (or any other sounds which would disrupt a recording mix) in post-production.
19. A cutscene is a small clip that plays when triggered by the player. It is usually cinematic in nature and the player loses all control of their character until the scene has played out. A triggered dialog sequence is similar however the player may sometimes have the ability to choose a dialogue response.
20. Jolie Menzel, "Level Design Workshop: A Narrative Approach to Level Design," GDC, accessed April 27, 2022, https://www.gdcvault.com/play/1024302/Level-Design-Workshop-A-Narrative.
21. Harvey Smith and Matthias Worch, "What Happened Here? Environmental Storytelling," GDC Vault, last modified 2010, accessed April 20, 2022, https://www.gdcvault.com/play/1012647/What-Happened-Here-Environmental.
22. Fern, "Environmental Storytelling - How to Use a Game Level Design to Tell a Story."

Pacing in Games

Video game pacing is the rhythm of the game as it progresses. Matthew Scott states, "It can be used to convey certain emotions to players, and also helps control the impact of events to the player."[23]

With linear media, such as animation or film, these events are referred to as "story beats". These events can be considered "player incentives" or rewards in games. These could be mechanical rewards such as game currency or a new ability as well as story elements. This is used to keep players playing the game.[24] It can be visualised as an interest curve[25] (Figure 1) with the player entering high-intensity sections of gameplay to engage the player, followed by a reward and lull to relax the player, allowing them time to reflect on the actions and narrative of the previous section.



A: Initial interest. The player should be interesting in the game otherwise they would not be playing it.
B: 'The Hook.' Captivates the player and encourages them not to stop playing.
C, D, E, F: This is a repetition of high intensity and low intensity sections. The experience should build despite declining during rest stages (D, F).
G: The climax. This is what the game has been building up to, e.g. final boss.
H: The resolution. The player leaves with some interest. "Wanting more."

Figure 1: Interest Curve. Based on: Schell, The Art of Game Design. It can also be found in Pechuel et al., Game-Based Learning for Teachers A Journey Through A World of New Ideas!

Game designers can use this knowledge to create levels that generate interest and challenge the player without diminishing the overall experience.[26] With good pacing, a game will build focus and motivation in the player so that each action or section feels more important than the last. This lays the foundation for the theory of game flow.[27]

23. Matthew Scott, "Level Design Workshop Section Three: Pacing" (Presented at the Game Developers Conference China, Shanghai, China, 2014), accessed May 6, 2022, https://ubm-twvideo01.s3.amazonaws.com/o1/vault/gdcchina14/presentations/833762_JoelBurgess_MattScott_LeePerry_3_Pacing_EN.pdf#:~:text=Pacing%20can%20be%20a%20tool,of%20events%20to%20the%20player.

24. "Pacing of challenges was designed so players could continually experience enhanced competence as they progressed in the game, with challenges increasing apace with player ability. This balancing of game difficulty and player skill was critical to the success of arcade games; if the challenges underwhelmed players, they would lead to boredom, and if they overwhelmed the player, they would generate frustration. Developers sought to avoid either in order to hold the interest and loyalty of players." Andrew K. Przybylski, C. Scott Rigby, and Richard M. Ryan, "A Motivational Model of Video Game Engagement," *Review of General Psychology* 14, no. 2 (2010): 154–166, accessed May 8, 2022, http://journals.sagepub.com/doi/10.1037/a0019440, 155.

25. Jesse Schell, *The Art of Game Design: A Book of Lenses* (Amsterdam ; Boston: Elsevier/Morgan Kaufmann, 2008), 248.

26. "Simply putting more interesting moments in it might not be enough since if the interest level was too high, it would diminish the interest of what was to come later." Schell, *The Art of Game Design*, 250.

27. Alex Harkey, "Dimensions of Games – Pacing," *Games Precipice*, December 9, 2014, accessed May 8, 2022, https://www.gamesprecipice.com/pacing/.

Game Flow

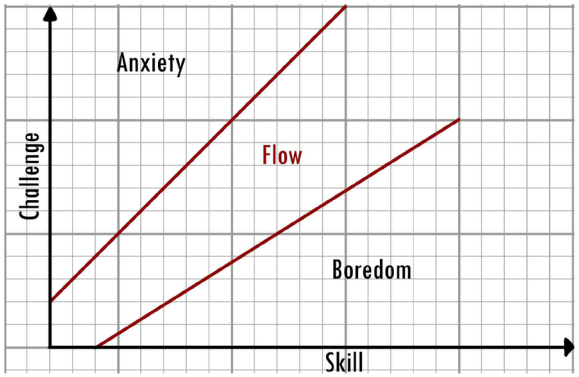


Figure 2: Game Flow. Based on: Rogers, Level up! The Guide to Great Video Game Design. And: Macklin and Sharp, Games, Design and Play. Can also be found in Pechuel et al., Game-Based Learning for Teachers A Journey Through A World of New Ideas!

Game designer and theorist Jenova Chen explains the concept of game flow,[28] which positions the player between anxiety and boredom by designing levels with the right amount of challenge compared to the player's ability to overcome it (Figure 2).[29]

Game flow is a term that is often used by game designers when discussing difficulty, pacing and challenge in games.[30] Unfortunately, this is a term that is widely used in game design as a substitute for 'fun' or 'quality' which is too broad to use for this research.[31] Therefore, this research looks beyond game flow to investigate player motivations. Player motivation can be broken down into three main aspects: Game goals, challenge, and rewards.

Goals, Challenge and Rewards

"A game's goal frames the play experience, suggesting to players how they might engage the game."[32]

When designing the goal of the game, it is important for the designer to consider what the player's experience will be; this is known as challenge.

All games have a level of challenge, and while game flow would suggest that challenge should be linear and in proportion to the player's skill as the game's difficulty increases, there are other ways designers can challenge the player.

"Instead, the game might confront the player with a challenging narrative or an experience that the player can enjoy regardless of skill."[33]

An investigation into game rewards is required to understand what makes a player engage with challenge. There are two types of rewards in games; extrinsic and intrinsic. Intrinsic rewards are given to the player as a direct result of performing an action. For example, the player enjoys the challenge of puzzles that involve moving boxes. An example of an extrinsic reward would be if the player received a monetary reward for moving the boxes. There is a potential for extrinsic rewards to distort intrinsic motivation, leading to ethical issues of rewarding game players.[34]

Misuse of extrinsic rewards can lead to "skinner's box"[35] games. A skinner box is a psychological experiment, typically involving rats or pigeons where the animals push a button to receive a reward (food). The button is then configured to give rewards less frequently or even randomly. The result of this experiment shows that a player, if given a button to press, will continue to press it for rewards, like a slot machine. This research seeks to use an ethical application of player rewards to motivate the player. In his book *An Architectural Approach to Level Design*, game designer Christopher Totten discusses different types of rewards that can be achieved through level design.

28. Game flow is different from the physiological theory of flow described by Mihaly Csikszentmihalyi in *Flow: The Psychology of Optimal Experience*. Jenova Chen's theory of game flow is based on this theory however is more relevant to game design studies.
29. "In order to maintain a person's Flow experience, the activity needs to reach a balance between the challenges of the activity and the abilities of the participant. If the challenge is higher than the ability, the activity becomes overwhelming and generates anxiety. If the challenge is lower than the ability, it provokes boredom." Jenova Chen, "Flow in Games," *Welcome to Flow in Games*, last modified 2006, accessed May 6, 2022, http://www.jenovachen.com/flowingames/thesis.htm.
30. Anna Anthropy and Naomi Clark, *A Game Design Vocabulary: Exploring the Foundational Principles behind Good Game Design* (Upper Saddle River, NJ: Addison-Wesley, 2014), 224.
31. Ibid.
32. Colleen Macklin and John Sharp, *Games, Design and Play: A Detailed Approach to Iterative Game Design*, First edition. (Boston, MA ; San Francisco, CA: Addison-Wesley, 2016), 53
33. Ibid
34. Tynan Sylvester, *Designing Games: A Guide to Engineering Experiences*, First edition. (Sebastopol, CA: O'Reilly, 2013), 213
35. Ibid, 207.
36. Totten, *An Architectural Approach to Level Design*, 247.

This research looks to his concept of "Rewarding Vistas", where instead of offering gameplay resources, such as health or new abilities, the player is rewarded with impressive views of scenery.[36]

Totten suggests that this form of reward is important for pacing purposes as they provide a moment of calm after intense challenge. On the interest curve, rewards could be given to the player at points; B, C, E, and G (Figure 1). Point B which is "the hook" is a key part of engaging a player in a game and should include an impressive narrative moment. Schell describes the hook as giving "the guest a hint of what is to come and provides a nice interest spike, which will help sustain focus over the less interesting part where the experience is beginning to unfold and not much has happened yet."[37] These points are chosen because at the highest point of interest, the player will be attempting to overcome the challenges set for them and once they have completed the task, will be looking for a reward. After this peak, the player can relax and reflect on their success, and if the reward the player receives is narrative exposition, the player is likely to use this rest time to reflect on "what happens next" in the game story.[38] This is because the player is still engaged from completing the previous section's challenges and wants more. A reward is used here because giving the player more mechanical challenge at this point will cause a decline in interest as: "Simply putting more interesting moments in it might not be enough since if the interest level was too high, it would diminish the interest of what was to come later."[39]

This research uses this knowledge to analyse the first section of the survival horror game *Darkwood*.[40]

Before the game starts, the player is greeted with a message: "Respect the woods. Be patient. Focus." This message directly instructs the player what to do when they begin playing. This is the first goal given to the player. Should the player disregard this message, the game reinforces the message mechanically after the intro when the player takes their first steps outside of the relative safety of the starting house to immediately stand on a poisonous mushroom. The player then slowly loses health, which they do not know how to get back at this point in the game. This interaction increases anxiety, setting a baseline for the rest of the game; the player will now move slowly and carefully, watching where they step. Rewarding the player with an increase in their health "could make them more confident", therefore, removing health from the player would have an inverse effect.[41]

While the player is in this cautious and observant state, they are more likely to notice and engage with different environmental objects; tyre tracks, a broken tractor, and a torn-down fence. These scenery elements mean nothing on their own; however, the player begins to build a story when observed as a whole.[42] The discovery of these narrative elements is a reward for the player listening to the goal of 'be patient'.

With this understanding of how designers can influence the player with their environment, this research investigates how sound design can achieve a similar outcome.

37. Schell, *The Art of Game Design*, 248.

38. Totten, *An Architectural Approach to Level Design*, 249.

39. Schell, *The Art of Game Design*, 250.

40. D*arkwood* (Acid Wizard Studio, 2014).

41. Stephane Bura, "Emotion Engineering: A Scientific Approach For Understanding Game Appeal," *Gamasutra*, last modified 2008, accessed June 30, 2022, https://gamasutra.com/view/feature/3738/emotional_engineering_a_scientific_.php?print=1.

42. Smith and Worch, "What Happened Here?"

Sound and Player Engagement

Game sound has already been proven by game and sound designers as an effective tool for improving player immersion and affective perception: "[sound in games] can also work as support to gameplay (K. Jørgensen, 2008). Additionally, sound is a valuable component of overall game aesthetics and affective perception. Furthermore, it may be used to create and enhance emotional impact (Ekman, 2008) and contribute to immersion (Collins, 2008a; Grimshaw, 2007, 2008)."[43] Therefore, designers should be able to use atmospheric sound design to guide the players pacing for an improved narrative investment.

Darkwood exemplifies this idea by using sounds designed to keep you on edge.[44]

During the nights, the player must return home and make preparations as creatures, and supernatural occurrences will plague them until morning. The game employs abstracted audio to represent the different monsters and creatures that circle the house, making it hard for the player to anticipate what is outside. The player also cannot see anything outside their vision, so the only indication that something has broken into their house is the sound of doors and barricades breaking. Because of the risk involved in confronting the creatures making the sounds, the player must be patient and wait out the night while listening to the sounds of the creatures outside.

When players are scared, they will usually act more cautiously, slowly investigating every corner and object. By emotionally engineering the player to stay in this emotional state, the designer can direct players to observe the environmental storytelling and investigate narrative vignettes without making them feel their agency is being taken away from them. The difference between using sound and mechanics like the poisonous mushroom is that the player does not feel as though they are being challenged with sound.

Sound poses no risk to the player, it only hints at it, and by using abstracted sounds like those of the nighttime scenes in *Darkwood*, the player is left to imagine what that danger could be.
This type of sound design works well in a linear environment like *Darkwood*, where the designer knows that the player will have to return home each night and can create a soundscape for each day. However, when designing non-linear levels, dynamic soundscapes are required.

There are ways of creating a dynamic soundscape that engages the player just as effectively as seen in the game *Flower*.[45]

Flower is typically thought of as more of an experience than a game because of its simplified controls and lack of story.[46] However, through its simple mechanics, the game's narrative reveals itself. With its heavy use of sound, the game creates an emotionally engaging experience for all types of players. In *Flower*, players take control of a single petal, and as they move through the level, they brush past other flowers, which prompts a musical note depending on what colour flower they collided with. Rather than creating a soundscape for the game after the levels were finished, the development team worked alongside sound designer Vincent Diamante to ensure each flower was placed in the correct position. They experimented with different colours and combinations of flowers which would form a soundscape as the player progressed through the level. During a Game Developers Conceference (GDC) talk, Co-Founder of *Thatgamecompany*, Jenova Chen explained that "[They] wanted to try and create a rise and fall story with no actual protagonist to speak of."[47] Vincent discussed in an interview that he "spent a lot of time looking at the level design in Maya and understanding how it was organised into discrete components. Knowing how each of these individual pieces of the gameplay experience operated, I was able to build a score that fit that."[48]

43. Mark Grimshaw, ed., Game Sound Technology and Player Interaction: Concepts and Developments (IGI Global, 2011), accessed June 26, 2022, http://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-61692-828-5, 363

44. An example of how Darkwood scares the player using only atmospheric sounds can be found here: Matthew Clarke, "Darkwood Review: A Trip Through Haunted Woods," Darkwood Review: A Trip Through Haunted Woods, February 10, 2017, accessed September 26, 2021, https://elitegamer.ie/2017/10/02/darkwood-review-trip-haunted-woods/.

45. *Flower*, Microsoft Windows (Thatgamecompany, 2009).

46. The game has a narrative and a story that can be realised through the gameplay and progression, it is simply not told to the player, they have to engage with the gamplay to figure it out. This is usually described as narrative game mechanics.

47. Mike Schramm, "GDC: The Music and Sound of Flower," *Engadget*, accessed May 12, 2022, https://www.engadget.com/2010-03-16-gdc-the-music-and-sound-of-flower.html.

48. Jeraiska "Interview: A Beautiful Flight - Creating the Music For Flower" *Gamasutra*. 2009. https://www.gamasutra.com/view/news/113404/Interview_A_Beautiful_Flight__Creating_The_Music_For_Flower.php

The clear communication between game design and sound design helps the sound design shine through the gameplay elements, and every time the game is played, the soundtrack is different. Mark Grimshaw reinforces these ideas in *Game Sound and Player Interaction*, stating, "Designers should not be searching for excuses to use sound: they should be designing ways in which sound may contribute to the purpose of the application."[49]

Building on *Flower's* audio development pipeline will be one of the goals of this research.

Another case study that will support this goal is Limbo.[50]

"*LIMBO* is an artistic 2D black & white platform puzzle game about a nameless boy searching for his lost sister in LIMBO.[51] The overall atmosphere is dark, evocative and sinister, with an unsettling uncertainty that comes directly from the ambiguous audiovisuals and lack of explicit storyline."[52]

Sound designer Martin Stig Anderson joined the development team for the game late into development; however, game director Arnt Jensen already had a plan for the sound for the game. Similar to how the visuals for the game were simplified, the sound was designed to emphasise silence and ambience while avoiding music that would "manipulate the emotions of the player."[53] Martin decided to use the sounds of the environment and the ludic foley sounds from the character to create an atmospheric soundscape that would engage the player. He found that by taking these natural environmental sounds and distorting them, he could achieve "a bigger psychological impact."[54] He also discovered that working in a non-linear environment enabled him to quickly iterate on individual sounds, making the final composition dynamic and responsive to the player's actions and progression. These techniques will focus the practice and will act as research goals when evaluating each artefact.

The first case study, *Darkwood*, showcases how atmospheric sound design can increase or decrease player anxiety, refocusing the player on the game goal and ensuring they follow the intended pacing. This research will seek to build on this effect using the non-linear sound environment of Limbo and use level design harmoniously to create an engaging gameplay experience like *Flower*.

49. Grimshaw, *Game Sound Technology and Player Interaction*, 364.

50. *Limbo* (Playdead, 2010).

51. The theological concept of 'Limbo' is a Catholic afterlife condition for those who die without moving to heaven or hell. It is usually depicted as a waiting room or an area outside of time where people are left to wander. "Limbo," *Wikipedia*, May 16, 2022, accessed May 19, 2022, https://en.wikipedia.org/w/index.php?title=Limbo&oldid=1088114573.

52. Miguel Isaza, "Audiokinetic Customer Profile: Interview with Martin Stig Andersen, Sound Designer/Composer on 'LIMBO,'" *Audiokinetic*, 2010, accessed July 2, 2022, https://designingsound.org/2010/07/13/audiokinetic-customer-profile-interview-with-martin-stig-andersen-sound-designercomposer-on-limbo/.

53. lostchocolatelab, "'Limbo' – Exclusive Interview with Martin Stig Andersen," *Designing Sound*, 2011, accessed July 2, 2022, https://designingsound.org/2011/08/01/limbo-exclusive-interview-with-martin-stig-andersen/..

54. Ibid

Methods and Methodology

This research will employ an iterative design methodology, including the methods of conceptualisation, prototyping and evaluation. The iterative design cycle, specifically the second order design cycle, is a proven methodology for game design.[55] These methods will be applied cyclically, repeating the process until the artefact meets the designer's needs. In this research, the pipeline will consist of 2 stages, separated by a critical reflection method, similar to the evaluation method.[56] The first stage of pre-production will focus heavily on the methods of conceptualisation and evaluation. The goal of pre-production is to clearly outline the design goals and milestones for creating a working prototype or proof of concept in as little time as possible.[57] The final stage of the pipeline, production, will focus on the methods of prototyping and evaluation. For the sound component, field recording will be used to source the sound files required to build the final product. The sound mastering and the field recording processes will still follow the iterative design cycle as recorded sounds will need to be planned, recorded then tested and evaluated. These methods are outlined in the following paragraphs.

> "We can't not plan at all, but nor can we plan every detail to the end of the project. We need a middle ground. We need to iterate."[58]

With game design, designers do not know exactly what they are making until they have made it.[59] Therefore, it is not possible to work with a linear design methodology. The solution is to plan in small stages and evaluate as aspects are built and tested, creating a final artefact after several passes through the iterative design cycle.[60]

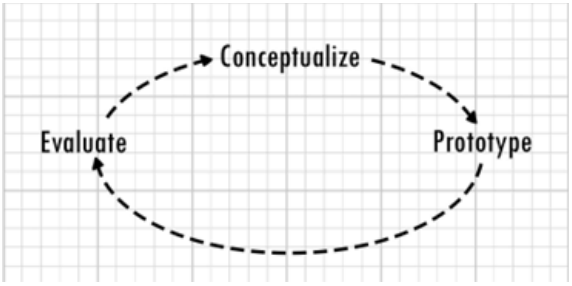


Figure 3: Iterative Design Cycle. Based on: Macklin and Sharp, Games, Design and Play; Sylvester, Designing Games

(Figure 3) shows the iterative design cycle used for this project. Most iterative design cycles used in game design rely on playtesting as a method before evaluation. This research will be using self-testing in place of playtesting and will combine playtesting and prototyping together. Game designer Tynan Sylvester explains that self-testing may not be as reliable as user testing. However, it can reveal problems with pacing, flow, and balance through simple observation of the game's systems.[61] It is also the easiest way to find technical issues with prototypes. This type of testing will frequently happen throughout the prototyping stage. Therefore, for this research, the two methods will be combined.

Conceptualisation

This research will rely on conceptualisation for generating and documenting new ideas during the iterative design process. Conceptualisation uses mapping, sketching, and writing to ideate potential game mechanics and artistic influences and outline the "six basic elements of game design."[62] In this research, conceptualisation will frequently feature in the pre-production stage of each prototype as a clear design goal should be set for each prototype. Conceptualisation will then be implemented again after evaluating the prototype to iterate on the realised mechanics of the prototype.

55. Macklin and Sharp, *Games, Design and Play*, 152.

56. Adams, *Fundamentals of Game Design*, 110. Adapted from the three stage design process.

57. Michael Salmond, *Video Game Design: Principles and Practices from the Ground Up* (London Oxford New York; New Delhi Sydney: Bloomsbury Publishing, 2016), 144.

58. Sylvester, *Designing Games*, 283

59. "Game designers can't really "see" their designs until they are played, and their games can't be played until they are made." Macklin and Sharp, *Games, Design and Play*, 151.

60. "This means we don't have to predict events deep into the future. We need only plan as far as the end of the current loop. Each time we test the game, we check our assumptions against reality. That reality check provides reliable knowledge on which to base our plans for the next loop." Sylvester, *Designing Games*, 283.

61. "The cheapest test protocol is to play alone. Even though the designer's play is biased by his knowledge of the game, just watching the game systems in motion brings a tremendous amount of understanding. It reveals many problems in flow, pacing, and balance. And, of course, technical bugs are best found in self-tests. The earliest loops of an iterative process should conclude with self-tests." Ibid, 296.

62. Macklin and Sharp, *Games, Design and Play*, 31.

Concepting ideas before prototyping them refines the ideas and allows the designer to think through the writing and drawing processes, generating new ideas that generate new potential case studies to refine the game concept further. This process requires time to document, and the designer can easily miss this step during intensive design cycles. It can also result in more experimental and unpredictable outcomes for the designer as the original idea can be lost through several cycles of reflection and ideation. Once the designer has established the core gameplay,[63] they can implement these mechanics into a prototype. Each prototype and iteration created for this research will feature some form of conceptualisation.

Prototyping

Prototyping is the next step in the iterative design process. It involves taking the ideation from conceptualisation and realising it as a prototype. The goal is to have the mechanics from ideation implemented and ready for evaluation in the next stage of the design cycle.[64] This prototype will undergo many iterations as the designer evaluates it and concepts new ideas. Therefore, the initial prototype will be a simple draft with little refinement. While prototyping, playtesting is employed to evaluate small elements of the design. This type of evaluation is different from the method as this playtesting and reflection is rapid and in response to more technical questions such as, can the player make this jump? These reflections do not usually require documentation. Prototyping is the most technical part of the design process and, as such, can fail.

Depending on the evaluation results, the prototype will either continue through the cycle of iteration and refinement, or the designer may decide that the prototype is a failure. A failed prototype is still beneficial, sometimes more so than a successful prototype, as they fail early. When a successful prototype fails in development, it is more time-consuming to fix.[65]

The disadvantage of prototyping this way is the lack of documentation surrounding many design choices; for example, a designer may decide to scrap a mechanic because of technical limitations. Unless the designer documents this decision, the scrapped mechanic may never be prototyped again; therefore, it is essential to evaluate the finished prototype before moving to production to avoid the loss of any documentation.

Evaluation

Evaluation is the last method used in the iterative design cycle as it allows the designer to assess the effectiveness of the prototype. This evaluation method is based off the method of critical reflection described by Christine Morley as "a process of identifying ways in which we might unwittingly affirm discourses that work against us… through examining out implicit assumptions.[66] Evaluation is similar to the reflection used in the previous methods; however, evaluation is a more focused interrogation of the prototype produced. This evaluation will determine if the designer continues to develop this prototype in the production stage of the design pipeline.

Evaluation is a well-documented process and relies on tools of mapping and writing to communicate and record the discoveries attained through rigorous playtesting. The prototype may need to return to the beginning of the pre-production stage if critical concepts such as the core gameplay are deemed ineffective to the aims of the prototype. This process can take more time than the other methods since the designer will need to repeat the evaluation several times to refine the prototype before the production stage.

63. The mechanics of the game combined with the games rules creates gameplay. The core gameplay is the combination of a core mechanic and core rules of play.

64. "Iterative design is a play-based design process. Emphasizing playtesting and prototyping, iterative design is a method in which design decisions are made based on the experience of playing a game while it is in development" Katie Salen Tekinbaş and Eric Zimmerman, *Rules of Play: Game Design Fundamentals* (Cambridge, Mass: MIT Press, 2003), 1.

65. "The decision to enter the prototype stage is critical. Moving too early without a clear concept wastes a lot of time, as it is much simpler to change things in one's mind than in a physical prototype. Moving too late may not reveal design weaknesses early enough and may require a complete redesign." Tekinbaş and Zimmerman, *Rules of Play,* 11.

66. Christine Morley, "Critical Reflection as a Research Methodology," in *Knowing Differently: Arts-Based and Collaborative Research Methods*, 2008, 265–280.

Field Recording

Field recording is the act of recording sounds at site for digital reconstruction. Referring back to the work of Chattopadhyay in *Reconstructing Atmospheres*, it is easy to see how recording sounds on site creates a relationship between the recorded site and the imagined one.[67] This coincides with Daniel Percheron's writing on sound in cinema that states, "sound is an element which reinforces the impression of reality."[68] This research seeks to control the players pacing through a game level, so the field recording method is appropriate for reinforcing the authenticity of the world. These recorded sounds have the added benefit of having a personal narrative context which can help with the production of an imagined one.[69] As stated above, these sounds will still go through the iterative design cycle as any distracting elements in the sound files, such as cars or voices, will break the immersion. The sounds are first planned with the level design to outline which sounds will be required. This is where the planning of site is useful as identifying one that contains multiple potential recording sources saves time and enhances the relationship between the game world and the site.[70] These sounds are then recorded and edited. This is still the conceptualisation stage for the sounds as it can be difficult to evaluate the quality of the recording on site. Once the sounds are edited, they can be prototyped into the game and evaluated just like a game mechanic or level.

Each of these methods are demonstrated below in the documentation of practice section. Throughout this research, I would frequently refer back to case studies and rely on concept sketches to aid in conceptualisation. This ideation would influence the prototyping of new features that would be tested and evaluated before returning to the cycle with the same feature or a new one.

67. "ambient sounds used in the narration directly relate to the sites depicted on the screen to project a diegetic space, but the relationship between the site and sound is (re)constructed according to the craft of the sound practitioners in terms of what they intend to suggest in order to enhance the auditory setting of the narrative." Chattopadhyay, "Reconstructing Atmospheres", 355.

68. Daniel Percheron and Marcia Butzel, "Sound in Cinema and Its Relationship to Image and Diegesis," Yale French Studies, no. 60 (1980): 16, accessed May 21, 2022, https://www.jstor.org/stable/2930001?origin=crossref, 17.

69. G. W. Childs, *Creating Music and Sound for Games* (Boston: Thomson Course Technology, 2007), 23.

70. An example of this can be found in this interview with Quinton Tarantino's sound designers in Django Unchained. Wylie Stateman and Harry Cohen, "Django Unchained," December 2012, accessed May 21, 2022, https://www.youtube.com/watch?v=yw2YE-vh2w0&abchannel=DP%2F30%3ATheOralHistoryOfHollywood.

Documentation of Practice

This research began with the assumption that multiple, small prototypes would be used to explore the role of atmospheric sound design in games. The early making procedures revealed the importance of detailed audio and visual elements, so the practice shifted to a production pipeline for a single prototype.

Early Prototypes

Before creating any prototypes, I first needed to look at how sound could be implemented in the *Unity*[71] game engine. Since this project would rely on modular effects and atmosphere controls, I decided to investigate software that would link to *Unity* rather than use *Unity's* default audio controls. I chose *FMOD*[72] because it can live link into Unity and has better documentation than the other options.[73]

Before prototyping, I investigated how Unity handled audio by default. I familiarised myself with the default audio controls and features shown in the video[74] (Figure 4).

From this simple test, I discovered that the default *Unity* audio systems were heavily code-reliant and had little in the way of effects asides from reverb.

While it was easy to test and add sounds in 3D space, my assumption that I would need to use 3rd party audio software was correct. Due to the simplicity of a 3D first-person prototype, this test inspired me to explore possible player perspectives to experiment with different sound spatialisation.[75] This perspective did not need a player model or animations to function, so it was used again to test *FMOD's* audio approach. This allowed me to focus solely on the game audio.

(Figure 6) shows how *FMOD* was used to create a soundscape similar to the first sound test. In order to continue developing sound tools for use in future prototypes, this prototype[76] focused on the implementation of footstep sounds that changed based on the material the player was standing on. This feature would contribute to making a more convincing game world.

(Figure 5) shows how the sound was supposed to change based on the material parameter in *FMOD*. However, when programming the link to *Unity*, I could not get the code to detect the material below the player (Figure 8).[77] The failure of this test prompted me to continue iterating on the footstep controller in *Unity*. This continuation of iteration and development led me to begin experimenting with *FMOD* to *Unity* scripting, which would become a large part of the research.

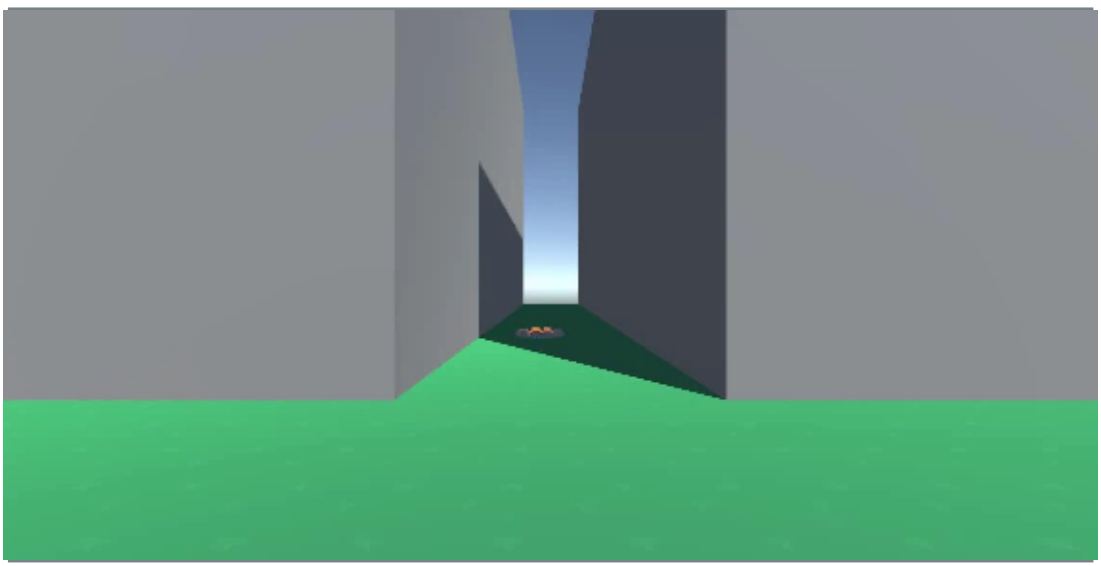


Figure 4: Unity default audio control test.

71. *Unity*, Microsoft Windows (Unity Technologies, 2005), https://unity.com/.
72. Firelight Technologies, *FMOD*, 1995, https://www.fmod.com/
73. Other options included Wwise and Elias. Both of these are free with unity integration, however FMOD was chosen as the interface and documentation was easier to navigate.
74. Tutorial used: https://coding.degree/unity-audio-tutorial/
75. Research into sound spatialization was conducted and can be found in the appendices
76. Tutorial used: https://www.youtube.com/playlist?list=PLp4vT3ssm5SW0CjE3PEAj_BCUQN5gs8Rl
77. I know what the issue was, however I felt it was not important to have the unity prototype working since the FMOD project was a success.

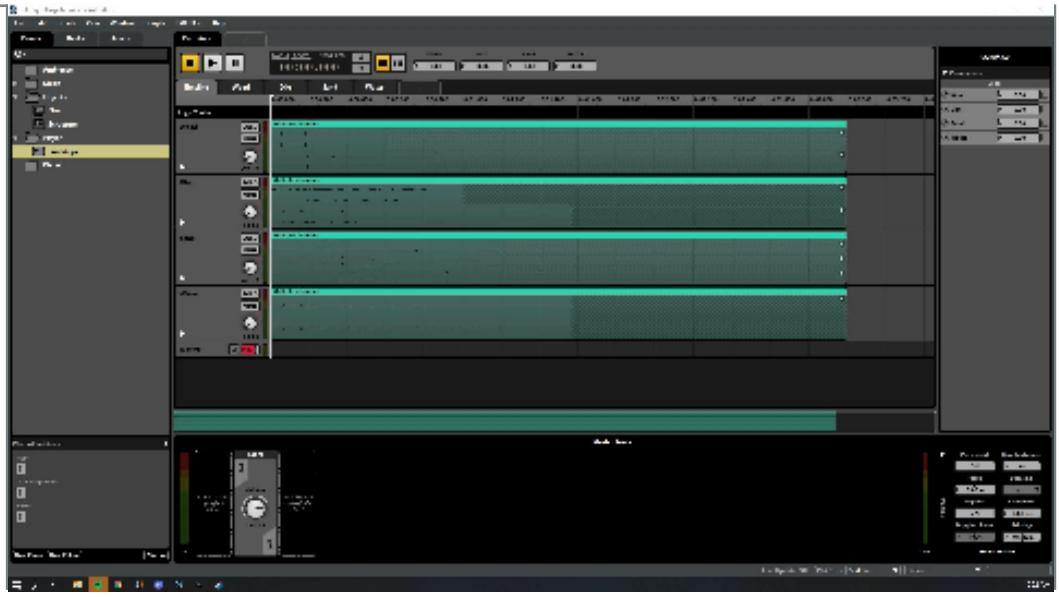


Figure 5: FMOD project test

Figure 6: FMOD project to unity test

The last spatialization test I conducted before evaluating each prototype was to use 3D audio in a 3D isometric[78] perspective. This would require a player character and animations to function as a gamespace but allowed for the experimentation of leading sounds. This test aimed to see if 3D audio could be used to direct the player to move in a particular direction, either towards or away from the sound. The main challenge of this experiment was trying to handle player rotation, as the audio listener would have to be positioned on the player for them to know which direction the audio was coming from. I tested two rotation methods: one where the audio listener would rotate with the player character (Figure 7) and one without rotation (Figure 8).

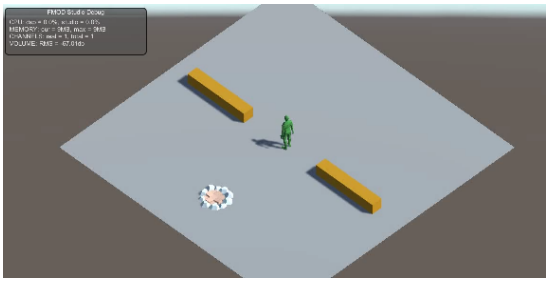


Figure 7: 3D audio with player rotation

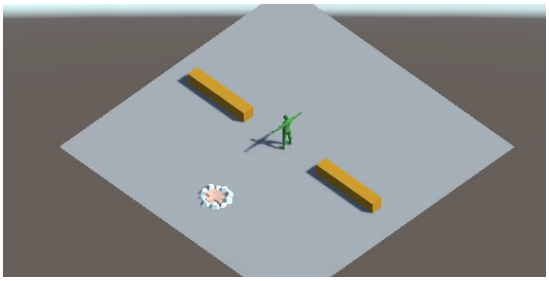


Figure 8: 3D audio without player rotation

When playtesting, I found that both methods of 3D audio were disorientating for the player, so the prototype was scrapped. The failure of this test led to the cancellation of another test I had planned, 2D top-down, as the goal for both perspectives was to find a way to control the player's movement through the level with audio.

78. The isometric perspective was popular in a particular genre of games around the 2000's known as CRPG's (Computer Role-Playing Game). This is a genre I am very familiar with mechanically and narratively.

After evaluating the spatialization tests' results, I returned to the conceptualisation stage of the iterative design cycle. The goal of this ideation was to research more potential gamespaces as I found the results of the previous tests were lacking, despite the reliability and simplicity of the first-person perspective. This investigation discovered Gillian Smith's work in *Launchpad: A Rhythm-Based Level Generator for 2-D Platformers*, which generated the idea of a 2D platformer as a potential gamespace.[79]

Smith proposes that 2D platformers have simple rules but exhibit complex level design, which heavily influences a player's experience. This allows a designer to focus on the level design without the challenge of creating complicated game mechanics.[80] For the development of this 2D platformer prototype, I focussed on the development of my game mechanics and level design. The narrative component of this research would be included once the level design and mechanics were established.

This discovery led me to believe that 2D would be the best space to experiment with level design as asset creation and greyboxing[81] would be simpler than the first-person perspective.[82] Another feature of the 2D platformer genre is that it is known for its rhythm and pacing,[83] which I assumed would have a good overlap with sound design.

With some research into this genre, I found that platformers are incredibly varied mechanically. I used Limbo as the main inspiration for which mechanics to include in my prototype. During this time in development, I had decided that this research would require the creation of multiple prototypes, and so I created a 2D platformer template that would act as a base for each prototype (Figure 9). This template used a finite state machine,[84] allowing me to add new mechanics as 'states' which would allow me to turn off specific mechanics. This way, I could create several prototypes using this template, each with different mechanics and levels. I decided this would be an excellent way to save time when creating multiple prototypes and help me understand the relationship between level design, player actions and pacing. The ability to remove mechanics from prototypes would also help with player attention as each new mechanic the player has to learn will tax their experience.[85]

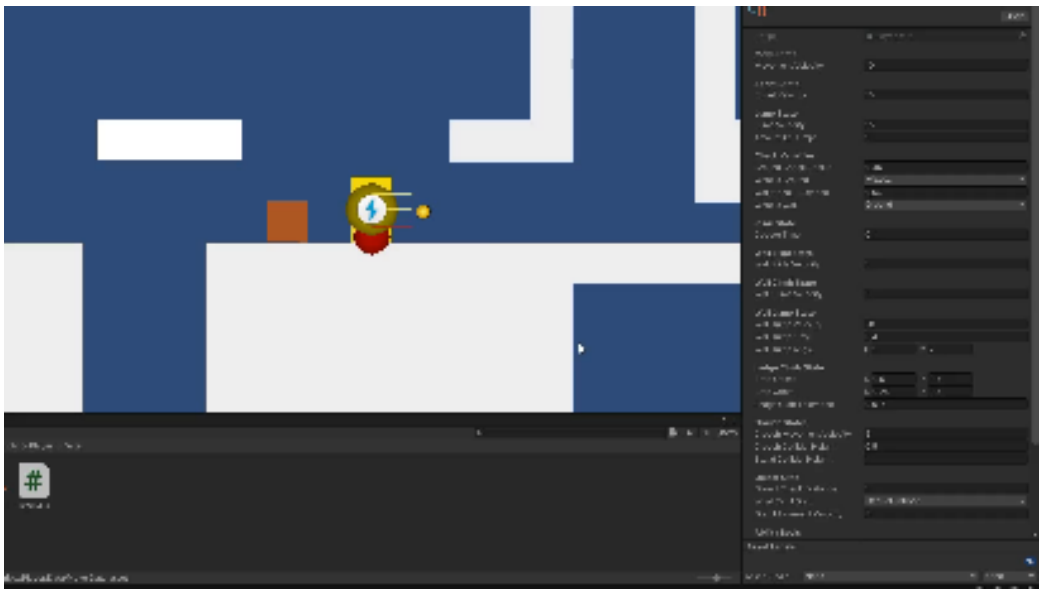


Figure 9: 2D Platformer Template with player data on the right allowing for in-game customisation of mechanics. The majority of the code was sourced from tutorials 20-27 in the playlist "2D Platformer Controller" by *Bardent*[86]

79. Gillian Smith et al., "Launchpad: A Rhythm-Based Level Generator for 2-D Platformers," *IEEE Transactions on Computational Intelligence and AI in Games* 3, no. 1 (2011): 1–16, accessed June 16, 2022, http://ieeexplore.ieee.org/document/5648340/.

80. Ibid, 1.

81. Greyboxing is the act of mapping out a level using grey boxes instead of final artwork so that levels can be tested and iterated on quickly and efficiently without the lengthy process of creating and changing art assets.

82. My reasoning for this was based on the difference between 3D asset creation which requires 3D modeling, texturing and UV mapping, vs 2D asset creation which only needs a sprite/image.

83. Smith et al., "Launchpad."

84. A finite state machine is a computational model where a machine, in this case the player controller, is made up of one or more states. Only one state can be active at a time and so the machine must transition between these states based on set triggers.

85. Sylvester, *Designing Games*, 49.

86. Heinrich, "2D Platformer Controller - YouTube," Bardent, accessed June 15, 2022, https://www.youtube.com/playlist?list=PLy78FINcVmjA0zDBhLuLNL1Jo6xNMMq-W

While designing this template, I had several programming errors occur, and so to help me manage the elimination of these issues, version control[87] was implemented in the form of *Github*.[88] The introduction of version control was critical to the success of this prototype. With version control, I could overhaul sections of the project several times without consequence as I could always return to the previous save. This was instrumental for two main stages of production: The first was for iterating and updating large sections of the finite state machine code to produce a more modular template. Second, it proved invaluable for self-playtesting and iterating on greybox levels as I could restore previous level tests rather than deleting and recreating the levels.

With the template created, I began working on the audio design for the prototype. Because of the version control, if there were issues with the template, I could roll back the *FMOD* integration and continue working on the template without disrupting the audio files or effects, as these are all handled on the separate *FMOD* project.

The *FMOD* project for this prototype was very basic, using some recorded sounds and some placeholder sounds.[89] This integration aimed to test the new footstep controller, which would detect individual tiles on the tilemap[90] and play a corresponding sound. This design is a direct iteration of the original footstep prototype, remade for 2D (Figure 10).

With the template created, I used *Github* to create a new prototype based on this framework.

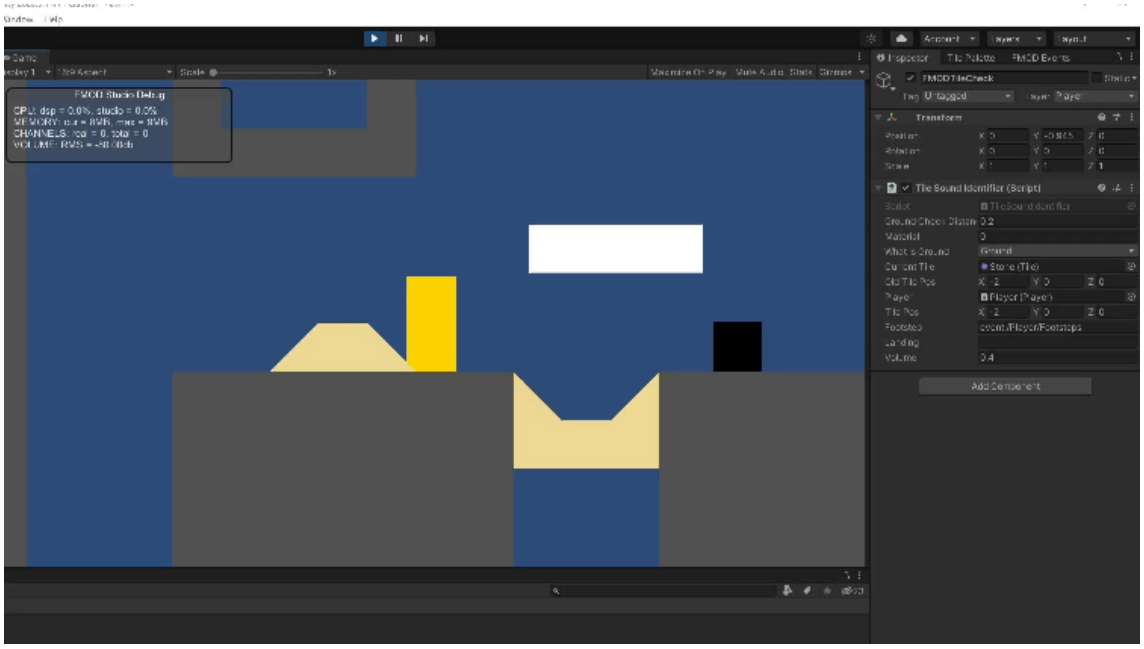


Figure 10: FMOD to Unity footstep audio controller working with 2D tilemap. Identifier script on right changes material parameter based on current tile's name.

87. Version control allows for the saving, and restoring of projects and their ascociated files. This means instead of creating a copy of my project everytime I worked on it, the version control software would upload my changes online where I could restore any previous save/version.

88. *GitHub*, Microsoft Windows (Microsoft, 2008), github.com.

89. Childs, *Creating Music and Sound for Games*, 20. Childs suggests creating prototypes as soon as possible with placeholder sounds.

90. Tilemaps, sometimes called tile graphics, are grid-based containers for individual tiles which make up a level. This is a modular design technique that was used to create large levels with minimal hardware requirements or artistic investment. Salmond, *Video Game Design*, 222.

Prototype 1: A Walk in The Woods

The above template was a successful prototype, and the next step was to begin ideating different games I could make with it. While I already had a wealth of reference games, most of these had been platformer games, so I decided to broaden the search. One of the games discovered through this search was *No One Lives Under the Lighthouse* (Sowoke Entertainment Bureau, 2020).[91]

No One Lives Under the Lighthouse appears to take some inspiration from the film *The Lighthouse* (2019),[92] with its level design and the themes of madness from isolation. The game visually seeks to replicate a *PlayStation 1*[93] style of rendering where the assets are low poly with pixelated rendering and textures. This art style complements the sound design as all the sounds are minimal and non-modulated,[94] leading to the decision to use pixel art for my prototype.

The sound design of the game inspired me to start with sound recording and atmosphere design. The atmosphere design is a layered soundscape of waves, wind, sea birds and the occasional horror sound effect. I planned to use similar sounds to test and iterate on the atmosphere controller, which would feature heavily in the production of this and future prototypes. Without access to a recording studio,[95] field recording became a focus of the research. Since I could not go too far from my house to find sounds, I used a public pathway in a nearby park as my recording site. This site had different pathway materials like concrete, gravel, grass and dirt, which could all be incorporated into my footstep audio. This site also contained a variety of different trees for recording wind, and the pathway led to a small bay where I would record waves. Unfortunately, this site was public, and there were many distracting sounds throughout the day and even the evening, such as cars or people walking the paths. Therefore, I had to experiment with different times, my original assumption being that after 10 pm would be late enough.

I conducted some atmospheric recordings and attempted to make some footstep sounds but quickly realised it would be easier to take one long recording of the experience and use that as a reference. I tried at 10 pm (Figure 11) and 3 am (Figure 12) on the same day.

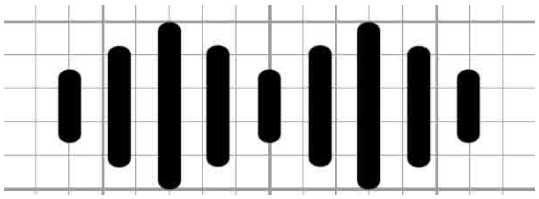


Figure 11: 10 pm sound test

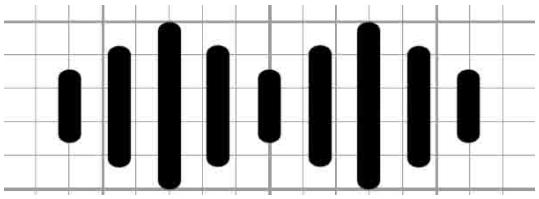


Figure 12: 3 am sound test

Recording this path at night gave me the narrative inspiration for this prototype: A Walk in the Woods, where I recreated the experience of walking down one of these paths at night. Once the sounds were recorded, they needed to be cut, equalized and levelled.[96]

To record the sounds of the wind through the harbour, I attached a windshield to the microphone and attempted to limit the amount of wind that would hit it by placing it inside a bag. This created a limiter effect where the high-frequency sounds of the wind could be heard without the low-frequency interference of the wind directly hitting the microphone (Figure 13).

91. *No One Lives Under the Lighthouse*, Microsoft Windows (Sowoke Entertainment Bureau, 2020).

92. Robert Eggers, *The Lighthouse* (A24, 2019).

93. Also referred to as PSX, this game console was release by Sony Electronics in 1994

94. Older games made for consoles rely on short, repeated sound files with few effects to save on memory.

95. This research began with the assumption that I would have access to the university facilities which were unavailable due the lockdown restrictions at the time.

96. Each sound file should have the same perceived volume or 'level'. Childs, *Creating Music and Sound for Games*, 72.

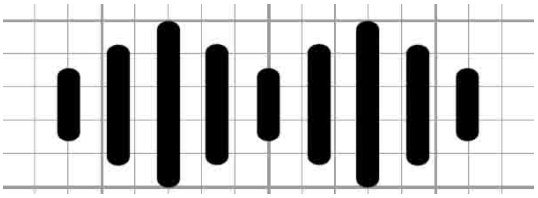


Figure 13: Sea wind recording

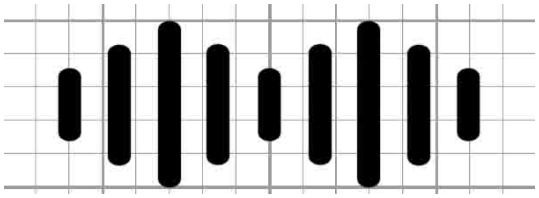


Figure 14: Wind from leaves

After experimenting with field recording and collecting enough sounds to create a simple atmosphere track, I started creating some sketches of my game level. This level plan would contain a strong audio transition, where the player would move from busy urban sounds to a forest scene and then a sea-side soundscape (Figure 15). Moodboards were created to assist with the visual style of the level.

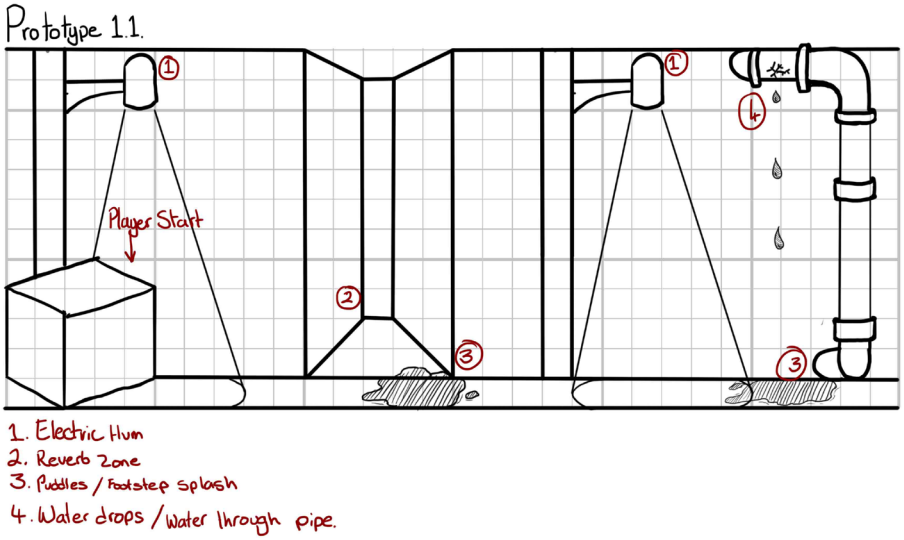


Figure 15: First level sketch

After designing a player character for the prototype, I decided to redesign the level and remove the transition element. I came to this conclusion after considering what was important for the prototype; the recreation of site through field recording.[97]

My plan with this level design was to explore verticality and create a level that has the player descending further and further down into some woods. I could then change the atmosphere design and add layers as the player descends. This downhill layout should promote caution, slowing the player down to get them to listen and engage with the environmental storytelling more (Figure 16).

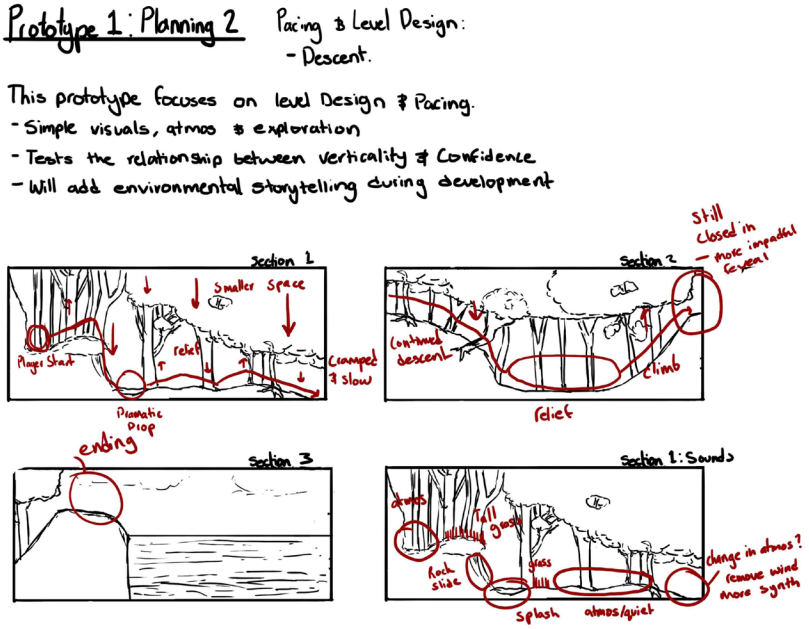


Figure 16: Developed level sketch

97. As discussed in the field recording section of the methods and methodology.

Figure 17: Images taken of the site where I recorded the sounds.

(Figure 17) shows the site which was used for this prototype. These images were also used as the inspiration for the prototype's visual elements. To work as efficiently as possible and have the option to reuse art assets for other prototypes, I used modular assets with a maximum of 8 colours (Figure 18). These modular assets would allow me to rearrange the level as I developed it and would help with performance.[98] When drawing the assets, a limited colour palette was employed to maintain the artistic style and speed up the process of recolouring the assets, should they be recycled and used in another prototype (Figure 18).

Figure 18: Modular assets

Figure 19: Atmosphere sound test.

98. An example of this in practice can be observed in the game *Hollowknight*. Team Cherry 2017.

With the first section completed, I began integrating *FMOD* into the prototype. *FMOD* became my main digital audio workspace for this project during this process. The library of effects included was sufficient and had the added benefit of being programmable with *Unity* scripting. Sound files in *FMOD* were controlled with parameters that would modulate the volume and which effects to apply for each track. This *FMOD* project was connected to Unity with an atmosphere controller script,[99] allowing me to master the audio as I played the game. This proved to be a significant discovery for this research. With linear sound design, such as designing the soundscape for a film or animation, I would need to return to the Digital Audio Workspace (DAW) every time I needed to make a change and re-export the audio. With this dynamic audio workflow, I would be able to 'playtest' sounds and make reflections on each element of the mix and iterate in response to these evaluations quickly and effectively, as I have done with the level design. I would continue to develop this controller as it would answer one of the goals of this research; developing game audio during production and working in a non-linear design environment.[100]

Prototype 1 Evaluation

This first prototype was a success audio-visually. However, through playtesting it was found that the minimal gameplay elements resulted in a lack of interest for the player. It was clear that for a working prototype to entice users long enough to test the effect of atmospheric sound design, it would need a level design plan with obstacles to challenge the player. The narrative of 'A walk in the woods' was also deemed too weak of a story and left little room for the development of environmental storytelling elements. Therefore, the next prototype would require a new level and narrative design.

Prototype 2

In order to create a new prototype that would avoid the previous pitfalls, I first considered the above evaluations and researched appropriate level design techniques in response to the revealed issues. The first issue with the original level design was scale. For level design to have any tangible effect on the player, it needs to be large enough that the designer can repeat elements and hint at what is to come. A key observation I made when returning to the case studies *Limbo* and *Darkwood* was the use of tutorials in the early parts of the game. Both games use the early sections of the level to allow the player to learn the game's mechanics. Introducing game mechanics one by one and repeating and combining them acts as gameplay padding to scale up the level and engage the player for longer.[101]

As discussed in the contextual review section, I applied the theory of interest curves to aid in conceptualising a new level and evaluating the previous level (Figure 20).

99. More information on the atmosphere controller can be found in the appendix

100. Discussed in the contextual review section

101. Mark Brown, Super Mario 3D World's 4 Step Level Design, 2015, accessed June 27, 2022, https://www.youtube.com/watch?v=dBmIkEvEBtA.

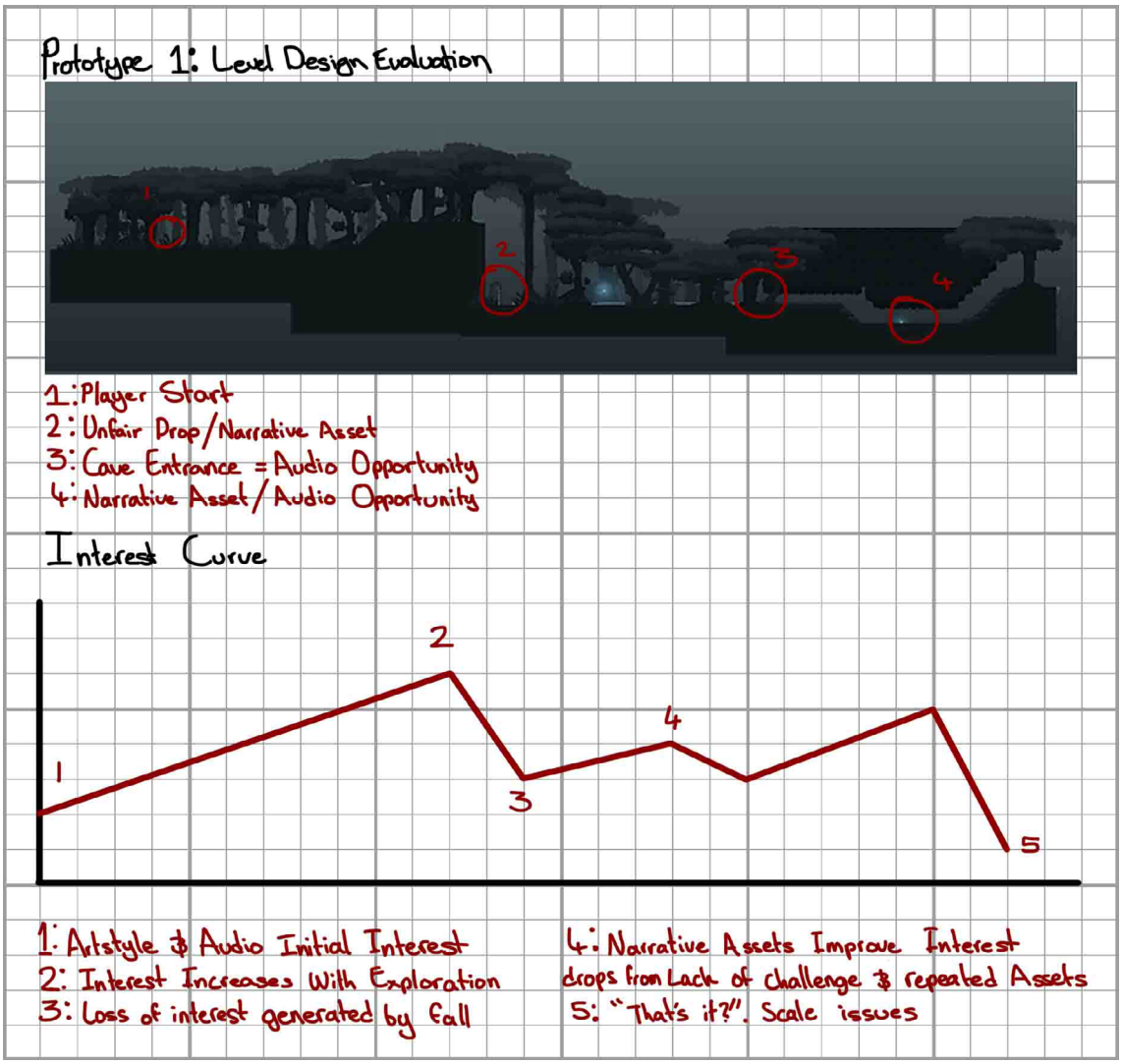


Figure 20: Prototype 1 evaluation with interest curve.

(Figure 20) demonstrates how the level design is flat and how unfair elements in the level can negatively affect the experience. This process of evaluation is subjective. However, the same process was used to create a new level design, starting with the intended experience curve (Figure 21).

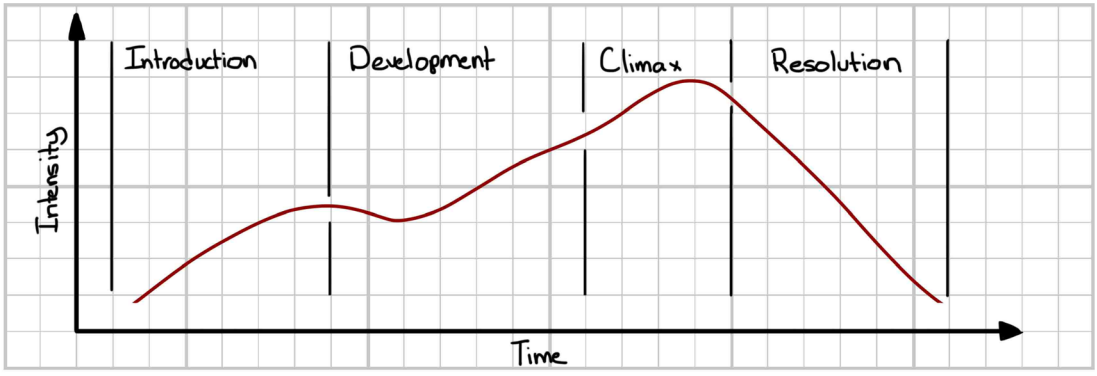


Figure 21: shows intensity (challenge) over time. This graph is used for evaluating narrative pacing in storytelling. I used this graph for my gameplay pacing, level design and narrative pacing.

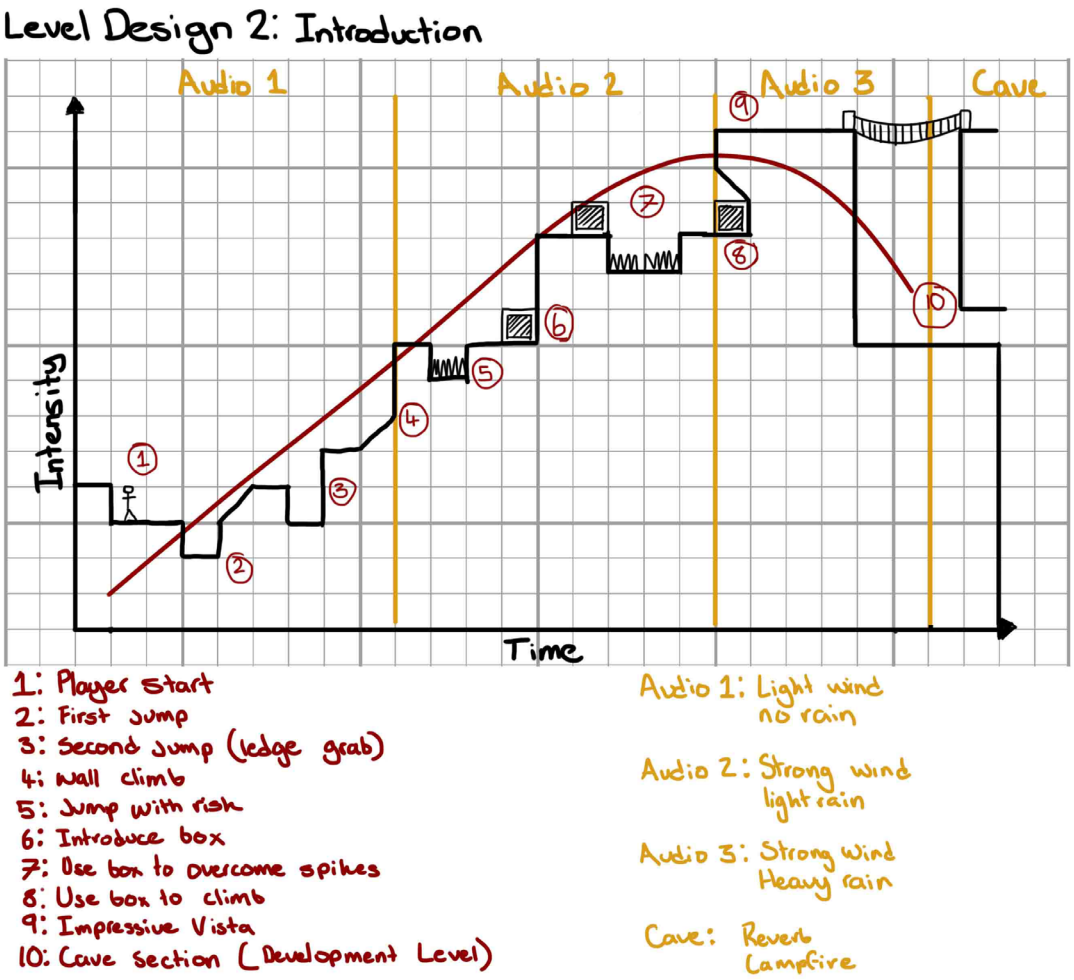


Figure 22: Level design plan using interest curve as a guide.

Through this process, I discovered that the narrative and level design would follow the same interest curve, which made selecting where to place environmental storytelling elements easier. This prototype would focus on the introduction stage of the curve, which narratively required a hook to draw in the player (Figure 22).[102]

The large establishing shot at the top of the level would act as a narrative hook, a goal for the player and a reward for completing the tutorial section of the level (Figure 23).[103] This early goal is important for keeping the player engaged, something the previous prototype failed to do. Based on the research I had undertaken throughout the development of this prototype, the narrative hook became a lighthouse, with the player character becoming a lighthouse keeper who is lost in the woods.

Figure 23: Rewarding vista used as a narrative hook and reward.

102. "Having a good hook is very important. It gives the guest a hint of what is to come and provides a nice interest spike, which will help sustain focus over the less interesting part where the experience is beginning to unfold and not much has happened yet." Schell, *The Art of Game Design*, 248.

103. I combined the two reward types, narrative exposition and rewarding vista for this goal.

The idea for a lighthouse and lighthouse keeper came from research into stories from H.P. Lovecraft,[104] and *No One Lives Under the Lighthouse*. The lighthouse also represented an attempt to create a 2D weenie[105] based on a demonstration of 3D level design techniques by game designer Peter Field.[106] For a weenie to work as an architectural landmark, the player needs to be able to see it frequently, to perceive the relative distance between where they are and where they need to be. This proved to be a challenge with 2D; while it was possible to manipulate the image of the lighthouse in 3D space to create a parallax effect, the lighthouse was still only visible in one section of the level (Figure 24).

The solution was to create an iconic sound associated with a lighthouse, a foghorn, and layer it through the level design. This way, the player will hear the lighthouse without seeing it (Figure 25).

The effect of this sound is two-fold, as described by composer Michel Cion:[107] Firstly, the repetition and attenuation of the sound give the player perception of the distance between them and the lighthouse, and the frequency of the repetition gives the player perception of time. Secondly, the sound is dramatic and orientates the player towards a goal with the expectation that they will discover the source of the sound.

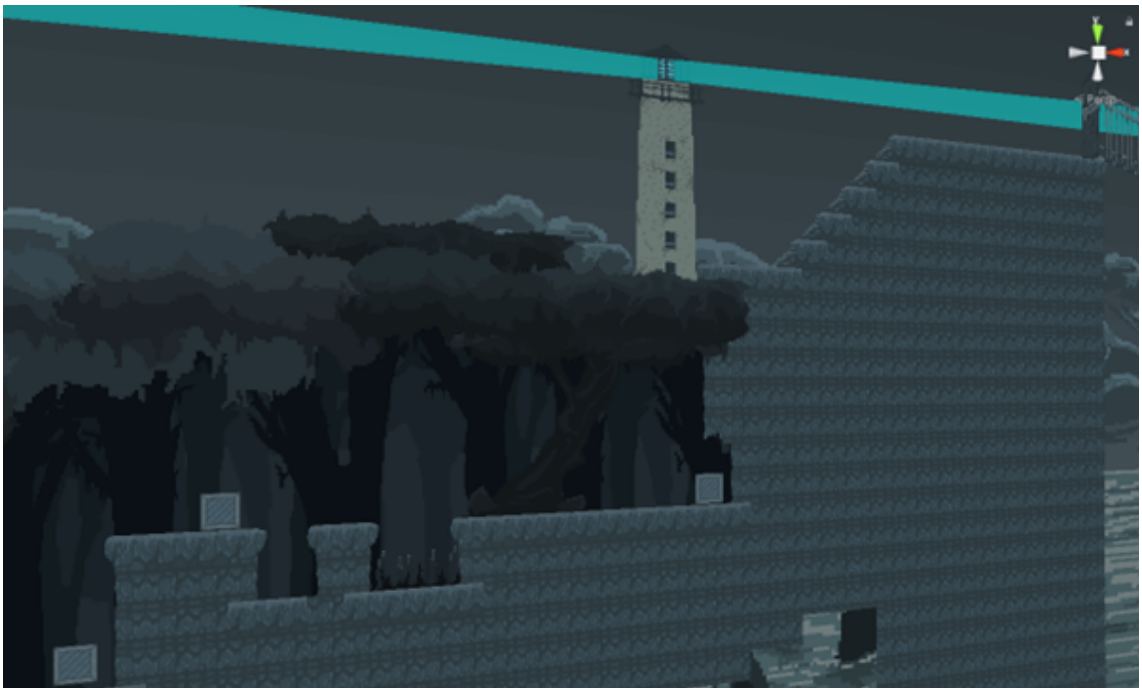


Figure 24: Lighthouse positioned on the Z-Axis creating depth and parallax.

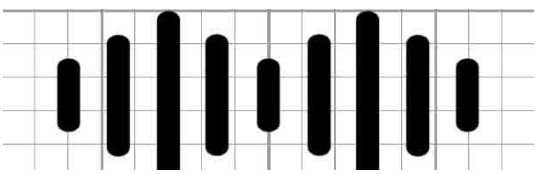


Figure 25: Foghorn audio, created in FL Studio. Inspiration / Reference: https://www.youtube.com/watch?v=iHCmzvzCmhI&ab_channel=JJJamieson

104. Stories include: *Dagon* (1919), *The White Ship* (1919), *At the Mountains of Madness* (1936).

105. The term 'Weenie' comes from Walt Disney. A weenie is an architectural landmark which is used to attract users to a goal, like an animal with a sausage (weener in the U.S.A). Totten, *An Architectural Approach to Level Design*, 136; Schell, *The Art of Game Design*, 289.

106. Peter Field, *Level Design & Environment Art Tips and Techniques from Peter Field*, Media Molecule (Into Games, n.d.), accessed June 14, 2022, https://www.youtube.com/watch?v=xN_dHI3Ibis.

107. Michel Chion, Claudia Gorbman, and Walter Murch, *Audio-Vision: Sound on Screen* (New York: Columbia University Press, 1994), 36-38.

Audio Controller Redesign

In order for the new audio design to be implemented, the current audio controller script would need to be overhauled as the current iteration of the controller could only support one audio zone. This new controller would allow for the dynamic mixing of all atmospheric sounds in the project relative to each audio zone. The player is still able to save the audio settings; only it now saves to each zone independently. When the player transitions between zones, the current audio event stops, and a new one begins, with the fade between the two events being managed in *FMOD*. In her book, *Game Sound*, Karen Collins highlights some of the challenges of working in a non-linear environment but also proposes that variability is essential to ensuring that game audio is more responsive to the player and to the narrative.[108] After reflecting on this, I included additional effects and parameters to the atmosphere mix, allowing for greater sound variation.

Some sound events were not part of the atmosphere event, like the campfire. Since I considered the audio controller a core part of this research, I investigated how I could link these sound objects to the controller User Interface (UI). I created an audio link script that was modular so that the same script could be used for each individual sound object. This script connected individual *FMOD* events to the main atmosphere controller UI. This link allowed for editing individual event parameters in-game but not saving.[109] To keep the UI for the controller minimal, I made the link script activate the controls for the separate events only when the event was playing.

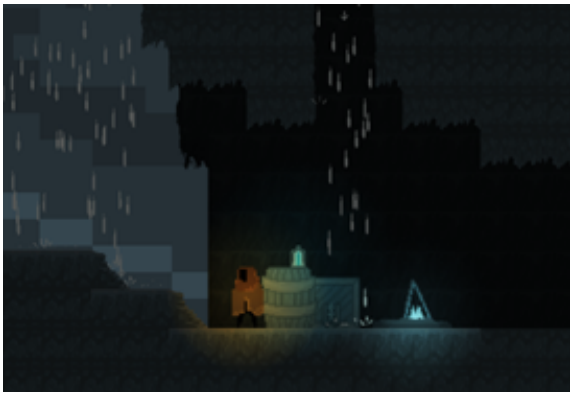


Figure 26: Cave entrance with environmental storytelling assets

Environmental Storytelling

With the creation of a story hook, I began to build on the themes of isolation and madness that were prevalent in the researched examples. I wanted to create assets that would further the narrative of a lighthouse keeper who is paranoid of something in the woods and disregards their duties, resulting in a shipwreck.

Through playtesting the new atmosphere controller, it was found that the atmosphere design would work to slow player pacing in certain areas, especially when combined with the foghorn. Reflecting on my own experience, I found certain areas of the level to be better suited to environmental storytelling elements due to this change in pacing from the audio design. One such example was the area outside the cave where the rain sound fades, and the campfire can be heard (Figure 26).

Originally, I had a collection of supplies further inside the cave (Figure 27) until I made this discovery and moved them so that players who stopped and listened to the rain and campfire would have a narrative reward. The campfire and the supplies should encourage deeper thought; who brought all of these supplies into the cave and lit a campfire? The campfire is still burning, so it must have been someone recent, and there are bear traps among the supplies. These are the type of questions that I have tried to encourage through the design and placement of these assets. The addition of lighting helped emphasize the importance of these assets.

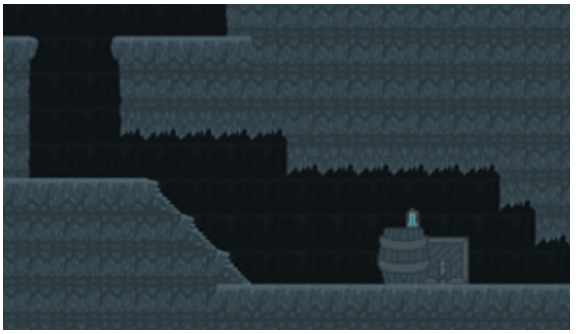


Figure 27: Original supplies location before moving to cave entrance

108. Collins, *Game Sound*, 147.

109. This feature can be included in the controller but is not within the scope of this research.

The hazards were changed to further the themes of paranoia and bring continuity to the bear traps among the supplies. Initially, the level used generic spikes to challenge the player (Figure 29). These were changed to bear traps as they made more narrative sense to be in the forest and reflect the lighthouse keeper's paranoia (Figure 28). The audio would also be changed, and I found the result more impactful through testing (Figures 30, 31).

With playtesting, I also found that where players start would significantly impact how they play.[110] I changed the player's start position from the middle of the forest to inside a small cave surrounded by empty bottles. Another collection of supplies was added to the entrance of this cave as well. The observant player should notice the bear trap and be cautious when moving forward.

Michael Nitsche suggests in their book *Video Game Spaces* that there is a connection between narrative and space and that the character's placement is important for this relationship to be effective. By moving the player into this cave area, they are given a safe space which they are asked to leave to explore the level and explore the narrative.[111] This decision also allows players to orient themselves to the level and controls before being asked to overcome any challenges.
The placement of these assets should be enough for the player to begin to piece together a narrative. Through playtesting, I found that placing these assets in the areas with the best audio improved engagement by rewarding the player with narrative and sonically engaging sites.

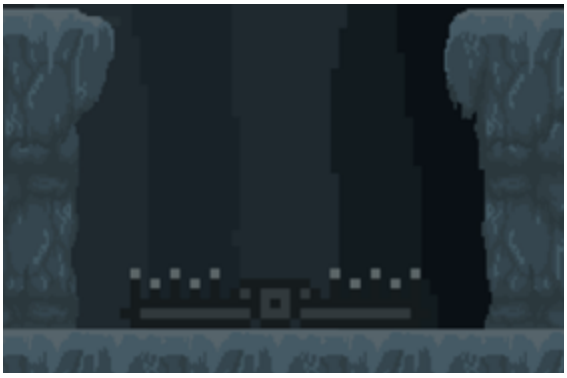


Figure 28: Bear trap asset

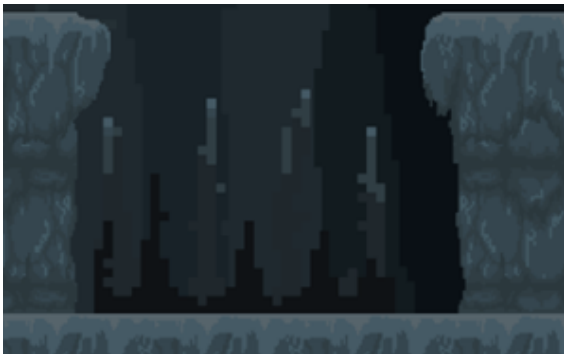


Figure 29: Spike asset

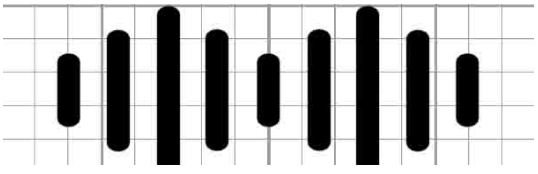


Figure 30: Bear trap audio

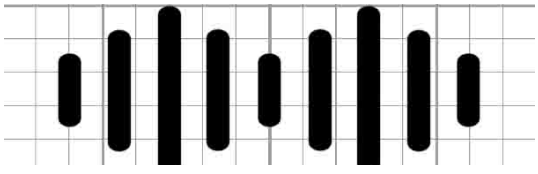


Figure 31: Spike audio

110. Scott Rogers, *Level up! The Guide to Great Video Game Design*, 2. ed. (Chichester: Wiley, 2014), 359.

111. Michael Nitsche, *Video Game Spaces: Image, Play, and Structure in 3D Game Worlds* (Cambridge, Mass: MIT Press, 2008), 45.

Conclusion

Through the development of the game prototypes central to this research, this project offers the potential to be useful as a guide for game designers who wish to incorporate audio as a tool to further player engagement and make meaningful design choices when planning sounds. Despite focussing on implementing *FMOD* into *Unity*, the same principles outlined in this research should apply to other game design and audio software. The final prototype uses sounds recorded on-site, and the visual elements reflect this inspiration creating an audiovisual connection. These atmospheric sounds immerse the player in the virtual world. The use of particular sounds, like the foghorn, adds narrative context to the level and generates interest as the player explores. The process of designing audio alongside game features in an iterative design environment has helped me to build on the non-linear audio design pipeline generated from the case study research. Developing sound while working on gameplay, generated ideas for levels, mechanics, and visuals and was integral to the success of the artefacts. It produced a narrative direction for both prototypes that would not have been discovered if the sound design had been left until post-production. The creation of the final prototype revealed that atmospheric sound design could impact player pacing when it is combined thoughtfully throughout the level design process. As a result of this pacing change, players are more likely to engage with narrative elements. The success of these prototypes can be attributed to the correct application of the chosen methods during the making procedures. I believe this research successfully answered the research question and achieved the research goals by producing a game audio pipeline for other designers to build on and creating a level that represents a site audiovisually. The creation of these prototypes and the research that inspired them has expanded my knowledge and prepared me for future research inquiries and creations.

While I believe this research was successful in answering the research question, there is always room to iterate and develop. Therefore, for future research, I think playtesting should be separated from prototyping as a method and include multi-disciplinary users for accurate evaluations. Further research could also incorporate a larger game world to fully realise the potential of pacing and its relationship to level and sound design.

This research will form the basis for further exploration into the connections between site, level and narrative and potential investigations into other narrative delivery and audio types such as dialogue and music. Sound design should be recognised as an effective tool for game designers, and this research hopes to inspire future makers to utilise it effectively in their work by incorporating it into their production pipelines. It is believed that the inclusion of sound in early development cycles results in a more thoughtful execution of sound design decisions, which results in enhanced narrative delivery and experiences for players.

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Appendix

Below are areas of sound and game design that were researched during the early parts of this research. The investigations into these topics have influenced the making process and overall outcomes however they lost relevance as the goals of the research evolved. I have also included a short explanation, with images, of how the audio controller was implemented in the final project.

Sound Spatialisation

I conducted research into game sound spatialisation as a result of the early experiments, the goal of which was to find a genre and perspective to work with. I found that many theorists regarded the 3D first-person perspective to be the most immersive for sound design. When there is a player character on screen there is a separation between the player and player character.[112] Through my own experimentation I found this perspective to be the easiest to prototype and iterate with, and so for a future enquiry, I would return to this spatialisation research and explore 3D audio more with a first-person perspective.

Audiovisual Dissonance

When designing the audio for this prototype, it was important to consider what rules exist for game audio. As with games, it is sometimes easier to investigate what makes something bad rather than what makes it good. In this case, *About the sound of Bananas – Anti Rules for Audio Game Design*[113] provided a good starting point. The article describes how a "grand challenge in audio game design is the sonification of objects" and how the game experience can be greatly affected by audiovisual dissonance; this is when the audio does not reflect what the user perceives visually. The example presented in the article is when the sound of a banana is represented by "the jingling of a bell and a piano tune."

Michel Schion describes this further, describing it as an audiovisual counterpoint.

> "Audiovisual counterpoint will be noticed only if it sets up an opposition between sound and image on a precise point of meaning. This kind of counterpoint influences our reading, in postulating a certain linear interpretation of the meaning of the sounds."[114]

Knowing this, we can use this audiovisual counterpoint to create audio stereotypes:

> "counterpoint reduces our reading to a stereotyped meaning of the sounds, drawing on their codedness (seagulls = seashore) rather than their own sonic substance, their specific characteristics in the passage in question."[115]

This research helped me when recording sounds and deciding what sounds would need to be included for each zone. For the forest, I knew that the player would expect the sounds of trees and wind. The player would see every object in the game an have an expectation as to what it would sound like and so it was important to record and implement audio that would fit relative to this expectation.

Emotional Engineering

While researching the effects of sound design on the player, I found myself leaning heavily on affect theory as an effective tool. My assumption was that affect theory would be able to explain what was happening to players emotionally when they listen to a particular sound. This research enquiry proved too broad for the scope of this research and so was refined into the theory of Flow which had more relevance in the research. However after researching into flow more it became apparent that flow was the same as affect theory and was a term often used wistfully to explain complicated ideas. Therefore, my research into affect and flow theory was removed in favour of the more useful terms, player incentives, motivations and goals.

112. Shaw and Warf, "Worlds of Affect.", Collins, Game Sound.

113. Urbanek, Fikar, and Guldenpfennig, "About the Sound of Bananas — Anti Rules for Audio Game Design."

114. Chion, Gorbman, and Murch, Audio-Vision.

115. Chion, Gorbman, and Murch, Audio-Vision.

FMOD – Unity Audio Controller

Below are images showing how the audio controller works.

The level is separated into audio zones (colliders) which each have their own scriptable object which controls the parameter values.

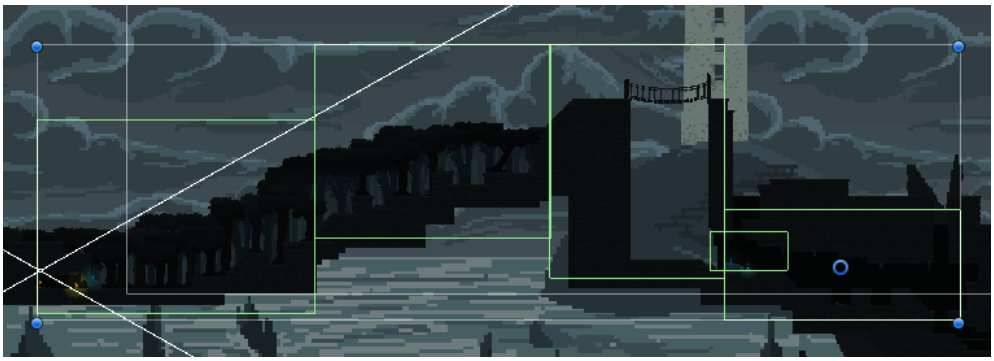

Figure 31: Audio zones in level

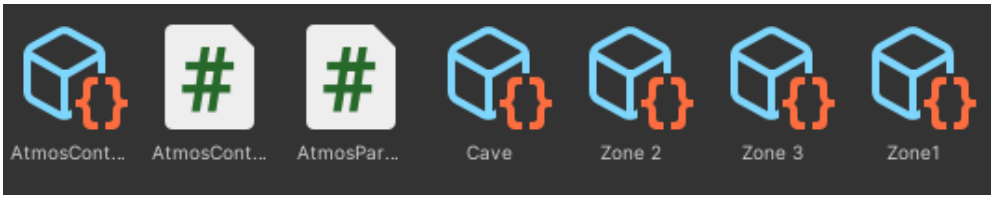

Figure 33: Controller objects for each zone

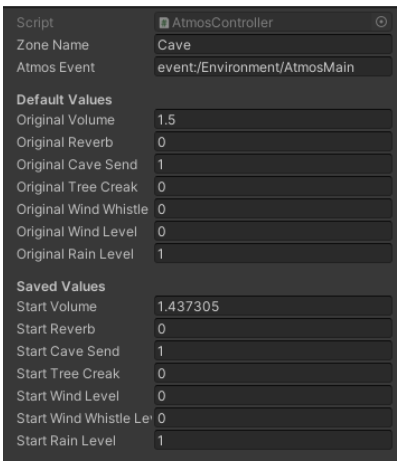

Figure 34: Controller object options

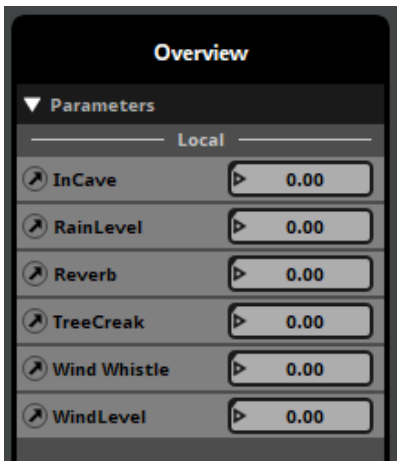

Figure 35: FMOD Event parameters

These parameters link to the ones in the FMOD project and the UI allowing for live edits. I have also included the FMOD event linker which allows for individual FMOD events with parameters to be attached to the UI.

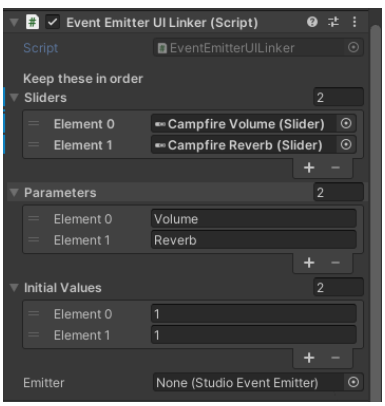

Figure 36: UI Linker script

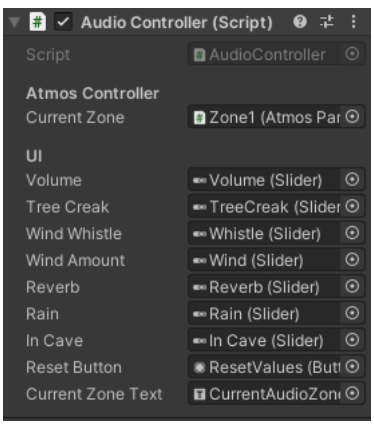

Figure 37: Audio UI Manager