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Recapture: A Virtual Reality Interactive Narrative Experience Concerning Perspectives and Self-Reflection

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RECAPTURE: A VIRTUAL REALITY INTERACTIVE NARRATIVE EXPERIENCE CONCERNING PERSPECTIVES AND SELF-REFLECTION

by

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ABSTRACT

This project presents a virtual reality (VR) Interactive Narrative aiming to leave users reflecting on the perspectives one chooses to view life through. The narrative is driven by interactions designed using the concept of procedural rhetoric, which explores how rules and mechanics in games can persuade people about an idea, and Shin's cognitive model, which presents a dynamic view of immersion in VR. The persuasive nature of procedural rhetoric in combination with immersion techniques such as tangible interfaces and first-person elements of VR can effectively work together to immerse users into a compelling narrative experience with an intended emotional response output. The narrative is experienced through a young woman in a state between life and death, who wakes up as her subconscious-self in a limbo-like world consisting of core memories from her life, where the user is tasked with taking photos of the protagonist's memories for her to come back to life. Users primarily interact with and are integrated into the narrative through a photography mechanic, as they have the agency to select "perspective" filters to apply to the protagonist’s camera from which to view a core memory through, ultimately choosing which perspectives of her memories become permanent when she comes back to life. This project hopes to provide an example of effectively applying procedural rhetoric to a VR interactive narrative so that future interactive narrative designers can further apply and explore how procedural rhetoric can work with immersion techniques to create compelling and immersive VR experiences.

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INTRODUCTION

Today, virtual reality (VR) is one of the most emergent technologies being explored in the realm of storytelling, whether it is through VR film, VR games, or VR interactive narratives. The focused goal of VR storytelling is "to tell a story that will stimulate emotions that will influence action" [1]. Concepts such as immersion, presence, empathy, and embodiment are often assumed to be inherent to VR technology, and in the context of VR storytelling, the driving forces stimulating a user's emotions and consequently actions. Immersion, in particular, is a defining term used to describe fully immersive systems such as head-tracked displays, or headsets. "With novel affordances such as multisensory inputs and naturalistic control of point of view, immersive virtual environment technology (IVET) allows for a literal demonstration of climbing into another person's skin to embody his or her experiences first-hand" [2].

While VR devices do allow users to visually, audibly, and sometimes even tangibly enter another world, Hamari and Trentini suggest that immersive interfaces alone do not necessarily enhance a user's sense of engagement or satisfaction [2]. When designing and developing a story experience for a VR platform, the narrative elements and intentions of storytelling bring another dimension into the creation and design of the VR story. The features of VR, such as immersion or empathy, need to be further explored and reconsidered within the context of VR storytelling, especially if the story has a desired emotional output, intent, or underlying message.

What, however, makes a story told in VR truly immersive? And what role does immersion play in influencing how users experience the VR story? In recent years, key findings have established the importance of immersion in VR story experiences mainly comes from user cognition, rather than being pre-embedded within technological properties or existing entities

[3]. Essentially, the value a user places on a VR story, and thus how strongly users immerse themselves in a VR story, is largely dependent on the individual trait's users bring to the VR experience. These individual traits can be referred to as cognitive processes that occur or appear when experiencing a VR story, and ultimately how users empathize and embody VR stories [1]. Shin derived a cognitive model that can be applied to VR stories that are specifically directed at user motivations and attitudes [1].

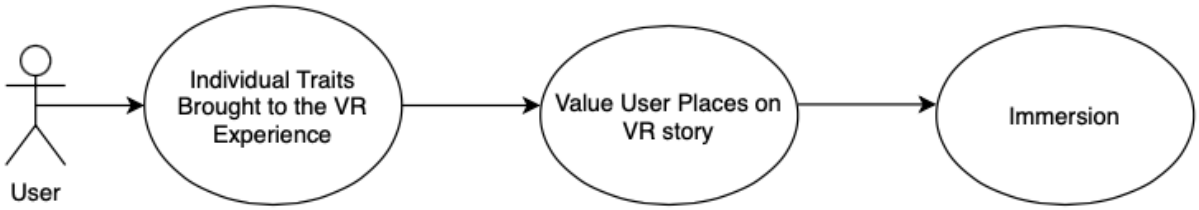

Fig. 1: Flow of events generating immersion in VR stories based off Shin's cognitive model [1]

In tandem to Shin's cognitive model, the game design concept of procedural rhetoric can also be used to address the challenge of making immersive VR stories users' value. Procedural rhetoric explores how rules and mechanics in games can persuade people about framing an idea [4]. The concept ties directly into Shin's cognitive model, which supports that effective immersion is largely dependent on the individual trait's users bring to the VR experience. Using the concept of procedural rhetoric in parallel to Shin's cognitive model, *ReCapture* was designed—a VR interactive narrative motivating users to recapture a protagonist's core forgotten memories through photography and with the expressive goal to influence users to reflect on the way we choose the perspectives we carry through life, often redefining our character and actions.

LITERATURE REVIEW

Since *ReCapture* aims to elicit a specific emotional response output from users, research focused on the VR storytelling field at large. Topics such as current design challenges in VR storytelling and how research or applications have responded to those design challenges were reviewed to better understand the current state of VR storytelling and best practices to consider when developing a VR story. To develop meaningful mechanics tying into *ReCapture's* narrative, procedural rhetoric was researched, in addition to a review of existing photography-themed interactive experiences on extended reality platforms in order to note the differences and contributions my thesis project can bring to the existing library of VR photography-based experiences.

Design Challenges & Recommendations in VR Storytelling

One of the most significant challenges in VR storytelling is understanding how users feel about the stories they experience in VR and the role immersion plays in influencing the meaning or value a user assigns to a VR story. A lack of understanding user experiences and the role immersion plays in VR stories results in less effective user-focused interaction and interface designs for VR stories that could trigger users' sense of empathy and embodied experiences [1]. Embodiment in VR creates the sensation of personally having the VR experience [1], while empathizing can "help to more strongly combine VR and physical reality, thus producing higher credibility" [19]. The ambiguous nature of the term immersion [20] was a key component to research in considering these challenges.

In order to understand the significance of immersion in VR storytelling and its

inclusion as a design feature in *ReCapture*, my research focused on Shin's cognitive model. Shin's cognitive model is a theory that provides key design considerations addressing current challenges in VR story design, particularly that of the ambiguous nature of immersion. Applying the model, Shin found that the importance and definition of immersion in VR story mainly comes from individual traits and experiences users bring into the VR story, rather than VR technology [3].

The model is a theoretical two-tiered process of immersion comprising presence and flow, which Shin considers are elements generated by the technology, and thus experienced by users in the first place, and then empathy and embodiment [16], which are selectively experienced by users, and based on the quality of experience [1]. Significant to this theoretical model is how flow may link the technological and the emotional individual. Flow is "experienced when an activity's challenges fully engage a user's skills without overwhelming them" [1]. The consequence of the theoretical cognitive model is engagement [1], or the meaning and value a user generates for the VR story.

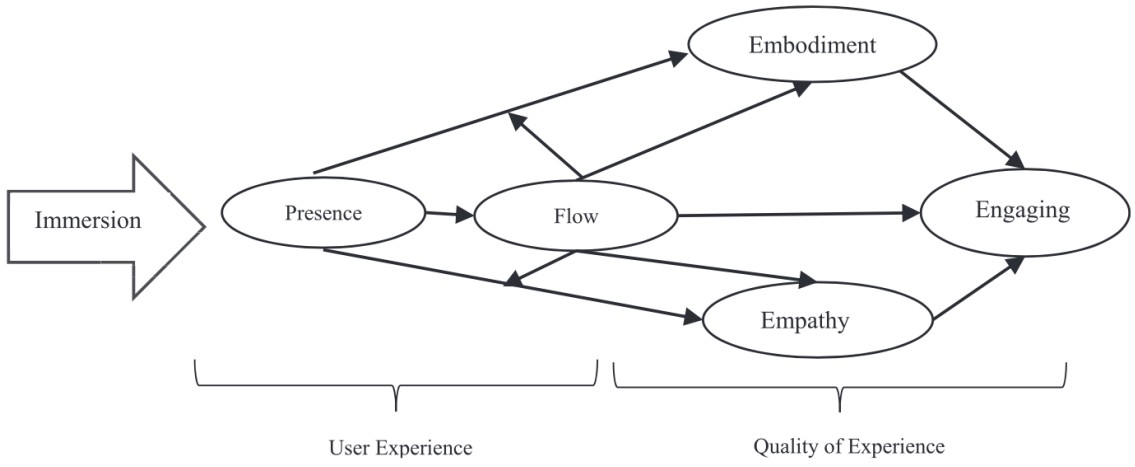

Fig. 2: Shin's two-tiered process of immersion [1]

Overall, Shin's cognitive model can be described as an all-encompassing and dynamic definition of immersion. You can have a VR story experience presented through universally accepted "immersive" technologies, but users make and bring meaning or value to that experience based on their personal traits and individual experiences. Keeping user traits and experiences in mind can help in designing VR story elements familiar to users, triggering them to bring in their individual traits and experiences into the VR story, thus achieving immersion. In understanding this, mindful interactions and narrative can be designed in an open-ended way allowing space for the user to naturally bring as much of their individual traits to the experience and interactions.

Additional recommendations taken into consideration include Brenda Laurel's, author of Computers as Theater, who recommends designing "cues and affordances that encourage the participant to make dramatically interesting choices" [5]. When a participant is "engaging in an immersive virtual world with various affordances and themes", they are essentially creating "a story, or many stories, by traversals of the world" [5]. Laurel also recommends including spatialized audio, natural gesture and movement, and the principle of action, or a participant's "ability to take action in the world and perceive the effects" [5]. This principle of action touches on a sense of personal agency that I wish to inspire in users of *ReCapture*, in order to influence a sense of self-reflection as users carry out the narrative through provided mechanics and interactions.

Interactive Narratives in Virtual Reality

An interactive narrative is "a form of digital interactive experience in which users create or influence a dramatic storyline through actions… such that he or she believes that they

are an integral part of an unfolding story and that their actions can significantly alter the direction and/or outcome of the story" [6]. At its core, *ReCapture* is more of an open-ended exploratory narrative and environment, reminiscent of a museum gallery space. In my literature review, there was limited research published on specific Interactive Narrative Experiences in VR. Most content on this topic was the actual Interactive Experience instead of the research and intention that went behind developing it. I did, however, come across a capstone project grounded on narratives in VR. *Imagine Trees Like These* is a VR narrative concerning forests, futurity, and ephemerality that explored questions for what is possible with narratives when new technologies become available. The capstone focused on VR technology and "how its immersiveness can help (participants) navigate complex and abstract narrative" [7]. This research touched on ways to use actual physics to introduce symbolic elements into the narrative, motivating reflection on nature by developing interactable and animated trees as a proxy for the idea of nature. It demonstrated how surfaces in virtual environments can be designed to be a part of telling the story, especially if the narrative itself is more abstract and indirect. This project inspired me to look at *ReCapture* in a new light, motivating many of the technical advances of the thesis. Specifically, to make greater use of symbolism and integrate it within surfaces and interactions in *ReCapture's* narrative, leading me to game design concept of procedural rhetoric to serve as a design guide for symbolic mechanics and interactions.

Procedural Rhetoric & Meaningful Mechanics

Because *ReCapture's* narrative aims to elicit a desired emotional response from users, particularly that of reflection on perspectives, procedural rhetoric was used as a guiding design principle in *ReCapture*. Ian Bogost first coined and defined the concept of procedural rhetoric as the art of persuasion through rule-based representations and interactions rather than the

spoken word, writing, images or moving pictures [8]. In games implementing procedural rhetoric, rules and processes are the primary means by which they communicate meaning. The situation involves a designer that intentionally encodes or creates a system that generates meaning, and it's up to the player to complete this meaning by interfacing with the system. A simple example is the adventure game Journey, a game that improves a players' abilities to leap in the presence of others in comparison to when the player is alone, in turn reinforcing its themes of unity and togetherness.

Teresa de la Hera and Joost Raessens consider persuasion in interactive experiences more broadly, suggesting that "persuasion through digital games is not only reduced to procedural rhetoric and that the persuasive options are multiple" [9]. In their breakdown of how to design persuasive games efficiently, they suggest designers to consider the following from users and players: 1) the different levels of player resistance and 2) prior knowledge of the topic being covered in a game [9]. This consideration results in three persuasive goals they believe games may try to achieve: shaping, reinforcing, or changing the attitudes of players. The goal of reinforcing attitudes in players aligned most with *ReCapture's* expressive, "persuasive" goals, considering that many people, whether intentionally or not, do already have established perspectives from which they view life through. All *ReCapture* aims to do is trigger a space or sense of reflection of these intentionally or not intentionally established perspectives. In the case of designing games or interactive experiences to reinforce existing attitudes, de la Hera's and Raessens's recommendations are to design a game experience in which the game goal and the persuasive goal are "somehow related to each other, even though they do not overlap" [9]. An example of this can be seen in the game *Papo & Yo*, a "3D puzzle-platformer driven by a story that allegorizes what it means for a child to grow up with an

alcoholic father" [9]. The persuasive goal is to help players understand there is nothing a child can do alone to prevent the damage an alcoholic parent can cause, accomplished through mechanics that require the player to receive help from other characters that allows the game protagonist, and thus the player, to "jump across gaps that are otherwise too wide for him to overcome" or who provide guidance on the protagonist's journey [9]. The game goal is to guide the game's protagonist, Quico, on "a quest to find a cure for his best friend, Monster, a gentle, fruit-consuming giant that transforms into a recklessly violent behemoth after he consumes his favorite snack, frogs" [9]. The only issue is, Quico will never be able to protect himself from Monster alone whenever he does transform into a "violent behemoth", and thus has to find characters that can help him [9]. This is where the persuasive goal and the game goal intertwine. This game is an example of how narrative and visual elements are used to frame a message expressed through procedural rhetoric is perceived by users or players. *ReCapture* aims to do something similar, with an abstract interactive narrative, non-hyperrealist visuals, auditory cues, and tangible interfaces.

Photography-themed Interactive Experiences in Extended Reality

Keeping in mind meaningful mechanics, a list of both VR and AR games or interactive experiences where photography was a core aspect were compiled and researched. This list contains interactive experiences with a camera and photography aspect technically and narratively implemented in different ways.

Photogeist is an augmented reality (AR) game in which "users use a physical handheld camera device to take pictures of floating virtual ghosts" [10]. The design thinking that went into *Photogeist* was focused on the game's interface, or "the link between the game and the

player", and how the interface can be "just as important as the content itself when it comes to creating an engaging, entertaining experience" [10]. The game's camera mechanic interface is developed to be intuitive for first-time players, as photography is considered "common knowledge" to most [10]. Overall, *Photogeist* promotes utilizing novel interfaces in order to create enjoyable games that will engage users or players to continue playing [10]. This application is an example of a photography being implemented within a ranking system, in contrast to *ReCapture's* more open-ended, non-ranking, and exploratory interactive narrative.

Caves RD Interactive published a series of exploration and photography VR game experiences based on different nature-themed locations around the world, such as Mýrdalssandur, Iceland, Fushimi Inari, and Wakarima Valley, NZ. For each of the experiences, the narrative is open-ended and exploratory based, without any additional motivators to remain in the game other than to explore the environment and take pictures. To keep players interested in the game, effort was focused on detailed environment design, creating "realistic, densely forested scenes using photo-scanned 3D assets that could run smoothly in real-time" [11]. Notable is the implementation of the camera mechanic. In the *Wakarima* and *Mýrdalssandur* VR experiences, users can use their hands to capture a photo by forming a rectangle with the index finger and thumb from each hand, entering a visual "Hand framing" screenshot mode. The frame shaped by the hands can be extended or narrowed, accomplished using hand-tracking capabilities of compatible VR headsets. In contrast, the *Fushimi Inari* VR experience provides users access to the camera mechanic through a VR headset's hand controllers, where input triggers can be processed in order to take a photo. Within the rendered environment, the left controller is rendered as a typical VR hand controller, while the right controller is rendered as a DSLR camera. When the user brings the DSLR camera up to their face, they begin viewing the

environment through a camera lens and have entered a mode where they can take pictures [12]. All VR photography and exploration experiences published by Caves RD Interactive also allows teleportation and locomotion movement options.

I also reviewed *Magic Hour,* a "VR app designed to be a new experience of photography" [13]. The experience allows players to wander through a virtual world and adjust camera and lens settings. The intent of Magic Hour was to get users understanding and learning "how certain shutter speeds, apertures, and ISO values affect the aesthetics of an image" [13]. The camera mechanic is implemented as a separate window acting as a square shaped "live view display within the virtual world" [13]. A player can use both controllers to interact with the live view display through which they can angle the direction of the camera, zoom in and out, modify aperture, shutter speed, and exposure using sliders, and select the picture to be taken. As far as the narrative in Magic Hour, there was nothing direct and clear-cut. Magic Hour simply provided users an environment with various objects and scenes without narrative meaning to explore and take pictures of.

Lastly is *VR Photo Jam,* a VR game that transports players into the shoes of an action sports photographer stationed in a skate park where they can teleport around to find ideal angles to capture photos of skaters performing tricks on a halfpipe [14]. Photographs taken by the players are scored based on timing, framing, and subject position. The game's camera mechanic is implemented similarly to Caves RD Interactive's Fushimi Inari VR Experience, where the player raises a hand controller rendered as a camera in the virtual environment to their face and the game switches to a camera viewfinder mode.

This list of games and interactive experiences provided insight on how the act and

concept of photography has been implemented in games today, specifically made for the Extended Reality platform, which includes VR and Augmented Reality (AR). For a majority of VR games and interactive experiences related to photography, not much is invested into the experience in terms of narrative. The intention of a majority of these experiences aim to teach photography skills or straightforward, but engaging game applications with point systems. Since my thesis focuses on enhancing narrative through more meaningful game mechanics and environment design connected to the story, I will be contributing an interactive narrative with unique elements not present in the existing library of Photography-centered interactive experiences for VR or AR platforms.

RECAPTURE CONCEPTUAL DESIGN

The following discusses the narrative of the VR experience, the interactive controls and mechanics that allow users to interact with *ReCapture's* narrative and world, and each of the core scenes the user has to visit in *ReCapture.*

Narrative Overview

In *ReCapture*, the narrative's protagonist is an 18-year old girl named Luna who has suffered a tragic, unknown accident putting her in a limbo-like state between life and death. The narrative begins with Luna awakening in a minimalistic, sort of "limbo" world, not yet dead but also not alive. This limbo-like space is representative of Luna's subconscious, housing isolated, character-defining scenes and memories from her life spread out among the world environment. Luna is welcomed into the world by a small, astronaut-looking character called Astro that will serve as Luna's guide through this limbo-like world. Through Astro, Luna realizes she remembers little to nothing about her life. Astro tells Luna that in order to fully come back to life and awaken from this "limbo"-like world with her lost memories intact, she must take pictures within the three memory scenes spread out amongst the limbo-like world in order to recapture her memories. Before moving on, Astro gives Luna a special camera that contains three sets of emotionally themed filters corresponding to the three memory scenes, appearing and changing only when Luna arrives at a filter set's corresponding memory. With this special camera, Luna traverses the limbo world environment looking for the three memory scenes to take pictures in, using the filters to decide how she wants to remember, or "recapture", her memories. Once Luna visits the three memory scenes and takes pictures in

each, she can return to the memory orientation room she woke up in and look through a Photo Gallery of the pictures she took, confirming with Astro that these photos are the perspectives of her memories she wants to have become permanent, and ultimately form her character when she comes back to life.

Interactions and Mechanics

Users experience *ReCapture's* narrative in first-person, through the eyes and shoes of Luna, the narrative's protagonist. As *ReCapture* is an interactive narrative, the user drives Luna's narrative through interactions with the limbo-like world. Certain interactions in *ReCapture* are conditional, based on where the user is in the narrative, positioned in the world environment, or even where their hands are positioned, meaning that interactions bound to specific inputs will only be triggered when a condition is met that activates those specific inputs. In the following paragraphs, I go over *ReCapture's* core interactions and mechanics, and how and when they can be processed and triggered.

Dialogue System

Narrative dialogue interactions in *ReCapture* occur in two different ways depending on where the user is in the narrative. At the beginning of the narrative, when the user wakes up in the limbo-world's memory orientation room as Luna, they will be met with Astro, the only interactable character in *ReCapture*. Astro will be floating idly, with a circular and glowing visual effect at their feet to catch the user's attention. Astro automatically begins the narrative approximately 1 second after the *ReCapture* application begins. Much of the narrative is expressed using text that sticks to the bottom of the VIVE headset screen. Each line of Astro's introductory dialogue text will appear on the screen a certain number of seconds before moving on to the next line. Using this text, the user's attention will be directed towards Astro, whose

introductory dialogue serves to explain Luna's situation, the limbo-world she's arrived in, and the steps to take in order for Luna to come back to life, motivating users to move forward into the narrative.

Throughout the remainder of *ReCapture*, Astro will appear again at each memory scene the user arrives in to give context to the user about the presented memory relative to Luna's life. When the user is in a memory scene room environment, instead of narrative dialogue automatically appearing, the user will have to interact with Astro by clicking the left-hand controller "X" Button input to generate Astro's dialogue.

Traversal Mechanics

ReCapture has two mechanics allowing user movement around the environment: walking and teleportation. In order to walk around the environment, users will use the left-hand controller Joystick input in order to walk forward in the direction they are facing. Using best practices for walking and smooth locomotion, the walking mechanic limits user's to walking forward, and not left, right, or backwards.

In order to teleport around the limbo-world environment, users will click the left-hand controller Trigger input. With the teleportation mechanic, the user will be restricted to teleporting to pre-determined areas marked by a flag. Since the environment design concept of the limbo-world environment was largely inspired by moon and space themes, flags serving as markers or signals that a significant memory scene to explore was nearby seemed fitting. The flag markers and teleportation make it easier and faster for users to traverse to the spread-out memory scenes in the limbo-world environment.

Camera Mechanic

To traverse the scenes of this limbo space and carry out the narrative, the user will have a camera at their disposal accessible through the right-hand VIVE controller. This camera mechanic is the most involved and central to the narrative, consisting of two different interactions: taking photos and shifting through filters corresponding to specific memory scenes. The camera will have an inventory of dedicated filters users can shift through when in photography mode, effectively altering the rendered memory scene before them. These filters will be themed on different emotions and attitudes one can view life through, such as ignorance, romance, simplicity, or sadness. When a user applies a filter and views a scene or object through the camera's lens, the subject matter will be rendered differently according to the filter's theme.

All inputs to access camera mechanic interactions belong to the right-hand controller. To take photos, the trigger on the right-hand controller must be clicked. To shift through the filters available for a memory scene, the Bumper input on the right controller must be clicked. The camera mechanic is conditionally activated in two ways. One conditional is based on the user's location and the other conditional is based on the user's position of the right-hand controller.

In terms of location-based conditionals, the camera mechanic can only be accessed when the user exits or is outside the memory orientation room environment area, as the memory orientation room is an area intended to look through photos taken rather than to take photos. Even though the camera mechanic interactions can be accessed anywhere once the user leaves the memory orientation room, photos taken with the camera mechanic are only stored

and saved as images when the user has entered a memory scene area. This is managed using Box Colliders around each of Luna's memory scenes and the memory orientation room that trigger certain functions once the user enters or exits them. Once the user enters an area with a surrounding box collider, a corresponding C# component script attached to the box collider game object updates a game manager script attached to the user that control which set of available filters to shift through and apply to the memory scene while the user is within the memory scene area.

Once the user is in an area where the camera mechanic can be used, to officially activate controller inputs for taking photos and shifting through filters, the user's right-hand controller must be raised to eye-level, mimicking the action of raising a camera to one's face to take a photo. As long as the right-hand controller is raised to eye-level, the camera UI design appears, signaling to the user they can begin taking photos and shifting through a memory's available filters. Figure 3 below shows the camera UI design, which includes a familiar viewfinder interface found in most camera applications, and the name of the current filter applied to the memory scene at the bottom of the UI as a button with text. Anytime the right-hand controller is below eye-level, the camera UI overlay is removed, and the camera mechanic inputs for taking photos and shifting through filters are deactivated. Finally, once the user begins taking pictures with a selected filter, they will no longer be able to apply the other filters to the memory scene. This rule will be emphasized during Astro's introductory dialogue to ensure the user is mindful about when they start taking pictures, and thus the perspective filter they choose to for Luna to remember her memory from.

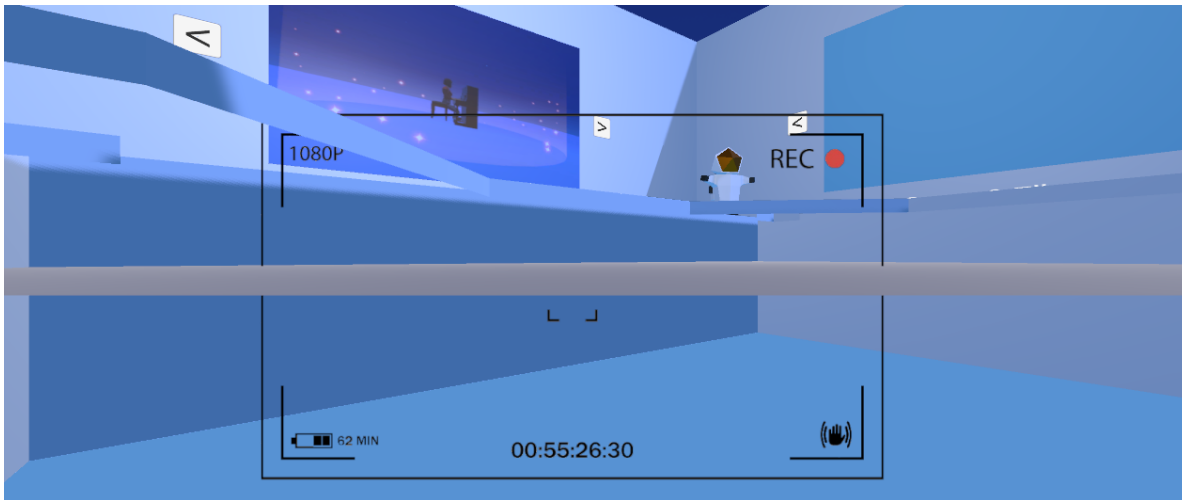

Fig. 3: Camera Viewfinder UI

UI Interactions

The user will only need to interact with UI elements in the final iteration of the memory orientation room once they have visited each of Luna's three memory scenes. When the user arrives at the final iteration of the memory orientation scene, the three empty walls will serve as a gallery of all of the photos the user took at each of Luna's memory scenes. Each wall gallery corresponds to photos taken in one of the three memory scenes. The Photo Gallery Canvas UI on each wall includes a 3D flat Plane game object where the pictures the user took will be rendered, as well as "Next" and "Previous" buttons the user can interact with to look through each photo taken in a specific scene. To interact with these Next and Previous buttons, the user can click the left-hand controller "X" Button input to look through the photo gallery. Directly centered above the Photo Gallery wall is the title of the memory scene rendered as Text UI. Right below the gallery is the selected filter users explored the memory scene through and took pictures with. Figure 4 below shows the UI design for the Photo Gallery walls corresponding to one of Luna's memory scenes.

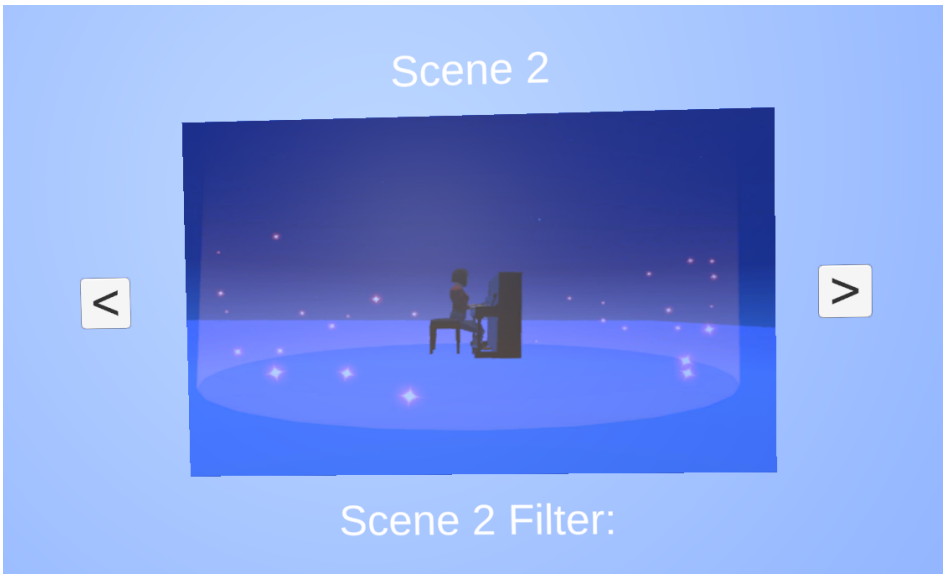

Fig. 4: Photo Gallery Wall Interactable UI in Memory Orientation Room

Environment Design and Scenes

The "limbo"-like environment the user traverses and experiences *ReCapture's* narrative in consists of four core scene areas, each with a different narrative purpose and affording unique interactions. The theme of the world environment is based on moon and space themes, motivated by Luna's name, which translates to "moon" in English. Since the limbo world narrative setting also serves to act as an exploration of Luna's subconscious, where her core memories are located, moon and space themes were used to design scene visuals, such as the spaceship themed design for the memory orientation room, and the overall world environment design. The moon and space theme motivate the design of a minimalistic, somewhat rocky and bumpy area the user traverses to get to different memory scenes, with tall mountains, that cannot be looked over, surrounding the edge of the limbo world (See Figure 5 below).

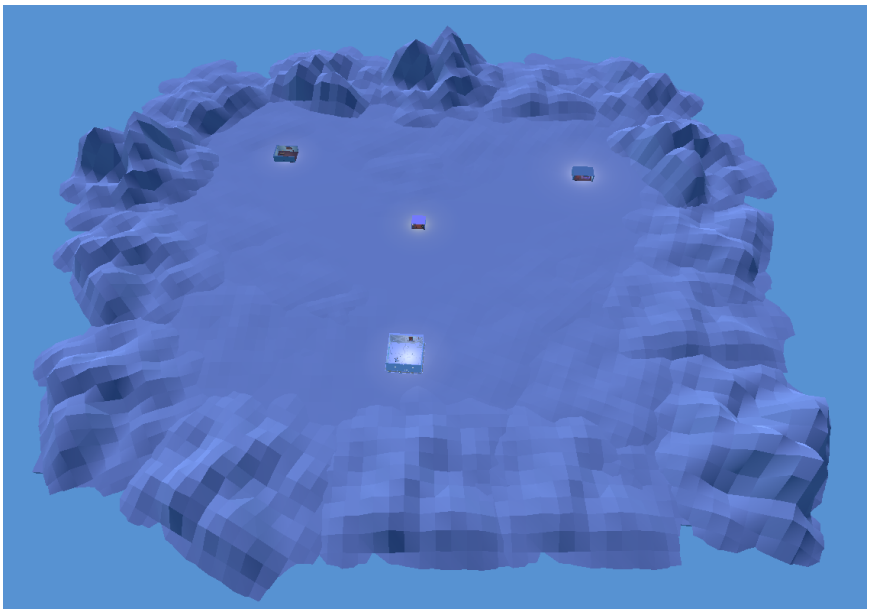

Fig. 5: Aerial view of *ReCapture's* limbo-world environment including memory scenes

Memory Orientation Room Scene

The first scene the user is introduced to is the Memory Orientation Room scene. The room is made up of four walls, with one wall providing the user a door to exit the room from and enter the limbo world, and the remaining three walls each acting as photo gallery walls containing pictures the user took throughout the memory scenes in the limbo world. Each photo gallery wall corresponds to a specific memory scene in the limbo world, and thus only contains pictures taken in that world.

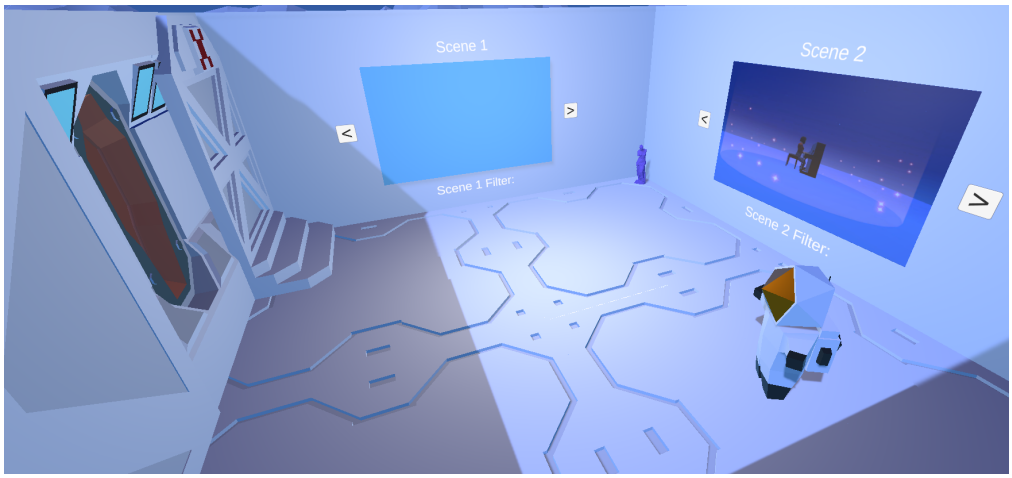

Fig. 6: Memory Orientation Room Scene Design

The memory orientation room serves two purposes depending on what point in the narrative the user is in. At the beginning of the narrative, the Memory Orientation Room is the room scene the user wakes up in and is introduced to Luna's background story, current situation, and exploration ahead. At the end of the narrative, once the user has collected a number of photographs that recapture the essence of Luna's life through selected filters, the user will be transported back to, or can traverse back to, the memory orientation room. In this final stage, the photo gallery walls of the memory orientation room will be interactable, as the user can look through the gallery of photos took using the provided UI on the photo gallery wall. At this stage, the memory orientation room really represents which perspectives of her memory will become permanent when she wakes up, forming how she will view the world. This room is an amalgamation of the reflective process the user experiences through Luna as they traverse the limbo world environment and significant, personal, and some character-defining memories to Luna's life. This memory orientation room is where the story begins, initially representative of lost or forgotten memories that need to be recaptured. It is also where the story ends, becoming representative of the outcome of reflection, of taking time to confront

the perspectives we can choose to carry through life. As its title bears, the memory orientation room is where Luna's memories are fully re-oriented according to the perspective filters the user chose to remember Luna's memories from and settled as permanent.

The Lifecycle of Dreams

Fig. 7: "In the Zone: A Realized Dream" filter applied to Lifecycle of Dreams memory scene

Fig. 8: "Living the Dream" filter applied to Lifecycle of Dreams memory scene

The Lifecycles of Dreams memory scene represents Luna's experiences and lived memories as a piano player. Through the applied filters, the scene represents the motions one often goes through in life when they fall in love with a dream: the initial discovery, the integration of those dreams as part of their life and character, the trails of committing to achieving the dream's success, and experiencing a dying dream. Table 1 below outlines the names of the emotionally-theme perspective filters that can be applied to the default version of

The Lifecycle of Dreams scene, with the corresponding changes those filters would have on the scene's design, as well as the narrative meaning behind those changes.

Table 1

"The Lifecycle of Dreams" Filters

Filters	Scene Description
In the Zone: A Realized Dream	Luna is playing the piano while a ring of glowing particles swirls around her, representing how she's entranced when playing the piano, and her newfound dream.
Living the Dream	This filter represents the integration of Luna's newfound dream as a Piano player into her life. When applied to the scene, Luna's bedroom appears, where Luna is still playing the piano, but the glowing ring that once surrounded her is not as tall or noticeable as it was in the previous filter.
Lost in a Dream	This filter represents Luna's dying dream and how her feelings towards playing the piano has changed because of the pressures of finding conventional "success" in dreams. To represent how burnt out and disconnected she feels to the rest of the world, Luna's room is in disarray, with sheet music are all over the floor, crumpled, and in her overflowing trash bin. Finally, trophy's that were once showcased in shelf cases are now in the trash can, and the shelves they were showcased in now empty.
A different kind of dream	This filter represents Luna focusing on finding comfort and interest in other parts of life rather than the pressures of solely achieving her dream

School Presentation

Fig. 9: “Getting Through It” filter applied to School Presentation memory scene

Fig. 10: “Why So Serious?” filter applied to School Presentation memory scene

The School Presentation memory scene references how Luna deals with attention and confidence in a public-speaking presentation setting. Table 2 below outlines the names of the emotionally-theme perspective filters that can be applied to the presented default school presentation scene, with the corresponding changes those filters would have on the presented scene.

Table 2

“School Presentation” Scene Filters

Filters	Scene Description
Default Scene	This School Presentation scene as is, with no camera mode applied, will be a small enclosed classroom with seats full of students

	looking forward to the front of the classroom where the main character is doing a presentation in front of a projector. The *Default* camera mode will also be a raw view of the scene as is, without animations
Getting Through It	This is a school presentation in its simplest form. Luna is simply getting through the presentation, with no visible worries. Animations will only be applied to Luna to demonstrate she is moving forward with the presentation. The applied filter represents a "surface-level" view of the situation
Nerves	When the *Nerves* camera mode is applied, the School Presentation scene will be updated to include audio of snickering and whispering sounds to represent what the main character hears and visualizes when she gets nervous presenting in front of class. To exaggerate this, some of the students in the classroom will be visually animated as whispering in each other's ears. Additionally, the human avatar representing the main character will go back and forth between crossing their arms and swinging them by her side. This camera mode and scene speaks to experiencing life through a lens of fear and insecurity in front of other people.
Why So Serious? (Take life less seriously, it can actually be fun!)	When the *Why So Serious?* camera mode is applied, the classroom of seated students in the School Presentation scene will be changed from human students to a wacky element such as teddy bears. This shows how the main character copes with commonly nerve-wracking life experiences through a lens of silliness, and simply taking things less seriously, making her more confident and capable.

Family Dinners

Fig. 11: Family Dinners Scene Design

The Family Dinner memory scene references Luna's experiences with her family, and touches on the changing relationships between parents and children over time.

Table 3

"Family Dinners" Scene Filters

Filters	Scene Description
Default Scene	In the default version of this scene, Luna's family is simply sitting down at a dinner table in the kitchen getting ready to eat dinner together
The Adults are Talking	In this filter, the parents are animated as expressive or angry regarding something their child has done that has made them respond that way. Luna is listening obediently to her parents while her sister, Luz, is climbing over the parents allegorical "fence of protection"
The Kids Are Alright	In this filter, you see Luna and her sister being expressive and excited about something. Her and her sister are no longer inside the parent's fence barrier, but living and experiencing outside of the parent's fence of protection, while the parents look onwards
We Are Family	In this filter, you see all members of a family talking together, laughing together, supporting each other; simply having dinner

RECAPTURE SYSTEM DESIGN

The development of *ReCapture* is divided into two parts: one focused on the narrative storytelling aspect, essentially the message and themes I wish to express and leave users to explore; and the other focused on the technological aspect of the project. The technological merit of this thesis lies in the process of game development and design to create a VR Interactive Narrative, using tools such as the Unity game engine, the C# programming language, and the SteamVR Input System, while also keeping in mind overarching Virtual Reality development techniques for a VR headset. It was key to establish the concept of the narrative first in order to design mechanics, graphics, and animated physics that were attainable to develop within the time frame of the thesis, that can be effectively integrated for a Virtual Reality headset, and that could also effectively enhance a user's experience and consumption of *Recapture's* underlying messages. The process of technological design and development for the sake of the interactive narrative achieving a desired emotional response from users was largely guided by procedural rhetoric and Shin's VR cognitive model taking into consideration what features of VR storytelling actually impact how users perceive the value of a VR story.

Technical Specifications

ReCapture was built to be experienced on an HTC VIVE Cosmos, consisting of a Head Mounted Display (HMD), or VR headset, and hand controllers (See Figure 12 and 13). The VIVE Cosmos headset provides users the ability to occupy any single point in the real world where the user is free to rotate their body or head a full 360 degrees in order to experience *ReCapture's* virtual environment and narrative. The user can traverse the environment either standing up or sitting down position, however since the headset tracks the physical movements

of the head in three-dimensional space, a change in height will transfer over to the user's height position in the virtual environment. The VIVE Cosmos hand controllers provide the user button and joystick input types to interact with the virtual environment using their hands.

Fig. 12: HTC VIVE Cosmos Headset

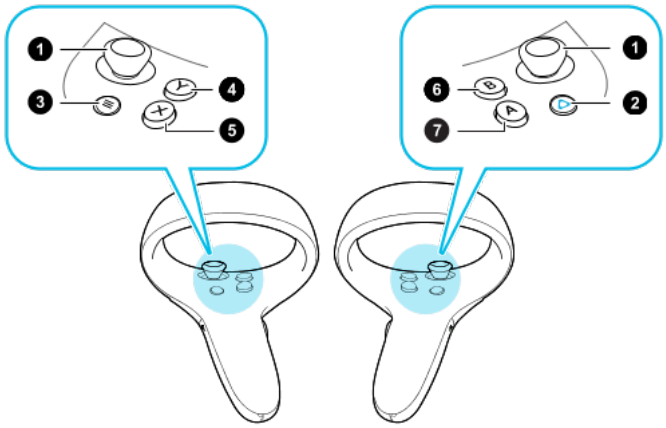

Fig. 13: Diagram of VIVE Cosmos Hand Controllers

Game Development

The *ReCapture* VR Interactive Narrative was developed using Unity 2019.4, C# scripts, object-oriented development, and VR development packages for Unity such as the SteamVR

Input System. To begin VR development for a headset, it is best to decide on an interaction system that "enables XR providers to integrate with the Unity engine and make full use of its features" [15]. The interaction system I use with the VIVE Cosmos headset is the SteamVR Input System.

The narrative text in *ReCapture* was created using a special unity object called "Canvas", where UI elements could be organized and rendered. This is where C# scripts attached to invisible triggers throughout the limbo-world environment send the narrative text to be seen and read by the user. The interactive narrative also utilizes these same invisible triggers to play sounds in certain environments. These triggers objects with the physics component attached and are listening for collisions with the user camera. Once the user collides with the trigger, the interactive narrative knows to activate the attached script.

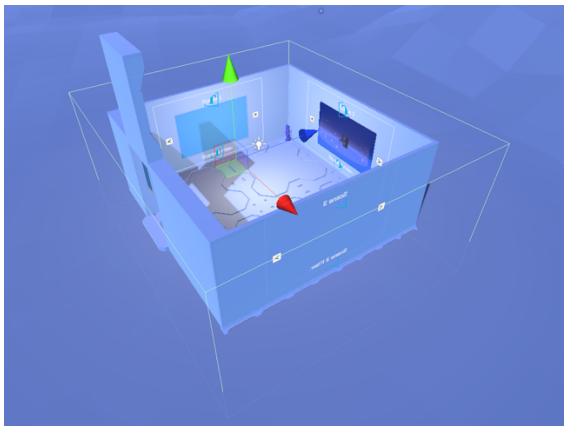

Fig. 14: Box Collider surrounding Scene Area in *ReCapture*

The environment design was done in Unity Editor using built-in terrain features and assets from the Unity Asset Store. Low poly 3D assets were used to design the scenes within the environment. The environment design is also impacted by the camera mechanic, since specific filters alter elements of a scene that will need to be rendered accordingly based on the

filter's emotional theme. Alterations to a scene can include lighting changes, applied visual effects, or modifications to game objects within the scene, such as animation changes or position changes.

Input System for Interactions in *ReCapture*

The interaction system for *ReCapture* was built using the SteamVR input system. SteamVR is a Unity plugin that allows developers to connect a variety of mainstream VR headsets and their hand controllers to Unity. Specifically, SteamVR loads 3D models of the VR hand controllers, handles input from those controllers, and estimates how a user's hands look like while using the controllers [15]. *ReCapture's* interactions were created by binding specific inputs on the VIVE's hand controllers to interactions programmed as C# scripts, using the SteamVR user interface to edit controller bindings.

The following table outlines what user input on a VIVE hand controller (shown in Figure 13) is used to trigger an interaction within *ReCapture*.

Table 4

Inputs and their Corresponding Interactions in *ReCapture*

User Input	*Corresponding Interaction in ReCapture*
Right Trigger	The right-hand controller Trigger input will serve as the input for snapping a photo within the environment.
Right Bumper	The right-hand controller Bumper input will serve as the input to shift through the set of filters corresponding to each memory scene
Right Controller Position	The position of the right-hand controller will activate the Camera Mechanic and corresponding Camera UI when the controller is at or above the user's eye-level and deactivate the Camera Mechanic when the controller is below the user's eye-level
Left Joystick	The left-hand controller Joystick input will serve as the input to walk forward in the direction the user is facing, or to stop walking

Left Trigger	The left-hand controller Trigger input will serve as the input to teleport to active teleportation areas
Left X Button	The left-hand controller X button input will serve as the input to interact with NPC or non-camera mechanic related UI, such as in the Memory Orientation Room Gallery where users can select the Next and Previous UI Buttons to look through photos taken at each scene

DISCUSSION

This section dives into the design-thinking decisions that went into interaction choices, narrative choices, how the technological and the narrative elements of *ReCapture* complement each other.

Using Procedural Rhetoric to Design the Camera Mechanic

In *ReCapture*, procedural rhetoric was used to design the camera mechanic, which involves two direct interactions: taking photos and shifting through available filters to apply to corresponding memory scenes. Although we afford the user walking, teleportation, and dialogue interaction mechanics, the camera is the core process that moves the narrative, and its underlying intent, forward. Without the camera mechanic, *ReCapture* would simply be an exploration through Luna's surface-level memories, rather than a reflection of the different perspectives her memories could take, revealing deeper and more personal feelings and interpretations of those memories. There are three interaction rules within the camera mechanic that each, when carried out, attempt to persuade the user about a different, but similar idea tied to the narrative. When all interaction rules are experienced together, the camera mechanic aims to elicit a desired emotional response on reflection on perspectives.

The first interaction rule is to take photos. The user must use the camera to take photos in each memory scene in order to recapture the protagonist's forgotten memories. This rule attempts to persuade users that the intent and selectivity behind a single photo can reveal elements not just about life and the world at large, but the individual behind the camera.

The second interaction rule is shifting through filters. In each memory scene, the user

must shift through the filters corresponding to that scene in order to make the "perspective" modifications to the scene. This rule attempts to persuade users that we play a role in choosing the perspectives to view and experience life through, all for different reasons or circumstances.

The last interaction rule, which is more indirect and consequence of the previous two interactions, is the to confirm a selected filter. Once the user takes a single picture with a selected filter, the applied "perspective" changes to the corresponding scene become permanent and from that point on the user can only take photos with that selected filter applied to the memory scene. This rule attempts to persuade users to actively reflect on what each applied perspective filter is revealing before permanently applying a filter their remaining photos are limited to.

How Procedural Rhetoric Can be Applied to VR

VR technology affords designers different input interfaces than conventional video game consoles or PC mouse & keyboards input systems. Making use of the HTC VIVE Cosmos hand controller to design the camera mechanic, I created physical rules using tangible interfaces that take part in a user's meaning-making of *ReCapture's* narrative. The physical rules users interact with include raising the right-hand controller up to eye level in order to take a photo or shift through filters and clicking button-like inputs on the hand controller to take pictures that are also similarly positioned to buttons in actual handheld cameras.

Tying physical action rules that are familiar to users, such that they mimic the action of taking photos with an actual handheld device, to interactions that are narratively presented and mindfully designed to persuade users about an underlying idea, I generated embodied cognition. Embodied cognition is an interaction of the body and the mind that takes place

within the context of a specific environment [16]. In virtual environments, embodied cognition "allow(s) users to gather spatial information about the virtual environment using the same perceptual systems they would use to gather spatial information about the real world", and may also "result in improved cognition due to the additional information users are able to collect through physical movement" [17, 18]. Using procedural rhetoric to design a camera mechanic for a VR storytelling platform, I make both the mind and body interact with each other in order to persuade users to reflect on perspectives, in turn generating a sense of embodied cognition. Thus, meaning making, or persuasion, can be supported by physical means as well as narrative means in VR storytelling.

How Procedural Rhetoric Ties into Findings from Shin's Cognitive Model

The broad and dynamic definition of immersion Shin presents through his cognitive model was a key design influence in *ReCapture*. Applying the cognitive mode, Shin found that "the intrinsic empathy of users plays a key role in triggering embodiment, which then determines engagement", ultimately meaning how strongly users immerse in a VR story depends on the user's individual traits [1]. In response to this finding, I used procedural rhetoric to develop embodiment and empathy triggers within the camera mechanic based in familiarity. The empathy-based triggers created within the camera mechanic were the relatable and familiar emotionally themed filters users interact with and the motivation for using the camera mechanic in order to bring the narrative's protagonist back to life with her forgotten memories intact. The embodiment-based triggers were the use of familiar body motor movements to access the camera mechanic moving the narrative meaning forward, thus an interaction of the body and the mind.

Another presented finding from Shin's model influencing *ReCapture's* design was that of flow being the link between what the technology brings to the VR story and what the individual brings to the VR story. Flow is "experienced when an activity's challenges fully engage a user's skills without overwhelming them" [1]. Through the camera mechanic, I engage users' motors skills to access the camera mechanic interactions through the tangible interface of a hand controller. I engage cognitive traits by generating narrative meaning through the physical use of the camera mechanic. Connecting these two findings from Shin's cognitive model to procedural rhetoric, I attempt to persuade users to bring in certain individual traits significant to the VR story. I guide users to recall their personal and individual traits when interacting with the camera mechanic, both emotionally, through the underlying narrative meaning expressed in the camera mechanic, and in a tangible manner, through a tangible interface that feels familiar to users.

Narrative & Visual Decisions Guided by Shin's Cognitive Model

Besides the design of the camera mechanic, the findings of Shin's cognitive model also give credit to the effectiveness of my narrative and character design. Through a VR story experience study using his cognitive model, Shin sound stimuli are reprocessed by users' own internal cognitive process, which are based on previous experience, intrinsic traits, and context. From that, I concluded if I wanted to persuade users to reflect on perspectives, I needed to focus on bringing in user's intrinsic traits by presenting familiarity not just within the mechanics, but the narrative.

In *ReCapture*, I do this within the narrative in two ways: One is how I present Luna, the character user's experience the narrative through, in an open-ended way. Since user's are given minimal context about Luna's background and who she is at the beginning of the narrative experience, they naturally bring more of themselves into the VR story in response to the presented situation of a young girl in a state between life and death who must recapture her forgotten memories before coming back to life. I am essentially asking users to bring their experience into the equation by asking them to re-create a part of who Luna is through recapturing her forgotten memories.

The second narrative and visual design choice working in tandem with Luna's open-ended character is the presented situation of recapturing forgotten memories in a minimalistic limbo-like world space. The limbo world is largely a representation of Luna's subconscious, with moon and space themed environment design, corresponding to Luna's name translating to "moon". There are minimal to no distractions in the world space, as most of the visual content is within each memory scene. This sets a tone of reflection within the limbo world space, where focus and interpretation can be placed within the memory scenes and camera mechanic. This connection between the narrative and environmental setting aims to create a space for self-reflection, matching *ReCapture's* desired emotional output response.

CONCLUSION

ReCapture serves as an example of applying research-backed VR story design research incorporating design methods from the game design industry, particularly procedural rhetoric, to achieve a desired emotional output response from users. In *ReCapture*, a VR interactive narrative was created that enhanced the intentions and symbolisms behind the use of photography as an interactive mechanic. Integrating procedural rhetoric to design the camera mechanic with findings from Shin's cognitive model related to generating immersion applied embodied cognition concepts. In doing so, users aim to be motivated to reflect on the perspectives one chooses to view life through. The *ReCapture* experience can be used to determine if the design decisions were successful at achieving certain attitudes and emotions from users, as well as a basis for an examination of what specifically the users brought into the experience, such as if users made decisions in the interactive narrative based on their own perspectives, or rather what they inferred the protagonist's perspective and situation called for. Finally, *ReCapture* can be a base to further explore how procedural rhetoric can work with immersion techniques, such as those presented in Shin's cognitive mode, to create compelling, persuasive, and immersive VR experiences.

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