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Conveying Personal Narrative in Virtual Reality using Procedural Techniques and Surrealism

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Conveying Personal Narrative in Virtual Reality using Procedural Techniques and Surrealism

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Fine Arts
Digital Production Arts

by
Austin W Brennan
May 2018

Accepted by:
Dr. Eric Patterson, Committee Chair
Professor Carol Collins
Dr. Jerry Tessendorf
Dr. Brian Malloy
Abstract

In this thesis a personal narrative is conveyed in a virtual reality experience where procedural techniques are used to create surreal environments. Virtual reality is a powerful way to build empathy and understanding of another individual’s experiences and choices. Procedural techniques enable an artist to create complex and highly stylized scenery. Surrealism can be used to depict emotions in a way that words alone are unable to describe. When combined, virtual reality, proceduralism, and surrealism can yield a compelling vehicle to express personal narrative.
Dedication

I dedicate this thesis first to my Lord and Savior Jesus Christ, who miraculously redeemed me and gave me a powerful testimony. The VR experience that I created for this thesis is based on that testimony, so without him this would not have been possible.

I would also like to dedicate this thesis to my loving fiancée and my family. Through their love and support, I have been able to pursue my dreams with Digital Production Arts and beyond.
Acknowledgments

This thesis would have not been possible without the support of my thesis advisor Dr. Eric Patterson who helped me craft a clear vision for my thesis and take proper steps to execute my vision. My faculty committee members Carol Collins M.F.A., who helped me learn how to develop a compelling story, and design impactful imagery. Carol’s consistent support of my project kept me going when I was overwhelmed. Dr. Jerry Tessendorf who has taught me so much about creating procedural and simulated production assets, and how to create a streamlined production pipeline. Finally I want to thank Dr. Brian Malloy for his positivity and support throughout this process.

I would also like to thank the theater and acting community at Clemson. Quinn Hernandez for his directing advice, and my wonderful cast Spence Ross, Ashley Ferenchak, Austin Wilson, Jeff Honea, George Terry, John Dorlon, and Monica Rozman, who lent their awesome voices and performance to bring the characters of this production to life. I also want to thank Tony Penna for initially connecting me with the theater department, Beth Anne Johnson for reserving rooms for the auditions and recording sessions, and Nic Brown for giving me script writing advice and resources.

I thank Alex Izydore, who’s recording expertise, musical talent and cool attitude allowed us to capture the unbelievable performances of our actors, and create sound effects and a musical score for *Who Am I?*.

Last but not least I want to thank the amazing professors and staff of the Digital Production Arts program at Clemson. I am so grateful for the experience I have had throughout this program, and am so proud to soon be an alumni. I look forward to maintaining my relationship with this program as I continue into my career.
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Chapter 1

Introduction

While driving back to Clemson to start the Fall 2017 semester, I discovered the idea for this thesis. I remember thinking to myself, “If I could tell any story, what story would I tell”. As I meditated on this thought on the long drive to Clemson, I came to the conclusion that the story that I was most interested in telling was my testimony of how I became a Christian. As I thought more about this idea, I remembered the testimony of St. Augustine in his autobiographical text *Confessions*. It amazed me how open Saint Augustine was with sharing his lifestyle prior to becoming a Christian and what experiences led him to become a Christian. While reading confessions I noticed that even though St. Augustine and I live nearly 1700 years apart from one another, I was still able to relate to his experiences. I was amazed that though his testimony is ancient, it still demonstrated the same saving grace that I experienced with my faith.

Figure 1.1: Saint Augustine by Bartolomé Esteban Murillo
Once I had an idea of what I wanted to do for my thesis, I thought more about how I would implement it using my knowledge of computer graphics and Digital Production Arts. It was at this point that I chose to use surrealism to represent the events that led up to my conversion. With surrealism I could give impressions of the events that led to my conversion. I would also have more artistic liberty with representing the environments and characters that were a part of my testimony.

I also started to think about procedural techniques for generating virtual environments. I thought this would allow me to generate the large amount of content required for telling my testimony.

Lastly I thought of the implications of using virtual reality as the viewpoint for my testimonial story. I thought it could lend itself well to the personal narrative. By immersing the viewer in the environments and situations that I experienced, I could bring him or her even closer to my testimonial story.

With all of this in mind, I have spent the past school year writing, designing and developing the VR experience that I had envisioned on my road trip back to Clemson last Fall. I spent much of the fall semester developing a script, and designing the visual style of the VR experience. This semester I held auditions and casted my actors. I then proceeded to direct my actors in voice recording sessions. I worked with my sound engineer to develop a score for the experience as well as sound effects.

I have also worked on the technical aspects of my production this semester. I developed a complete production pipeline for generating surreal environments for virtual reality. With this pipeline, I have generated nearly 10 minutes of the 15 minute VR experience. The name of the VR experience is *Who Am I?*, and I hope to complete and exhibit it at film festivals.
Chapter 2

Background

In this chapter I cover background material that is useful for understanding the concepts discussed throughout my thesis.

2.1 Surrealism

One of the forefathers of the surrealist movement, André Breton, defines the word surrealist as, “Pure automatism by means of which one intends to express, either verbally, or in writing, or in any other manner, the actual functioning of thought, dictated by thought, in the absence of any control exercised by reason, free of any aesthetic or moral concern.” [3] The goal of the surrealist is to express one’s thoughts and emotions without the constraint of logical reasoning restraining the creative liberty of their pure imagination. The idea stems from the work of Sigmund Freud, which in Breton’s mind, legitimized the imagination as a truer reflection of one’s identity rather than the actions, thoughts, and emotions one has in a ”fully conscious” state.

Like a dream the artwork created by surrealists blurs the line between reality and imagination. The subject matter of a surrealist piece of artwork is typically symbolic and cryptic. Surrealist artists also use illusion to challenge viewer’s perceptions of reality and lead them to see beyond the surface of a piece of art [14]. The surreal art movement was most notably popularized by the paintings of Spanish artist Salvador Dalí.

Dalí’s paintings embraced the ideas of his predecessors. His paintings typically depict dream like realities and extensively use illusion and symbols to uncover subconscious thoughts. In figure 2.1
one of Dalí’s paintings titled *Geopoliticus Child Watching the Birth of the New Man* can be seen in figure 2.1. Dalí’s notes on the painting say the following, “Parachute, paranaissance (sic), protection, cupola, placenta, Catholicism, Egg, earthly distortion, biological ellipse. Geography changes its skin in historic germination.” [5] The associations between the items of the list appear to be very disjointed yet their significance can be assessed upon further analysis. The cupola, Catholicism, and parachute for instance could explain the object hanging above the man in the painting. Both a cupola and a parachute are above a person’s head, and Catholicism or religion is transcendent and above man’s intellect. A parachute is made out of a material that can be folded and reshaped, while a cupola is made out of solid materials that can stand for centuries. The combination of the two subjects into the tent like structure above the egg in *Geopoliticus Child Watching the Birth of the New Man* may represent the reshaping of man’s understanding of the transcendent. What lies beyond the intellect may perhaps be less rigid than what is proposed by religious thought.

![Figure 2.1: Geopoliticus Child Watching the Birth of the New Man (1943) by Salvador Dalí](image)

Salvador Dalí also explored stereoscopic imagery in a series of lithographs he made later in
his career. One such lithograph, Christ of Gala, can be seen in figure 2.2. By focusing the right eye on the left lithograph and the left eye on the right lithograph, a sense of depth is added to the image. Through the use of stereoscopic lithographs Dalí is able to make the suspended Christ look as though he is truly floating in the clouds.

Figure 2.2: Christ of Gala (1981) by Salvador Dalí: an example of a stereoscopic painting [14]

2.2 Virtual Reality

The premise of virtual reality is to replicate sensory stimulation that we experience in the real world using technology to trick our senses into thinking that we are in another environment than the one we are actually in. The idea of trying to replicate sensory stimulation has been around for
quite some time. Photography precedes virtual reality as a technological attempt to convey another environment. The photograph replicates the sense of sight and stimulates our retinas in such a way that replicates the visual experience of being in a place at a specific time. The stereoscopic image, first created in 1838 based off of the research of Charles Wheatstone [23], demonstrated how the combination of the two viewpoints of our eyes allows us to perceive depth. This sense of depth was then replicated in stereoscopic photos and viewers. An example of what these photos and viewers looked like can be seen in figure 2.3.

![Figure 2.3: Examples of a stereoscopic photo and viewer [19]](image)

Replicating visual stimulation continued to progress throughout the 1800s. In the late 1800s photographers started to capture motion with a series of photographs. These photos would then be projected in a rapid succession in order to replicate the persistence of vision. This effect occurs when a series of discrete images shown in rapid session are perceived as a single moving image, or
“motion picture”. One of the pioneers in this field is Eadweard Muybridge. One of his photos of a horse galloping can be seen in figure 2.4.

Figure 2.4: Picture of a horse galloping by Eadweard Muybridge

The phonograph was also invented around this time period [1]. With a phonograph, sounds could be reproduced to create audio stimulation that replicated the auditory experience of being somewhere else. For instance the sound of a full orchestra could be reproduced in the home. This advancement brought yet another sense into the realm of technological trickery.

Figure 2.5: The cylinder phonograph invented by Thomas Edison

One of the most ambitious earlier attempts to replicate sensory stimulation is Morton Heilig’s Sensorama. Heilig invented the machine in the late 1950s and patented it in 1962 [19]. The machine displays stereoscopic motion pictures with a wide field of view. The viewer puts his or her head
close to a binocular like view port to see the visuals. Wind is blown on the viewer using fans, and smells are added to replicate the smells of the recorded places. Along with this, stereo sound is used to replicate the experience of hearing what is happening in the recorded places. The Sensorama, though short lived, gave viewers several more senses beyond visuals and sound to experience. A diagram from the Sensorama patent and an image of the machine can be seen in figure 2.6

Figure 2.6: Sensorama machine invented by Morton Heilig

Morton Heilig is also credited for inventing one of the first Head Mounted Displays (HMD). The Telesphere Mask could display 3D-stereo images and be paired with stereo sound to create an immersive experience [19]. An image of someone wearing the HMD can be seen in figure 2.7.

Figure 2.7: The Telesphere Mask: a head mounted display (HMD) from the early 1960’s

The first tracked Head Mounted Displays (HMD) was created by Philco in the early 1960s
[9]. A tracked HMD allowed viewers to control the view of the camera with the rotation of their head. This device was called the Headsight. With this system the viewer wore a headset with a video screen attached to it. The headset was connected to a camera that gave the viewer sight outside of the headset. The Headsight was the basis for visual assistance for helicopter pilots flying in the dark.

Later in the 1960's Ivan Sutherland invented a system for displaying computer generated imagery in a head mounted display with head tracking [20]. This invention has come to be known as the Sword of Damocles because the large equipment used to suspend the display in front of the viewer’s face.
The next major advancement in virtual reality as well as an early commercial venture in virtual reality came through the Visual Programming Lab (VPL) Research company. It is said that Jaron Lanier, founder of the lab, actually coined the term “virtual reality”. Some of the major advancements of the lab included an LCD Head Mounted Display, that displayed stereo-scopic images to provide a sense of depth. This headset was called the EyePhone. The lab also invented the DataGlove, which gave users a 3D tracked hand to interact with virtual environments.

After this period there were a slew of attempts to commercialize virtual reality systems with limited success throughout the 1990s. These attempts included arcade games that featured stereoscopic low-latency (less than 50ms latency) computer generated images, as well as home gaming consoles developed by SEGA and Nintendo [19]. Some of these devices can be seen in figure 2.11.
Over the last five years, during the mid to late 2010s, there has been a resurgence of interest in virtual reality systems. Many of the reasons that virtual reality did not catch on as a main stream form of entertainment, such as the high costs, high latency, poor visual fidelity, and low interactivity have been greatly improved by these newer systems. Three of the most popular home virtual reality systems are the HTC Vive, the Oculus Rift, and the PSVR systems. These systems offer a tracked Head Mounted Display and two tracked virtual reality controllers. They are also capable of producing low-latency stereoscopic images at less than 11ms refresh rates. These systems are popularizing virtual reality and its applications for entertainment and industry.
Virtual reality systems have become more affordable and more engaging over the course of time. Along with these technological advancements there have been studies about the psychological effects of virtual reality as well. One study by Nicole Schutte observed that the virtual reality format prompted greater empathy in viewers and that more engagement with virtual reality connects experiences in virtual reality to empathy [18]. To conduct the study, Schutte had viewers watch a documentary of a young girl living in a refugee camp. Some of the participants viewed the documentary in virtual reality, while others viewed the documentary in a traditional 2D format. The results of the study indicated that the viewers of the virtual reality version of the documentary experienced a greater level of engagement with the content and a higher level of empathy for the refugee girl than the group that viewed the 2D version of the documentary. Schutte’s finding affirms that higher levels of engagement connects virtual reality experience to empathy. Figure 2.13 shows the results of Schutte’s study. The questionnaire on the left asks the participants several questions.
about engagement with the content and their empathic response to the content. Schutte used two types of questions that are labeled with \( EP \) and \( EC \) in the questionnaire. The questions labeled with an \( EP \) asked about empathic perspective taking, while the questions labeled \( EC \) asked about empathic concern. Table 2 shows the mean and standard deviation of the results of the questionnaire. The results show that participants saw documentary in virtual reality were more engaged with the content and had higher empathic responses to the content.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Engagement and empathy items</th>
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<tbody>
<tr>
<td>Engagement</td>
<td></td>
</tr>
<tr>
<td>I was absorbed</td>
<td></td>
</tr>
<tr>
<td>I blocked out things around me</td>
<td></td>
</tr>
<tr>
<td>The time just slipped away</td>
<td></td>
</tr>
<tr>
<td>I lost track of the world around me</td>
<td></td>
</tr>
<tr>
<td>I was so involved that I lost track of time</td>
<td></td>
</tr>
<tr>
<td>During this experience I let myself go</td>
<td></td>
</tr>
<tr>
<td>Table 2</td>
<td>Mean and standard deviations for the virtual reality and control conditions</td>
</tr>
<tr>
<td>Measure</td>
<td>Virtual reality (( N = 12 ))</td>
</tr>
<tr>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Engagement</td>
<td>29.92</td>
</tr>
<tr>
<td>Total empathy</td>
<td>35.47</td>
</tr>
<tr>
<td>Empathic perspective taking</td>
<td>17.60</td>
</tr>
<tr>
<td>Empathic concern</td>
<td>18.42</td>
</tr>
</tbody>
</table>

Figure 2.13: Figures from Schutte’s study on engagement and empathy in VR

2.3 Proceduralism

Procedural techniques are a powerful way to create complex and varied visuals. By providing simple user controls, a procedural tool enables an artist to quickly iterate on the content that he or she is creating. This leads to more compelling environments, and added details that would have been too time consuming to create with a non-procedural technique.

Another benefit of procedural techniques is that they allow an artist to rapidly iterate on production assets. By defining a process for generating a production asset, rather than the production asset directly, the artist is not tied to any specific output that the process can potentially generate. This empowers the artist to create many variations of an asset, in order to find the desired
output.

For instance, let us say an artist needed to create a field of rocks. A non-procedural approach would be to model a rock, and then proceed to place instances of it around a scene with varying size and rotation. This approach is focused on the output, rather than the process of generating the field of rocks. A procedural approach might be to define a process of generating a rock, likely using noise and displacement on a sphere, then defining a process for scattering positions on the field, and finally applying random scales and rotations to the rocks and placing them at the scattered positions. By defining the process, one can start to add controls to it, and introduce a host of variety for the production asset. If the art director on the project wishes to improve the distribution of the rocks, the distribution of random positions could be adjusted. If the rocks were too jagged, the rock itself could be adjusted, and the changes would move downstream. In the non-procedural workflow however, the artist would potentially need to start from scratch on each iteration of the asset. Proceduralism enables the process of generating production assets to be highly iterative, and gives an artist the ability to make major and minor tweaks to an asset with ease.

In his paper, Toward Procedural Decorative Ornamentation in Games [24], Jim Whitehead notes that computer games attempt to portray real-world structures, such as castles, palaces, temples, and cathedrals, but are unable to capture the densely packed ornamentation that these real-world structures have. Whitehead then goes on to point out some of the work that has been done to replicate culturally significant patterns such as the Islamic star patterns, and the Celtic knot pattern, among others. He notes that the algorithms that describe these patterns, can be used to create tools that allow artists to quickly fill sparse spaces in the game-world with ornamentation.

Figure 2.14: Comparison between Islamic patterns on a wall at the Alhambra (Granada Spain) and an Islamic styled temple in Prince of Persia [24]
Procedural techniques can also be used to mimic complex systems found in nature as well as man-made structures. One of the earlier use cases of procedural modeling was for rendering mountainous terrains. In *Computer Rendering of Stochastic Models* [6], the authors describe a process of using layered noise functions for displacing surfaces in such a way that look like mountains. This paper was published in 1982, and the application of techniques like it are still being used today.

![Terrain](image)

Figure 2.15: Terrain Generated by Stochastic Models 1982 [6]

There is also a great deal of research for using procedural techniques to generate trees. In *Simulating Tree Growth Based on Internal and Environmental Factors* [11], Zhuming Lam and Scott King, use a variety of environmental factors to replicate the process of tree growth. The results are a wide variety of tree species that avoid obstacles and attempt to maximize overall health as they grow.

One of the front-running pieces of software for creating procedural tools is Houdini by SideFX. Houdini features a node-based structure that lends itself well to defining procedures that generate assets [26]. In Houdini, a node represents some operation that is acting on an asset, it will typically add, remove, or modify incoming data to generate some output. Nodes can be linked up
to create a network that represents the process that the data associated with an asset goes through, as it generates a procedural asset.

As an example, this procedure could generate the field of rocks mentioned. The steps go like this:

1. Create a polygonal sphere.
2. Displace the vertices of the sphere with noise.
3. Scatter points on a field.
4. Copy the rocks to the field with random orientation and scale.
In the figure you can see the Houdini node graph that generates the field of rocks. Each of the nodes has parameters that can be adjusted to yield a new result. The node labeled `scatter_positions` for instance has a parameter to adjust the distribution of the rocks. The node labeled `displace_w_noise`, has parameters to adjust the way that the rock looks. The Houdini node graph is a visual scripting language for creating procedural assets. The node graph defines the procedure, while the viewport displays the results in real time.
Once a graph is completed, it can be packaged into what is called a Houdini Digital Asset, also referred to as an HDA. An HDA can be used in other Houdini Scenes, or can be brought directly into a game engine, using the Houdini Engine. The Houdini Engine allows the core technology of Houdini to integrate with other pieces of software [26]. It makes parameters that generate assets and the result of the node graph accessible in other pieces of software such as the Unreal Engine editor or Maya.

Procedural asset creation is becoming more pervasive in the games industry, as the demand for massive amounts of content in game-worlds grows. In the paper, *Asking the Impossible on SSX: Creating 300 tracks on a ten track budget*, [8] two Electronic Arts employees discuss the success they had with using Houdini on the development of the snowboarding game SSX. Their approach to building trails for the game started with using elevation maps from N.A.S.A. with sculpting tools developed in Houdini to create playable surfaces out of the terrains. As the production continued, requirements for more complex topological features in the terrain led the team to use a Signed Distance Function (SDF) approach to defining terrain. This allowed artists to sculpt more three-dimensional features into the terrain, such as ledges, crevasses and tunnels. Using a procedural approach for creating these features enabled the team to make adjustments with ease.

Guerrilla Games is another company that has adapted to a procedural approach for content creation in their games. In a 2009 article on *Killzone 2*, [2] Paulus Bannink describes how Houdini was instrumental in the game’s success. It was important that many of the assets in the game world of *Killzone 2* were destructible. The team used Houdini to generate fractured versions of existing assets, and added material and re-bar to the interior of the asset. This cut down a significant amount of time that needed to be spent on making assets destructible for the game. The studio has continued to adapt procedural workflows to their production needs. In their 2016 release, *Horizon Zero Dawn*, procedural tools were used to create the rivers and lakes in the game, as well as adding densely packed cable in sci-fi environments. [17] The tools were packaged into HDAs and brought into Maya with the Houdini Engine. This allowed the artists working in Maya to use the procedural tools to build their environments. *Horizon Zero Dawn* is a massive open-world game, meaning the player can roam freely in a large environment. This created a high demand to populate the game world with places that are varied and ones that players would find engaging. Procedural tools facilitated the production of assets to fill these places much faster than traditional workflows.

Ubisoft is also using procedural techniques to generate terrains and populate them with...
vegetation. In their 2017 release *Tom Clancy’s Ghost Recon: Wildlands*, the team created procedural landscapes using Houdini generated height fields [22]. The team then generated a host of tools that allowed artists to populate the world with vegetation. The team was also able to define rules about what kind of vegetation could grow in which part of the game world. This created a heightened level of realism to the open world maps. The views of this game look stunning thanks to the extreme level of detail that the team was able to produce with procedural workflows and Houdini.

![Figure 2.17: A screen shot from Tom Clancy’s Ghost Recon: Wildlands](image)

Figure 2.17: A screen shot from Tom Clancy’s Ghost Recon: Wildlands
Chapter 3

Related Work

In this section, I discuss narratives that make use of surrealism and personal narrative. These are pieces of work that inspired me throughout the design process of *Who am I?* and represent the strength of surrealistic techniques.

### 3.1 Inspiration from German Expressionist Films

One of the first sources of inspiration for this project came from viewing the *The Cabinet of Dr. Caligari* (1920) by Robert Wiene [25], and *Metropolis* (1927) by Fritz Lang [12].

While watching these films, I focused on the how the environments were constructed. I found that the backgrounds were constructed through the replication of simple shapes and forms. I also found that the environments didn’t make logistical sense for the most part. The buildings in *Metropolis* for example go in many directions rather than just upwards. This way of portraying the environments made the settings of these films feel less grounded in reality. The imaginative landscapes and cityscapes place the characters in a dream-like reality akin to the dream-like realities described by the surrealists.

In figure 3.1 you can see the triangle shaped structures that fill the environment of *The Cabinet of Dr. Caligari*. The lob-sided triangular shaped structures are rather alien looking. The film itself has some themes that relate to the psycho-thriller genre. The unevenness of the buildings in the background create a sense of uneasiness in the viewer. As I watched this film it felt as though something was off. I liked how such a simple set piece was able to create a unsettling feeling about
The imagery in these films provided more of an impression of an environment rather than a concrete setting for the characters to be in. Many of the compositions of Metropolis for example are a montage of several images. This can be seen in the top left image in figure 3.2. There are multiple ground planes from which the buildings emerge. From this composition, we get a sense that the setting of this film is in a complex city. The confusion caused by the composition also makes the city domineering. How would a city-goer navigate this city without becoming lost?

3.2 Motivated through Surreal Virtual Reality Works

Along with traditional films, I was also inspired by virtual reality works. The two that I drew the most inspiration from are Dear Angelica [21], and Dreams of Dali [15].

Dear Angelica is a virtual reality narrative based film. The story follows a teenage girl who is reminiscing of memories she has of her deceased mother. Her mother was a successful actor before
Figure 3.2: Screen-shots from *Metropolis*
dying from a terminal illness. The story is told through stunning 3D paintings that are painted into the environment that the viewer is standing in. As the paintings float around the viewer, the teenage girl narrates reminiscent memories of the characters her mother played in her films. The paintings depict the environments and characters that were in her mothers films.

Considering the teenage narrator was a young girl during her mother’s acting career, her memories of who her mother was and what characters her mother played are blurred. The film becomes both a love letter and a means for the narrator to process the emotions she has felt since losing her mother.

I really loved the way that the story was told through live paintings. Each scene would paint itself into existence with vibrant colors and dream like motion. While at SIGGRAPH 2017 I was fortunate enough to attend a talk by some of the creators [16]. The speakers discussed how they discovered the process for creating the imagery of Dear Angelica. It started with experimentation with traditional 3D modeling that attempted to emulate the look and feel designed by their art director Wesley Allsbrook. The traditional approach of modeling, texturing, and lighting these environments was not giving the team satisfactory results. Around this time one of the engineers developed a 3D painting tool during a company exploration coding day where engineers could develop anything they wanted. The engineer showed the tool to Wesley and she loved it. The 3D paintings she made with the tool impressed the rest of the team so much, that they decided to pursue a new workflow for the content creation for the production that utilized the 3D painting tool.

The team then engineered systems for animating the paintings in Houdini and bringing them into the Unreal engine. The paintings could then be animated in the Unreal scene. The idea of painting environments and characters into the scene during the runtime of the game was a novel approach to the medium. The process for generating these environments was also novel. I believe that there is a lot of power with this process of story telling, because of the speed at which the environments and characters can be developed. Many traditional parts of the animation pipeline are foregone, yet the visuals are still appealing and the story can still be communicated well.
I also found the *Dreams of Dali* VR film inspiring. This film was initially created as an exhibit at The Dali Museum in St. Petersburg, FL [15]. During this film the viewer flies through a 3D version of the Dali painting *Archaeological Reminiscence of Millets Angelus*. I was impressed by how *Dreams of Dali* adds dimension to Dali’s beautiful painting.

I really like the way that the creators used flight to send the viewer throughout the painting. The experience of flying enforces the dream like theme that the surrealist artists embraced. The movement through the 3D painting also reveals some more details about Dali’s artwork. For example, one of the towers that the viewer flies through has a ringing lobster telephone in it, referencing one of Dali’s sculptures.

Overall I really enjoyed how this experience brought the surreal world to life. The visuals are stunning, and the experience of flight feels like an out-of-body dreamy experience. Virtual reality enables the viewer to step through the canvas and experience the world that inspired Dali.
Figure 3.4: Comparisons between the *Dreams of Dali* VR film and Dali’s artwork

### 3.3 Tragic Personal Narrative Told Through a Game

Another major source of inspiration for my project is the video-game *That Dragon, Cancer*. The website for the game describes it as, “An immersive narrative video-game that retells Joel Greens 4-year fight against cancer through approximately two hours of poetic, imaginative gameplay that explores faith, hope and love.” [7] The game plays out as a series of interactive environments that the player traverses through in a point and click fashion. There are other points of the game that include other basic mechanics, such as obstacle avoidance, and a Mario-like jump-and-duck mechanic. For the most part, the player is observing the details of the settings that the game takes him or her through.

What I loved about this experience is the vulnerability of it’s creators. The viewer is invited
into some of the most intimate and heartbreaking moments that this family has gone through. The fact that the video-game is based on real events, makes it even more impactful. It is easy to relate to the characters and their struggle, because the emotions in the narration are authentic. Experiences like this validate the emotions one feels during his or her darkest times. By walking through someone else’s experience of grief, the player is able to reflect on his or her own times of grief. The loss of a loved one is such a difficult thing to process emotionally, and *That Dragon, Cancer* feels as though someone is lending out a hand to walk through the pain with you.

![Image of Ryan holding baby Joel at the hospital](image)

**Figure 3.5: Ryan holding baby Joel at the hospital**

The creator’s also use the game as a platform for other cancer victims to be honored and remembered. In figure 3.6 a wall of hands and footprints with the names of cancer victims can be seen. This is one of many ways that the game honors cancer victims. At another point of the game there is a house filled with cards with messages of love towards deceased loved ones from their family members and friends. The player is invited to move around the house and look at the cards. There are too many cards for the viewer to see them all, which adds to the impact of the scene. There is another section of the game where the player can read the journal entries of cancer victims. Each one is a message in a bottle, bobbing in the sea. The player can move to each one and hear from people affected by the disease.
Another aspect of the game is its use of abstraction and surreal environments to convey complex emotions. In one scene, Ryan (Joel’s Father) is swimming in an ocean. His wife Amy is in a rowboat without any oars. Amy is asking him to get into the boat, and telling him that it is going to be okay. Leading up to this point the player has seen that Amy is getting through this difficult time by her faith in God, while Ryan has become distant from God and his faith. He refuses to “get into the boat”. He sinks deep into the ocean and is surrounded by pulsing black spheres seen in figure 3.7. He is suspended there in the fetal position. Eventually the player is allowed to click on the screen which causes Ryan to attempt to swim to the surface. Though it looks like Ryan is swimming somewhere, it eventually becomes obvious that he isn’t actually going anywhere. When the player stops clicking, Ryan returns to the fetal position. The suspension in the deep ocean portrays the emotions of depression and a sense of isolation. It looks as though Ryan’s grief is causing him to feel cut off from the world. The spikey spheres represent the omnipresence of his son’s cancer, which plagues his conscience. His lack of ability to swim to the surface reveals that he is not able to escape the grief by his own strength.
Figure 3.7: Ryan drowning with pulsing spiky spheres

The experience that the game lends is emotionally raw; I found myself pausing throughout to reflect on the emotions that it stirred. This was the first time that I had such a response to a video-game. I believe that it is a brilliant use of the medium.
Chapter 4

Design

Humans are intrinsically story tellers. Telling and listening to stories allow us to process our experiences and make sense of the world. Through the retelling of the accounts of our lives, we are able to share in each other’s joys, hopes, and fears. We are able to use our stories as a way to relate with one another. By listening to the personal stories of others, we are able to glean insight into our own lives. The stories of others become a useful resource for shaping our thoughts about similar experiences we have had. They help us emotionally respond to our hurts, hopes, and dreams.

In this chapter, I discuss the unique way in which I approach telling personal narrative. A combination of surrealism and abstraction, virtual reality, and proceduralism, helps me to craft a compelling narrative. This unique approach to telling personal narrative is one that I believe is novel and will yield a profound affect on the viewer. My hope is for others to use this experience as a way to reflect on their own life, and sense of identity. Considering main theme of the narrative is identity, I gave it the title of Who am I?

4.1 Using Surrealism and Abstraction to Express Personal Narrative

In the personal narrative that I am telling, I use objects and scenery to represent the emotions that I had experienced during that particular time of the narrative. The main character, Adam, goes through a transformative process. He is struggling to understand who he is as a person.
The main theme of the narrative focuses on discovering one’s identity. In my own experience, I found that the process of discovering my identity was a transcendent one. Through the process I both explored blissful worlds in hallucinogenic journeys and also fell deeply into dark places of depression. Ultimately I found my identity through a personal encounter with Jesus Christ. Considering that the nature of many of these experiences was transcendent, I have used surrealism as a means to express them.

Some of the experiences I had while hallucinating on drugs brought me a strong sense of joy and wonder. It felt like I had journeyed into a whole new mental landscape: one that I could explore endlessly. As time went on however, my journeys grew darker and darker. The experiences that I had while not on drugs became more and more difficult to process. After years of searching for purpose and meaning in life, I eventually found my purpose and meaning through a personal encounter with Jesus Christ. This encounter not only prompted me to quit using drugs, but also transformed my life entirely. The end of Adam’s story portrays the saving grace of Jesus and the peace and purpose that he provides. In my personal narrative I wanted to represent these transcendent experiences in a way that was similar to how the surrealist represented his or her subconscious mind. As I was conceptualizing spaces that the viewer could travel through, I tried to capture the emotion of that period of my life with some surreal representation. There is not a complete logic to why the specific objects were chosen throughout the narrative, other than that they came to me nearly automatically as I meditated about that particular period of my life.

The dialogue and scenes in the VR experience were also created out of this meditative process. I would think of the period of my life that I was trying to portray, and wait for the characters, dialogue, and scenery to emerge from my imagination. Considering I had a particular time of my life that I was trying to portray, my imagination was filtered to some degree by my agenda to capture a specific feeling of that time. Though this may deviate from the surrealist philosophy in its lack of pure automatism, it enabled me to discover a representation of my experiences in a way that empowered the subconscious perception of my identity to shine through.

The transformation that I went through during this personal narrative was one that took many years to unfold. There are key moments in my life that have shaped who I am today. I try to compress these experiences into vignettes that capture the essence of many experiences. In this way, I am able to communicate the trials that shaped my process of personal growth in an accelerated way. The experiences that the main character goes through vary in their level of abstraction. In
some instances, the character is interacting in spaces that are represented in a very literal way.

<table>
<thead>
<tr>
<th>My life experience</th>
<th>Representation in <em>Who am I?</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimenting with drugs</td>
<td>Group of friends using drugs</td>
</tr>
<tr>
<td>Damaging relationship with parents</td>
<td>Adam is confronted by his mother</td>
</tr>
<tr>
<td>High school peer being murdered</td>
<td>Drug dealer gets shot</td>
</tr>
<tr>
<td>Having a near death wakeboarding accident</td>
<td>Adam &amp; Ryan get in a car accident</td>
</tr>
<tr>
<td>Having conversations with Christian peers and mentors</td>
<td>Adam talks with pastor Dan</td>
</tr>
<tr>
<td>Accepting Christ as my savior</td>
<td>Adam accepts Christ as his savior</td>
</tr>
</tbody>
</table>

Table 4.1: Real life experiences compared to Vignettes in *Who am I?*

In other scenes however, the character is floating through spaces that are representative of the emotions that the character is feeling at the time. The shift between abstraction and more literal interpretations of spaces and experiences helps convey that the narrative is based on both concrete events as well as an inner transformation that has less literal representation. By using both, the viewer is able to perceive the full extent of the character’s transformation - one that is both expressed through actions and interactions with others, as well as through a deeper shift in the perception of identity.

<table>
<thead>
<tr>
<th>Real emotional &amp; spiritual experiences</th>
<th>Representation in <em>Who am I?</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling a sense of wonder and awe on drugs</td>
<td>Adam floats through a trippy landscape</td>
</tr>
<tr>
<td>Attempting to develop spiritual awareness</td>
<td>Adam meditates in a poster cathedral</td>
</tr>
<tr>
<td>Feeling cut off from friends and family</td>
<td>Adam floats backwards through a series of shutting doors</td>
</tr>
<tr>
<td>Feeling depressed and totally isolated</td>
<td>Adam sinks into a black chasm</td>
</tr>
<tr>
<td>Being comforted by the Holy Spirit</td>
<td>Adam is surrounded in light</td>
</tr>
<tr>
<td>Feeling a part of the Christian community</td>
<td>Adam floats to a heavenly table</td>
</tr>
</tbody>
</table>

Table 4.2: Emotional and Spiritual experiences compared to their representation in *Who am I?*
4.2 Amplifying the Impact of Personal Narrative with Virtual Reality

build empathy and understanding of another individual’s experiences and choices. In this VR experience, the viewer is Adam. This means that when the viewer looks down at their own body, they will see Adam’s body instead. When other characters interact with Adam, they will be talking with the viewer.

The reason for doing this is to add a level of immersion to the experience. By having the viewer observe the story from Adam’s perspective, they are able to identify with his thoughts and emotions. My hope is that the viewer will be able to identify qualities of Adam that are similar to themselves. In this way, the narrative becomes a platform for others to reflect on their own identity. The personal nature of the narrative invites viewers to be introspective. My desire is for others to engage in a conversation with themselves about who they think they are, what is most important to them, and what their purpose in life is.

I would also like the viewer to assess their attitudes toward the transcendent. The narrative ends with Adam making a decision to follow Christ. By placing others in his shoes, he or she must confront his or her own convictions about Christianity and the implications of what it means to pursue a relationship with Jesus. Virtual reality makes it difficult to just be a passive observer of a narrative. The proximity of the viewer to the main character is as close as it can possibly be.

As Nicole Schutte’s study [18] shows, placing the viewer in a virtual environment can create a stronger sense of empathy towards the material that is portrayed. My hope is that the narrative is amplified by placing the viewer in Adam’s shoes.

4.3 Procedural Techniques for Surreal Environments

Proceduralism provides a great way to create surreal environments. As I mentioned in the Proceduralism background section, defining the rules for geometry generation allows an artist to explore an idea about form, and structure. Having a parametrized generation tool gives an artist the ability to test out the varied pieces of geometry that they can generate.

While developing the visual style of Who am I? I continuously thought of what procedures might yield an interesting result. I frequently experimented with Houdini, many times without an
exact goal in mind. This helped me grow more comfortable with the software and see what it was capable of. The following tool is an example of one of the procedural tools I have created while experimenting with Houdini.

Figure 4.1 and figure 4.2 were generated with the same procedural geometry tool. This tool simply extrudes the faces of a piece of geometry. The amount of extrusion is driven by sampling fractal sum Perlin noise at the center of each faces world space position.

![Abstract city-scape generated with the face extruder procedural tool](image)

Figure 4.1: Abstract city-scape generated with the face extruder procedural tool

In figure 4.1 I simply extruded the faces of three grids with varying face sizes. The size of the faces increases as the composition recedes into the background. The result is a strange abstract form that almost looks like a city-scape.
In figure 4.2 I subdivided and smoothed a cube before feeding the geometry into the face extruder procedural tool. The result is a planet-like form that has boxy landscapes.

Both the abstract city-scape and the abstract planet earth have similarities to the real world yet look synthetic as well. The style between the two images looks consistent because they were both generated with the same technique. The generative nature of this geometry creation method allows me to be playful with how I create forms. The resulting geometry is guaranteed to look complex and varied, yet the methods for generating them are straightforward and artist friendly.

For the procedural tool that I developed for *Who am I?* I wanted to create a tool that could procedurally generate 3D paintings. The tool would allow me to quickly generate environments that are similar to *Dear Angelica* without the need to manually create the curves of the paint strokes. Considering the VR experience focuses on the theme of identity, I wanted the environments to have a loose gestural style. This would give the impression that something is being created out of many complex pieces, similar to the way that our identity is formed out of a complex system of beliefs experiences and conditions. All of the environments in *Who am I?* are generated with this tool. The details of this tool are discussed in the Development chapter.

I had originally designed my tool to work in the Unreal Engine editor through the Houdini...
Engine, but found that the Houdini Engine was ill-suited to the complex operations that needed to be performed. The Unreal Engine editor would crash often while generating the procedural paint stroke assets, and it would take minutes to reload the editor to try again. Also the geometry that was generated using the Houdini Engine was stored in a temp folder in the Unreal Engine editor, and if I forgot to move it out of the temp folder, it would be lost between sessions Unreal Engine editor. Overall I felt that in order to have a stable solution that scaled the geometry generation process, I had to generate the geometry in Houdini and use a different approach to transporting the data to the Unreal Engine.
Chapter 5

Development

In this chapter I discuss the tools that I created and the techniques that I used to produce this VR experience. I have deferred some of the technical details of these techniques to the appendices. I start the chapter with a discussion of the physical production aspects of the VR experience.

5.1 Casting and Recording

One of the first steps in creating *Who am I?* was casting actors to voice the characters from the script. The process for finding actors started with a casting call, and an audition. With the audition, I used an assessment sheet that rated the strengths and weaknesses of the actors voices. The actors auditioned in groups of three, so each assessment sheet had a rating section for three actors. I also had a section of the assessment sheet where I marked what character I thought a particular actor would be a good fit for. Figure 5.1 shows this assessment sheet.
Once I had cast my actors I scheduled a table reading where the actors could read through the script and practice. I used this time to direct the actors and help them understand their characters motivation. I also had the actors take a script home and practice their lines.

We reconvened the next week for the first of two recording sessions. I organized the recording sessions in such a way that minimized the amount of time that any particular actor had to be at the session. I worked with Alex Izydore, a sound engineering student at Clemson to set up the recording equipment and record the voices. As Alex handled the technical aspects of the recording session, I sat with the actors and directed them between takes. Figure 5.2 shows the recording session setup with three of the actors.
Once we had acquired the voices for *Who am I?*, Alex and I sorted through takes and selected the best takes for each actor for each scene. Alex then edited these takes to create a master take that I used in the VR experience.

### 5.2 Painting in Houdini

One of the primary tools that I built is what I call the “Painting Tool”. The Painting Tool is a procedure created in Houdini that takes any piece of input geometry and generates Paint Strokes around it. These paint strokes are then brought into Unreal Engine and animated in such a way that it looks like the scene is being painted into existence.

In the design process for my VR experience, I created paintings that portrayed the environments that I was trying to create. These paintings guided the development of the Painting Tool. My style of painting is relatively loose. I start with creating an outline of the shape I want to create, and then I fill in the shape with broad brush strokes. I wanted my procedural Painting Tool to capture this process and produce something similar in 3D. The steps of my painting process is shown in figure 5.3.
Figure 5.3: Concept art painting process
To create these procedural 3D paintings, I start with an input piece of geometry. My tool of choice for modeling this base geometry is Maya. I do my base geometry modeling in Maya and export it as a Wavefront OBJ file. I then read this file into Houdini and run a procedure that generates paint strokes over the object. These paint strokes are then exported from Houdini as FBX (Filmbox) files and shaded and animated in the Unreal Engine. Figure 5.4 shows the stages of this process.

The shape of the strokes is defined by the shape of the input geometry and a vector field that is created with curl noise that flows around the input geometry. The process for developing this vector field is described in Curl-Noise for Procedural Fluid Flow by Bridson, Hourihan and Nordenstam [4]. Houdini has this functionality implemented in the Volume Operator (VOP) node, which runs CVEX, Houdini’s c-like language, on a set of volume primitives. I simply plug an empty volume and a VDB representation of my input geometry into the volume VOP, and create a Curl Noise node. I sample the Curl Noise at each voxel of the volume and bind the result to a voxel attribute called vel. I also plug the VDB representation of my geometry (OpInput2) into the curl noise sdf input. This causes the curl noise to curl around the SDF stored in the VDB representation of my input geometry. I found this process for generating curl noise around an object in Houdini in
a Stephen Knipping tutorial called *Applied Houdini - Rigid V*. [10] The resulting volume VOP can be seen in figure 5.5, and the curl noise that it generates can be seen in figure 5.6.

![Figure 5.5: Volume VOP in Houdini](image1)

![Figure 5.6: Visualizing the curl noise around a sphere](image2)

After this step, I scatter points over the geometry using a sudo-random placement with an even distribution over the geometry. I then move the points around the surface using the curl noise as a guide. The process of moving particles through a vector field is called advection. As the points advect over the geometry I build a list of each points previous position. This gives me a trail for each point, which I can then create a paint stroke out of. With the previous positions alone, I can create a line by attaching the points together, though this does resemble a paint stroke very well.
Instead I turn these trails into paint strips that have a width. My goal with this step is to create a strip of paint that is normal to the base geometry and follows the trail of the points. I do this by first going over each point and defining a coordinate system that is defined by three vectors; the normal, the tangent, and the bitangent. I get the normal vector by sampling the gradient of a signed distance field representation of the base geometry at the position of the point. Houdini has a node called VDB Analysis, which can be configured to take a scalar VDB grid and return a vector VDB grid of the gradient of the scalar VDB grid. The equation for calculating the normal based off of the gradient of a scalar VDB grid is as follows. In this case I use $\rho$ (density) to represent the scalar values of the VDB grid. I also normalize the resultant normal vector, which is not shown in this equation.

$$\vec{n} = \text{normal}$$
$$\rho = \text{density}$$
$$\vec{p} = \text{position}$$

$$\vec{n} = \frac{\delta\rho}{\delta\vec{p}}$$

I define the tangent vector as the the average of the normalized vector of the direction of the previous point to the current point and the direction of the current point to the next point. For the first point I only use the normalized direction vector of that point and the next point. For the last point, I only use the normalized direction vector of the previous point to the end point. This covers the edge cases. I average the two direction vectors for the other points to get a smoothed tangent vector along the point trail. I also normalize the resultant tangent vector, which is not shown in this equation.

$$\vec{t} = \text{tangent}$$
$$\vec{p} = \text{position of point}$$
$$N = \text{total number of points}$$

$$\vec{t}_n = \begin{cases} 
\vec{p}_1 - \vec{p}_0 & \text{if } n = 0 \\
\vec{p}_{N-1} - \vec{p}_{N-2} & \text{if } n = N - 1 \\
\frac{(\vec{p}_n - \vec{p}_{n-1}) + (\vec{p}_{n+1} - \vec{p}_n)}{2} & \text{otherwise}
\end{cases}$$

42
Next I define a bitangent as the cross product of the normal vector and the tangent vector. I also redefine the normal after this step as the cross product of the tangent and bitangent vectors. This ensures that the three vectors form an orthogonal basis. I also normalize these vectors, which is not shown in the following equations.

\[
\vec{b}t = \vec{t} \times \vec{n}
\]

\[
\vec{n} = \vec{t} \times \vec{b}t
\]

With the bitangent, I am able to create a width of a paint stroke. I do this by first defining a width, then iterating over the point trail and creating two new points; one at the bitangent multiplied by half of the width added to the current points position and one at the bitangent multiplied by half of the width subtracted from the current point position.

\[
w = \text{width}
\]

\[
\vec{p}_{n1} = \text{first added point position}
\]

\[
\vec{p}_{n2} = \text{second added point position}
\]

\[
\vec{p}_{n1} = \vec{p}_n + bt * \frac{w}{2}
\]

\[
\vec{p}_{n2} = \vec{p}_n - bt * \frac{w}{2}
\]

As I create these new points, I also define quadrilateral polygons using these newly created points.
To do this, I define the first two vertices of the polygon by the two newly created points. The
next two vertices are defined by the next point’s two newly created points. This process is continued
down the point trail, which generates a polygonal strip. Tapering is added to the polygonal strip
by varying the width of the polygonal strip along the point trail. In my project, I make the strips
thin at the ends. This gives a similar look to a round paint brush painting on a surface. The user
control for this in Houdini is a float ramp, which is shown in figure 5.8. The float ramp is sampled
along the length of the paint stroke. The point that is sampled is defined as the percentage of the
length that the point is along the total length of the paint stroke.

![Figure 5.8: Float ramp control for the width of a paint stroke](image)

I also generate UVs during this meshing process. As each vertex is added to the geometry,
it is mapped to a value in the UV coordinate system. The U coordinate is defined as either the
positive or negative half-width of the current points width. Each V coordinate is defined as the
accumulation of the distance traveled in each step of the point trail creation. This ends up creating
a pile of UV shells centered on the V axis.
\[ u_{n1} = \text{first added point u coordinate} \]
\[ u_{n2} = \text{second added point u coordinate} \]
\[ v = v \text{ coordinate} \]
\[ u_{n1} = \frac{w}{2} \]
\[ u_{n2} = -\frac{w}{2} \]
\[ v_n = \sum_{x=0}^{n} |p_x - p_{x-1}| \]

I use a UV layout node in Houdini to place each UV shell in the 0-1 range of the UV coordinate system. The UV layout node’s algorithm attempts to pack the UV shells in the UV space in such a way that minimizes wasted UV area. I has parameters for

![Image](image_url)

**Figure 5.10: UV islands before (left) and after (right) UV Layout node**

Lastly I delete the original point trail from the geometry. Considering these points were just a guide to create the paint stroke, they are not necessary anymore.
5.3 Bringing Paintings to Life in Unreal Engine

The next step in my VR production pipeline is to bring these procedurally generated paint strokes into the Unreal Engine. There were a few goals that I have for this process. First, I want to be able to paint the strokes into the scenes of the VR experience. This lends itself well to the surreal aesthetic style that I am trying to create. Also the story is about identity and this type of transition between environments serves as a way to represent the way that Adam is perceiving these environments. It looks as though these environments are conceived from Adam’s imagination.

Some other goals I have include shading the paint strokes with a variety of color, and creating texture for the paint strokes that looks like oil paint. This makes the strokes look more organic and gives the digital environments a less synthetic look.

In order to accomplish these aesthetic goals, I create several textures in Houdini which I then pass to the Unreal Engine. Once in Unreal, I use a material with these textures to create such an aesthetic.

For the first aesthetic goal; painting the strokes into the scene in Unreal, I start by generating a texture that stores the bitangent vector of each point in the paint stroke multiplied by the width of the paint stroke at that point. Considering that a texture stores three values for the red, green, and blue channels of an image, I can store a 3 component vector in a texture instead of color information. In this case, I store the x-component of the vector in the red channel, the y-component of the vector in the green channel, and the z-component of the vector in the blue channel. The TARGA image file format that I write this data out to requires that the values fall within the range of 0 to 1.
In order for each component of the vector to fall within range of 0 to 1, I apply a normalization step. I started by searching through all of the points within a paint stroke and finding the smallest and largest components of the bitangent vectors. I then fit all of the bitangent components from this range to 0 to 1. In the Unreal material, I refit the range of values from 0 to 1 back to the range found in Houdini.

This process for writing point data out to a texture is from a Mike Lyndon’s Illume Webinar titled *Houdini COP’s for Games* [13]. In this video, Mike shows a process for creating textures from point data with heightfield volumes and COP’s (Houdini’s Compositing Operators). These textures can then be written out to an image file. In my case, I use the TARGA file format (.tga file extension). I chose this file format, because the image can be stored in a RAW format with no compression. This is important to me, because the values stored in the texture must be preserved in their exact form. An example of one of these textures can be seen in figure 5.12.

In Houdini, I export objects in the FBX (Filmbox) format. Right before the export, I compress the width of the paint strokes to a small value close to zero. This way it is invisible when
it comes into Unreal. Considering I want the object to emerge out of empty space, it is easier to start with an empty space and recreate the width in an Unreal material.

![Figure 5.13: Before (left) and after (right) paint stroke compression](image)

Once the bitangent texture is imported into Unreal, I use an Unreal material to animate the paint stroke into the scene. To do this, I first remap the values from the 0 to 1 range to the range that is in Houdini. This remap process is shown in figure 5.14. The equation to remap the values is as follows:

\[
\vec{bt}' = \text{bitangent refit to original range} \\
\vec{bt} = \text{bitangent from texture sample} \\
bt_{\text{max}} = \text{maximum component of bitangents in Houdini} \\
bt_{\text{min}} = \text{minimum component of bitangents in Houdini}
\]

\[
\vec{bt}' = \vec{bt} \times (bt_{\text{max}} + |bt_{\text{min}}|) - \frac{bt_{\text{max}} + |bt_{\text{min}}|}{2}
\]

I don’t take the absolute value of \(bt_{\text{max}}\), because in my case it is always positive. The maxBT and minBT parameters are set in the Material Instance. The values are under the details of the geometry information in Houdini. I simply copy and paste the values from Houdini to the Unreal material instance.
I pass the result to a TransformVector node. This transforms the vector from local space to world space, which is required for objects that are rotated or scaled in the Unreal level.
This section of the material defines the vector that offsets the vertex position. This replicates the look of the paint stroke that was created in Houdini. By recreating the width of the paint stroke in the Unreal material, I can start my paint strokes with a width that is nearly zero, and expand them to give the appearance of paint emerging. With this step alone though, I can only have the entire stroke emerge at once, which is not exactly the look I am going for. Instead, I would like the paint stroke to start to grow at the beginning of the stroke, reach a maximum thickness and continue down the paint stroke, until the entire stroke is painted into the scene.

To do this, I create a texture that captures the time at which a paint stroke is painted. To create this I start by creating stroke time point data as paint strokes are being created. For each new point that is created along the point trail, I store a percentage of how much of the total length the point trail the current point is.

\begin{align*}
st &= \text{stroke time} \\
n &= \text{current point index in point trail} \\
N &= \text{total points in point trail} \\
st &= n/N
\end{align*}
Using Mike Lyndon’s texture technique [13] again, I write this data out to a texture. I then read this into an Unreal Material into a texture parameter called \textit{PaintedAt}. In the Unreal Material, there is a scalar parameter called \textit{StrokePoint}, which controls how much of the stroke is painted into the scene. A value of zero means that the stroke is invisible, and a value of 1.0 means that the stroke is fully painted into the scene. To illustrate this, figure 5.18 shows the difference between \textit{StrokePoint} values of 0.0, 0.5, and 1.0. I use this step of the material to generate a multiplier for the bitangent displacement that reveals the paint stroke in such a way that it looks like the stroke is being painted into the scene.
The *StrokeTime* scalar parameter controls the smooth step of the paint stroke being painted into the scene. A value of 0.25 means that as the *StrokePoint* increases, it will take any part of the paint stroke 0.25 of the *StrokePoint* increase to go from invisible to fully visible. Figure 5.19 shows the difference between a low *StrokeTime* and a high *StrokeTime*.

With the *StrokePoint* and *StrokeTime* I am able to describe how the paint strokes are being painted into the scene.

To add a little variability, I use the red channel of the *BaseColor* texture as an offset to the *PaintedAt* texture. The *BaseColor* texture simply stores a random color for each paint stroke. Creating this texture is also a technique used in Mike Lyndon’s video [13]. In this way, I am able to add some variability to when the strokes are being painted into the scene as I increase the *StrokePoint*.

I also want the paint strokes to undulate slightly once they are painted into the environment. To do this I added a second set of vertex displacement instructions to the material. These set of instructions can be seen in figure 5.20.
In this set of instructions I sample 3D Perlin noise at a sample position. The sample position is the absolute world position of the vertex multiplied by a very small number specified by Noise Scale. By multiplying the sample position by a small number the features of the 3D Perlin become larger. The effect of changing the Scale of the sample position can be seen in figure 5.21.

I also offset the position of the Absolute World Position by time. This is done by adding time to the three components of the sample position. I also multiply the time offset by a Speed parameter. The speed of the undulations is directly proportional to the Speed parameter.

The output of the 3D Perlin noise is a normalized vector, meaning its magnitude is 1.0. This vector is then multiplied by a scalar parameter called Displacement. This parameter determines how much the vertex is moved by the 3D Perlin noise vector. The affect of varying the Displacement parameter can be seen in figure 5.22.
The resulting vector is transformed from local space to world space with the Transform Vector node. The result of that addition is then added to the vertex offset calculated in the previous step, and plugged into the World Position Offset of the material.

In order to create a variety of colors in the paint strokes, I mix three colors using three random values stored in a texture called BaseColor. As I mentioned earlier, the BaseColor texture is created in Houdini. I use the Connectivity surface operator to give a unique ID to each UV shell on a piece of geometry. I then use this unique ID as a sample for a random function that generates a random color for each UV shell. The BaseColor texture is shown in figure 5.23.
As shown in figure 5.24, the three random values stored in the *BaseColor* texture are used to mix three user defined colors. The resulting value is used as the *BaseColor* of the material. The rest of the materials surface properties come from textures that are applied through texture parameters. These textures are used to adjust the normal, roughness, and ambient occlusion of the
There are many services online that provide tileable textures of these properties for real world surfaces. When applied to the Unreal material, these real world surfaces can be emulated in the virtual world. I also added a Scale parameter for the texture coordinates, which allows me to increase the overall size of the textures as they are tiled over a paint stroke.

Figure 5.25: Tileable texture parameters

5.4 Timing with the Unreal Sequencer

As far as timing, I used the sequencer in the Unreal Engine to time the animation of environments and props in the scene. The Sequencer is one of Unreal Engine’s solutions to timing events and animating parameters of blueprints and materials. Most of the attributes of objects in the Unreal Engine are animatable in the Sequencer. I used the Sequencer extensively to animate the environments of Who Am I?

Figure 5.26 shows what the Sequencer window looks like. It is circled in red. A closer look at it can be seen in figure 5.27.
The Sequencer has a play-head that is on the right side of figure 5.27. It is a vertical line with a red marker at the top of it. The play-head moves across the timeline and indicates at what point of the sequence the scene is currently at. The timeline is marked in seconds and the scroll-bar at the bottom of the sequencer allows the user to select what part of the timeline he or she would like to see.
The left side of the sequencer contains all of the parameters that are animated in the sequence. The parameters can be organized into folders. Figure 5.28 shows this section of the Sequencer user-interface. Unreal calls the animation of a specific parameter a track. The green button in figure 5.28 allows the user to add a track for a specific parameter. Objects can also be dragged into the Sequencer from the World Outliner. A track can then be added for an object’s parameter with the plus sign to the right of the object name in the Sequencer.

Once a track is added for a parameter, it can be animated. Keyframes can be added to the parameters animation track and are indicated with a marker on the timeline. Figure 5.29 shows an animation track for the AppearFX Material Parameter Collection parameters. The triangles represent keyframes with linear interpolation between keys, and the red circles indicate keyframes with cubic interpolation between keys.

Figure 5.28: The Unreal Engine Sequencer par
The keyframes can be further manipulated in the curve editor. The button to view the curve editor is pointed out in figure 5.30.

The curve editor not only shows the keyframes of a parameter, it also shows a graph of how the parameter is animated over time. Figure 5.31 shows the curve editor for the *AppearFX Material Parameter Collection*. The curves in this editor represent *AppearFX* parameters that have been animated. This view is valuable for visualizing how the interpolation between keyframes is affecting the values of a parameter. Throughout my project, I have used the curve editor to fine-tune the animation of parameters.
The *AppearFX Material Parameter Collection* is a material parameter that can affect multiple objects at once. It is basically a global variable for a material. Considering that the environments in *Who am I?* are composed of many objects, the *Material Parameter Collection* is a good way to adjust the parameters of every material instance in a scene. I use the *AppearFX Material Parameter Collection* to animate an entire environment into a scene. In order for this to work I set up a way to tag props and environment objects as part of a scene. I then add the *AppearFX* parameter to objects that have been tagged with a specific environment. In the Paint Stroke material, I add static switches that allow users to specify if a material instance is part of a specific scene. These static switches are then strung together in order to add all of the AppearFX parameters that apply to a material instance. This can be seen in figure 5.32.
In the material instance, the static switch for the scene that the object belongs to is turned on. Figure 5.33 shows a material instance with the static switch parameter for \textit{isTrippyWorld} turned on.
The AppearFX is a Material Parameter Collection. This is simply a collection of variables that can be referenced in a material. I use the AppearFX Material Parameter Collection to adjust global changes to the StrokePoint of material instances in my scenes. The Material Parameter Collection can be seen in figure 5.34.
I animate other aspects of my experience in the Sequencer such as the intensity of lights, and the colors of the sky dome. The sequencer makes animating these parameters extraordinarily easy, and provides consistent control over the production. Along with animating the worlds, I am also able to animate the viewers movement. The path that the viewer is animated along is actually drawn into the scene itself as a cyan line, which is very helpful for animating the viewer through difficult environments. Figure 5.35 shows the animation path that the viewer moves along through a tree.
Figure 5.35: Transformation path for the viewer animation (cyan line)

The *Sequencer* is the backbone of the VR experience. All of the events and dialogue that occur in the experience are timed using this tool. Considering that the *Sequencer* is very similar to other linear editors, the interface is intuitive.
Chapter 6

Results in Production

In this chapter I have compiled some screen-shots from the VR experience. The results of a narrative are difficult to portray in a document, but this chapter mainly serve as a means to document the visuals that were created for *Who am I?*. While viewing the results you should also look at the script and concept art in appendix D. This will give you an idea of how closely the visuals came to the way that I had originally envisioned them. This will also give you a better idea of how these visuals fit into the full narrative of *Who am I?*. 
Figure 6.1: Opening credits to *Who Am I?*
Figure 6.2: Adam's bedroom
Figure 6.3: Trippy World
Figure 6.4: Inside the Trippy World tree
Figure 6.5: Hall of Doors
Figure 6.6: End of the Hall of Doors
Figure 6.7: Poster in Adam’s bedroom
Figure 6.8: Inside the Poster World
Figure 6.9: Outside of Adam’s school cafeteria
Figure 6.10: Inside the school cafeteria
Figure 6.11: Series of shrinking rooms and closing doors
Figure 6.12: Death Spiral to depression
Figure 6.13: Depressed black chasm with lit towers
Chapter 7

Discussion and Conclusions

In this thesis I have discussed the process of discovery and creation that allowed me to realize a vision I had to tell a personal narrative using surrealism, procedural techniques and virtual reality. I started by looking at related works, which included German expressionist films, VR works such as Dear Angelica and Dreams of Dali, as well as the video-game That Dragon, Cancer. These works provided me with a reference point to build the VR experience from. I then developed the aesthetic for the VR experience, as well as the script. I casted voice actors and directed them in voice recording sessions to get the performance I desired. Finally I implemented the VR experience in the Unreal Engine using procedural tools that were developed in Houdini and features of the Unreal Engine editor.

This project provided me with an opportunity to explore ideas that are important to me. I’ve always believed that creating art can be a therapeutic process. Art provides us with a way to reflect on our experiences and transform emotions into something physical. Building the worlds and environments of Who Am I? allowed me to process important moments of my life and attempt to share the lessons that I have learned with others. My hope from the beginning was that this project would glorify God and have other people relate with the main character Adam’s spiritual journey. I certainly feel that I have improved as a story teller and director through the process.

Along with this project providing me with an opportunity grow as an artist and storyteller, it also made several contributions to the field of digital production arts. From a technological stand point the procedural process for generating paint strokes for real-time rendering is a novel technique. From an artistic stand point this project is novel for using virtual reality to tell a personal narrative.
From informal feedback that I have received from people that have tried the experience, I have found that people find the environments fascinating. Viewers say that they can relate to Adam, and the narrative is believable. Moving through the spaces feels very dream-like.

There are some aspects of the production that I believe could have been better. For one, the animation of the characters is very limited. Considering all of the visual elements of the production were my responsibility, I was not able to invest the time required to animate the characters well. The bodies of the characters are abstracted from an actual human, so the lack of animation can somewhat be attributed to a stylistic choice.

The painting tool itself presented certain challenges. I relied heavily on the tool to create painted versions of my geometry, and finding parameters that yielded good results could sometimes be very difficult. It wasn’t always obvious which parameter needed to be adjusted to yield better results. One of the main problems occurred when a particle would be advected through a particularly strong part of the velocity field. This would cause parts of the paint strip to become long and straight that did not match the flowy look that I desired.

It was also difficult to cover an object fully with paint strokes. The paint strokes had a tendency to converge to a similar part of the geometry. This left holes in the painted version of the geometry, which would be difficult to cover up. I would often have to fix this by adding many more paint strokes. This unfortunately has a performance cost.

All in all the project was an awesome process of discovery and creation. I was able to master some really powerful pieces of technology. At this point there is so much more that I am interested in exploring both technologically and artistically. I also learned so much from crafting the story and directing the production. I feel much more confident in my ability to take a story from a concept to a final product.

Moving forward, I plan to polish the VR experience that I created for this thesis and submit it to film festival as well as exhibit it here at Clemson.
Appendices
Appendix A  Unreal Engine Workflows

The following subsections cover the workflows that I used to create the experience in Unreal Engine.

A.1  IK Animation in Unreal Engine Blueprints

In order to get this to work, I set up a Unreal Engine blueprint that would apply IK transformations to two bones in an IK chain. To test out the workflow I started with a single arm (the left arm). I painted weights for the two sections of the arm; the part that goes from the shoulder to the elbow, and the part that goes from the elbow to the hand. I represented these sections with cylinders as proxy geometry. I then exported the Maya scene as an FBX file with the animation box checked.
Figure 1: The scene setup in Maya 2017. The arm is made up of two cylinders that were merged into one piece of geometry.
After that I imported the FBX into Unreal Engine. In Unreal, I added the imported skeletal mesh to the VRCamera blueprint, and placed it in the relative position of where the left arm would be. I also scaled it to match my arm size for reference.
With the ArmTest_Skeleton imported, I created an Anim Composite by first right clicking on the ArmTest_Skeleton and selecting Create then Anim Composite from the drop down. I renamed the resulting Anim Composite to StillArmAnimComposite. This will be used later.
I then created an animation blueprint called ArmAnimBP. I first created a variable called MC_Transform_L. I captured the transformation of the left motion controller in this variable using the Event Graph in the ArmAnimBP. I did this by dragging a line out of the Try Get Pawn Owner node and attaching it to a Cast To VRCamera node. I then turned this into a Pure Cast by right clicking on the Cast To VRCamera node and clicking on Pure Cast. I then pulled a line off of the Cast To VRCamera node and used the get function on the Motion Controller L variable that was created in the VRCamera blueprint. I then use the GetWorldTransform function to get the motion controllers transform and set MC_Transform_L to the motion controllers transform.
I then opened the Anim Graph and created a FABRIK node that calculates the IK transformations for an IK chain of an arbitrary length of bones. In this case we are just creating a two bone IK chain. In the details panel, I selected World Space for the Effector Transform Space and Copy Target Rotation for the Effector Rotation Source in the End Effector settings. I also selected the Hand for the Tip Bone and the Shoulder for the Root Bone in the Solver settings.
I also had to set up a State Machine. In order to do this, I right-clicked the Anim Graph in empty space and selected Add New State Machine... from the State Machine drop down menu. I then named the state machine Default State Machine and clicked on it to start modifying it. All I did here was drag the StillArmAnimComposite from the Asset Browser into the Default State Machine blueprint space. This created a node in the blueprint graph. I then connected the Entry node to the StillArmAnimComposite, and that was it.

Figure 7: Creating the State Machine.

Lastly, I opened up the ArmTest Skeletal Mesh from the Content Browser and added the ArmAnimBP blueprint to the Post Process Anim Blueprint in the Skeletal Mesh settings in the Asset Details panel.

Figure 8: Adding the ArmAnimBP to the arm Skeletal Mesh.
Appendix B  Houdini & Houdini Engine Workflows

Houdini is a powerful tool for procedural modeling. It is also a full featured 3D package with capabilities for animation, rigging, compositing, and effects. The procedural nature of the program carries through with these other production tasks as well. In *Who am I?* I used Houdini to create procedural paint strokes, which were then animated in the Unreal Engine.

B.1 Procedural Paint Stroke HDA

This is one of the primary tools that I developed to create the visual style of the VR experience. The tool wraps 3D objects with procedurally generated paint strokes. In this subsection I cover the process for generating these paint strokes.

To start out, I opened a session of Houdini and right-clicked on the Network Editor in the obj (object) context. I then clicked on the *Geometry* menu option and clicked the *Geometry* option in the sub-menu. This menu is highlighted in figure 9. This should create a *Geometry node* in the *Network Editor* that looks like the image in figure 10. I renamed the *Geometry node* from “geo1” to “painting_tool” by double clicking on the name and editing it. Once this node is created I double clicked on it to start modifying the contents of the *Geometry node.*
The first thing that I did was remove the `file1` node that is created with the *Geometry node*. I did this by clicking on `file1` node and pressing the delete key.
Considering that this tool is packaged in an HDA, one of the first things that I did was create a Subnetwork. I did this by clicking on the Network Editor, pressing the tab key and starting to type “subnetwork”. Once I started typing this, the menu should start filtering the sub-menu options until the option for Subnetwork appears. I then pressed the enter key with the Subnetwork menu option highlighted to create it in the Network Editor. I then renamed the Subnetwork from “subnet1” to “painting_tool”. This node can be seen in Figure 11.

Figure 11: Geometry node in the Network Editor

With the painting_tool Subnetwork created, I could then create the HDA. I did this by first selecting the painting_tool Subnetwork and clicking on the Assets Main Menu and selecting New Digital Asset From Selection.... This is menu is shown in figure 12.
I then modified the Operator Name and Operator Label in the Create New Digital Asset node dialogue box to “painting_tool” and “Painting Tool” respectfully. This dialogue box can be seen in figure 13. I then clicked “Accept”.

Figure 12: Create New Digital Asset From Selection... menu item
The subnetwork defaults to having four inputs, and I only needed one input for the painting tool for the input geometry. To modify the HDA, I clicked on the Assets Main Menu again and this time hovered over the Edit Asset Properties... menu item and selected the Painting Tool sub-menu. I then changed the Minimum Inputs and Maximum Inputs to 1. This is shown in figure 14. I also modified the name of the input by clicking on the Input/Output tab and changing the Input 1 Label to “Base Object”. This is shown in figure 15.

Figure 13: HDA creation dialogue box
Figure 14: HDA creation dialogue box
Figure 15: Modify Input 1 Label to “Base Object”

This sets up a Houdini Digital Asset (HDA), which can be referenced in other Houdini files and used in third-party applications.
Appendix C  Who Am I? Script

This appendix contains the script that I created for *Who am I?*. I developed this script between September 2017 to February 2018. It was slightly modified during the table reading and recording sessions. These modifications were marked on the script of the actor that had the change made to his or her lines.
"WHO AM I?"

By

Austin Brennan
INT. BEDROOM
Adam is in his bedroom preparing to smoke a bowl. There are two young guys with him.

RYAN
I got this stuff from Mike’s older brother. It’s called "Blue Dream". He said it’s good.

BEN
Make sure to grind it fine. Throw some keef on it, too.

ADAM
Yo, check out this drawing I did.

Adam pulls out a drawing of a trippy landscape and shows it to Ben.

BEN
That’s rad, man. It reminds me of 70’s album art.

Adam shows the drawing to Ryan.

RYAN
Dope, man.

Ryan lights the bowl and takes a hit and passes the bowl. Ben takes a hit and passes the bowl to Adam. Adam takes a hit and stands up. He walks over to a poster on the wall and stares intently at it.

ADAM
Check this out. It’s so intricate. I can’t believe that someone can just come up with this sort of stuff.

Ben walks over to where Adam is standing. Ryan is sitting at a computer listening to music on headphones.

BEN
Super trippy.

(CONTINUED)
ADAM
I know, right?

There is a silent pause as the two admire the poster.

BEN
Yo, life is really trippy. I mean, the fact that we exist at all. Do you ever wonder why we are here?

ADAM
Sometimes. Yeah, sometimes I think about it. I don’t know. I don’t think there’s a God or anything. I think people construct their reality.

BEN
What do you mean?

ADAM
I mean nothing really exists in and of itself. It all exists within a framework. We are all part of something bigger, you know, like a family or a culture. We’re tied to these things whether we want to be or not.

BEN
Is that a bad thing?

ADAM
I don’t know, I mean, it is what it is. Not like we have much control over it. You can’t escape it. It makes it hard to know who you really are when you are defined by the world around you.

BEN
Yeah, I guess so ... people are different though, within a given framework.

ADAM
Yeah, that’s true.

RYAN
Hahaha whoa... you guys have to try this out! Listen to this, and close your eyes.

(CONTINUED)
Adam walks over to the desk and sits down in a chair next to Ryan. Ryan hands him the headphones and Ryan tries them on. The music is ambient psychedelic electronic music. He closes his eyes.

FADE TO BLACK

TRIPPY WORLD

Adam finds himself transported into a new world. There is a quality of this world that is both ancient and futuristic. There are buildings that indicate that this place was at one point inhabited by a sophisticated culture. The forms in this world are a mixture of a melted landscape juxtaposed with architecture that heavily uses strong lines.

ADAM
Whoa man, it’s ... beautiful.

Adam appears to be outside of a city on a hill. The natural elements of the world have a melted form. The city on the hill is composed of a multitude of boxy buildings. It appears to be powered by big cables that unify the city into a web of wires and boxes. At the top of the city is a large tree. Adam floats towards it. Adam gets to the tree and starts floating to the top. He eventually gets to the top of the tree and there is a door. He enters through the door and the ambient electronic music fades out.

FADE TO BLACK

HALL OF DOORS

Inside the door is a hallway made of floating doors. Behind each door is a cable that extends outward into space. At the end of the hallway is a white door that is glowing. Adam floats down the hallway toward the white door. The door is bumping in and out in an animated fashion. Behind it is the same ambient electronic music he had been listening to before. He approaches the door, reaches out for the knob, and opens it.

INT. BEDROOM

The door leads back into Adam’s bedroom. He floats back to the same position that he was in when he started his journey (sitting at his desk). Ryan and Ben are gone. There is a bowl (smoking pipe), sitting on Adam’s desk. There is an abrupt knock at the door to his bedroom.

(CONTINUED)
ADAM’S MOM
Adam ... Adam, open the door.

ADAM
Yeah, sure, one second.

Adam quickly places his bowl in his desk drawer and walks over to the door. He unlocks it and opens it. Adam’s mom starts to walk into the room.

ADAM’S MOM
Honey, you need to start getting ready for -

Adam’s mom stops abruptly. She sniffs the air.

ADAM’S MOM
Adam, it smells ... funky in here.

ADAM
Really? I don’t smell anything.

ADAM’S MOM
Where is it?

ADAM
What?

ADAM’S MOM
Don’t you play games with me. Where is it?

ADAM
You know, Mom, I’m not a kid anymore. Why do you have to treat me like this?

Adam’s mom starts walking around the room, sniffing.

ADAM
Come on, Mom, stop it!

Adam’s mom gets to Adam’s desk. She pulls open the drawer that Adam has stashed his bowl. She pulls it out and turns to look at Adam. She is visibly upset.

ADAM’S MOM
You know, Adam, it hurts me. I don’t know why you keep doing this to me and your father. We’ve given you everything. Why won’t you just believe us when we tell you that this is wrong?
CONTINUED: 5.

ADAM

Mom -

ADAM’S MOM

We’re going to church ... You used to like going to church. I don’t want you going like this. Stay home. We’ll see you when we get back.

Adam’s mom leaves with Adam’s smoking paraphernalia. She slams the door on the way out. Adam sighs and then walks over to his desk. He pulls out a journal and pen out of a drawer. He opens it up and starts to write in it.

ADAM (V.O.)

She doesn’t get me. I’m just trying to make sense of it all. Life. What is it all about? How do I decide what’s right for my life? There is so much more to explore. I don’t want to close myself off to all of that. What I’m doing is special, she doesn’t get that. It’s self discovery. I want to understand who I am. I want to know what it’s all about; really what it’s all about.

Adam closes his journal and walks over to the poster on the wall. His room starts to transform into the world in the poster.

POSTER WORLD

The poster looks like the interior of a cathedral designed by Antoni Gaudi. There are many tall pillars reaching up to a kaleidoscope of geometry in the ceiling. The pillars surround Adam and the floor beneath him rises. He is seated in the center of an altar. As he is being lifted, he starts to meditate.

ADAM

In.

Adam breaths in.

ADAM

And out.

Adam breaths out.

Repeat x2
Adam continues breathing slowly.

ADAM
Empty your mind.

Adam continues breathing slowly.

ADAM
Relax.

Adam continues breathing slowly. The cathedral surrounding Adam starts to crumble. Outside of it is outer space. Adam ascends upward with the crumbled pieces of the cathedral. Above him, the pieces of the cathedral are forming a building. Adam floats towards it. As he approaches, he can hear a murmur coming from inside. He floats through the floor and enters a school cafeteria.

SCHOOL CAFETERIA

Adam finds himself in his high school cafeteria seated at a long table with Ryan and Ben.

BEN
You guys hear about what happened to Mike’s older brother?

RYAN
Yeah, he was shot.

ADAM
What?

RYAN
You didn’t hear?

ADAM
No ... no, I had no idea.

BEN
Apparently he was picking up, and the guy took his money, whipped out a gun, and shot him in the chest.

ADAM
Well, is he alright?

BEN
I mean, he’s still in the hospital. Mike didn’t come to school today.
CONTINUED:    

ADAM
That’s crazy ...

RYAN
Well, now who are we going to get our weed from?

ADAM
Come on man, how can you say that?

RYAN
What?

BEN
That’s kind of insensitive, man.

RYAN
Alright, too soon. I get it. We’ve got to figure something out, though. He was a good source.

Adam starts floating backwards away from the table that Ryan and Ben are sitting at. There is a utility closet behind Adam. He floats through it slowly backwards. As he floats through, the door slams shut. The sound of the door shutting sounds like a gun shot. There is a sequence of 10 more doors that Adam floats through backwards. As he floats through each of the doors, it slams shut with the same gun shot sound. In between each door is smaller and smaller room with bare walls. He floats through the last door. It slams shut. Adam finds himself in his bedroom again.

INT. BEDROOM

Adam floats over to his desk, and sits in his desk chair. His journal is sitting open on the desk with a pen next to it. He picks up the pen, and starts to write.

ADAM (V.O.)
Why am I so depressed? I feel like everyone around me is moving and I’m not. Maybe I’m just tired. Maybe it’s the drugs... I’ve just got to get some sleep. Good sleep. I’ve been feeling so tired lately.

Adam closes his journal. The journal sinks into the desk, and the desk sinks into the floor. A hole emerges where Adam’s desk was. The hole has a spiraling staircase that descends into darkness. Adam starts floating down it.
DEATH SPIRAL

Adam floats down a spiral staircase into a darker and darker place. The stairs turn to teeth and the walls into a flesh-like lining. The walls open up into a black chasm. There are lit towers in the distance of the black space. Adam is distant from them. Adam’s desk is floating in the black chasm, with his journal and cell phone sitting on top of it.

ADAM

Am I alone? Can anyone hear me? Is this my fault? Oh God, why am I like this? What happened? I used to feel happy. Now everything feels tainted and wrong. I feel bankrupt. My soul has abandoned me. The universe has abandoned me. Is anything pure? Is anything good? Is there a light out there? Anything that can bring back my joy. Death surrounds me on all sides my heart is rotting in sorrow. All is death, decaying flesh and bone. How could it come back to life? Almost like someone had come into my life and replaced everything that was real with a fabrication. The light... it’s so distant. Was it ever there to begin with?

The cell phone on top of Adam’s desk begins to ring. Adam floats over to it and picks it up.

RYAN (THROUGH PHONE)

Hey man, I’ve got a guy.

ADAM

Yeah?

RYAN (THROUGH PHONE)

I’m about to go grab a slice ... can you come with me?

ADAM

... uh sure, I can come.

RYAN (THROUGH PHONE)

Cool ... thanks man. I’ll swing by in half an hour.

(CONTINUED)
Adam floats down deeper into the black chasm, and away from the towers. There is a sound of a car door opening and closing. It is followed by the sound of a seat belt clicking. There is also the sound of a car engine running. There is the sound of a joint being lit, and someone taking a hit.

RYAN (V.O. MUFFLED)
You want a hit?

ADAM (V.O. MUFFLED)
Sure.

Adam takes a hit.

ADAM (V.O. MUFFLED)
Where is Ben?

RYAN (V.O. MUFFLED)
He felt sketched about going. His dad came down on him hard when he found his stash. I think he’s trying to play it cool.

ADAM (V.O. MUFFLED)
Gotcha ...

There is a clicking sound of a radio turning on. The same ambient electronic music that was playing when Adam was in the trippy world starts playing again. There is a red light in the distance and Adam is floating towards it.

ADAM (V.O. MUFFLED)
Hey man, are you going to stop?

RYAN (V.O. MUFFLED)
Huh?

ADAM (V.O. MUFFLED)
It’s red!

CRASH. There is an explosion of pieces of the vehicle with Adam floating in it. Some pieces are glass, some are metal, and there are car doors floating around Adam. All of the pieces are suspended. It looks like they are floating without gravity. The world fades black and tubes emerge from Adam’s mouth. Sirens start sounding and lights start flashing. Adam starts floating down the tubes. They become brighter and brighter as he floats down.

FADE TO WHITE
BLACK CHAMBER

Tubes are coming out of Adam’s mouth and stretching out into a black chasm. Lights are flashing and emergency sirens are sounding.

DOCTOR (ECHOED VOICE)
His vitals are dropping. We need to get him on the machine soon.

NURSE (ECHOED VOICE)
He’s convulsing. I’ll hold him down.

ADAM (V.O.)
Hello ... can you hear me? Am I Okay? I can’t breathe. I don’t want to die ...

The tubes coming out of Adam’s mouth engulf him and he starts traveling down them. The tubes become brighter and brighter.

FADE TO WHITE

HOSPITAL ROOM

Adam ends up in a hospital room. Tubes are coming out of his mouth and into a breathing machine next to him. His mom is on his left. She is weeping. Adam’s father is sitting next to Adam’s mother. He is holding Adam’s mother and trying to comfort her. A nurse is to Adam’s right fiddling with medical equipment. There is a steady beep, beep, beep, sound of a heart monitor, and a steady intake and release of the breathing machine.

ADAM (V.O. WEAK)
Mom... Mom, can you hear me? Mom, I’m sorry... I didn’t mean for it to be like this. I’m broken ... Mom. I wish I could tell you. I - I don’t know what I’m doing.

Adam’s mom continues weeping. A tunnel opens up in front of Adam and he starts moving towards it. The rhythmic sound of his machines turns into a deeper sound with the same rhythm. As he floats into the tunnel, it opens up into a cavern. There are black-knotted objects that are thumping like a heart beat.

Adam floats deeper into the tunnel and it turns to white. The thumping sound fades out.

(CONTINUED)
CONTINUED: 11.

NURSE (V.O. ECHOED)
He’ll be okay. He just needs rest.

ADAM’S MOM (V.O. ECHOED)
Thank you.

Adam floats along a little longer.

ADAM’S MOM (V.O. ECHOED)
Adam, how are you feeling?

ADAM (ECHOED VOICE)
Fine, I guess. Kind of fuzzy, but I’m alright.

ADAM’S MOM (V.O. ECHOED)
I set up an appointment for you to meet with Pastor Dan this afternoon. I want you to talk with him.

ADAM (V.O. ECHOED)
Uh okay, sure. I think I’d like that.

FADE TO WHITE

MOUNTAIN SIDE

Adam floats down onto the side of a mountain. There is a bench overlooking a valley. Pastor Dan is seated on the right side of the bench, and Adam floats onto the left. Pastor Dan turns to Adam.

PASTOR DAN
So Adam, how are you doing?

ADAM
Good, I guess. I don’t know -

There is a silent pause.

ADAM
Did my mom tell you that I’ve been smoking weed?

PASTOR DAN
Yes, but I’m not here to judge you. Adam... Your mom told me that you’ve been feeling down lately, especially since your accident.
... yeah.

There is a silent pause.

PASTOR DAN
Remember the canoe trip we did a few summers ago?

ADAM
Yeah, it was miserable. It rained the whole time.

Both Adam and Dan chuckle.

PASTOR DAN
Exactly, and each day we had to pack all of our gear into our canoes and paddle for miles. It was discouraging ... what kept you going?

ADAM
I honestly just wanted it to be over.

Both Adam and Dan chuckle.

ADAM
I guess I knew that it would end. I hoped that the rain would stop. When it didn’t seem like it was going to stop, I at least knew that the trip would eventually be over.

PASTOR DAN
So you had hope. You knew that the rain would end, or at least that there was a warm car waiting at the end of our trek.

ADAM
Yeah.

PASTOR DAN
Do you feel like you are in a similar place now?

ADAM
No... It isn’t the same as the rain. It isn’t something on the outside. It’s inside. I don’t even know what it is. It feels more like... (MORE)
ADAM (cont’d)
the lack of something, than the
presence of something I don’t want.

PASTOR DAN
I see. I think I know what your
problem is Adam.

ADAM
You do?

PASTOR DAN
Yes, and it’s not something you nor
I can fix. In fact, no one and no
thing can "fix" the problem you’re
describing Adam, except for the one
who can.

ADAM
What do you mean?

PASTOR DAN
It’s Jesus Christ.

ADAM
I don’t know... what do you mean by
that?

PASTOR DAN
Adam, the problem you’re describing
is sin.

ADAM
I don’t feel like I’ve done
something so wrong that God should
punish me like this.

PASTOR DAN
Sin is in the heart, Adam. It’s
that empty feeling inside of you.
Your soul misses the presence of
God. Our sin makes that
inaccessible to us.

There is a silent pause.

ADAM
... okay. Well, how do I get it
back?

PASTOR DAN
There’s not anything that you can
do. Jesus has already done it for
you.

(Continued)
ADAM
What do you mean?

PASTOR DAN
When Jesus died on the cross, he died not only to forgive your sin, he died to fill the void in your heart. Those feelings that you are alone, unworthy, shameful. Jesus died to fill the gap between you and God. That's redemption.

There is a silent pause.

ADAM
It just doesn't feel real to me. I've heard this at church... I just feel like if God really loved me, he would make himself real to me. I mean the Universe is so complex, how is Jesus, a man, supposed to be the explanation for everything.

PASTOR DAN
Oh Adam, Jesus is so much more than just a man. He is the embodiment of the infinite being of the living God.

The word "God" echoes into the valley.

THE VALLEY
Adam slides off of the bench and into the valley. The valley becomes darker and darker. Adam floats around to the opposite side of a mountain. The towers that he had seen in the black chasm are in the distance. The towers have lights spiraling down them.

ADAM
God if you are real, be real to me. I don't know who I am. I feel so alone. Jesus show me who you are.

Out of the distance, cables emerge from the lights in the towers. The cables flow towards Adam and connect to form a door. The door is glowing and opens. Out of the door emerge flowing silk and ribbon robes. The robes surround Adam encapsulating him in light.

Adam is breathing heavily yet rhythmically.

(CONTINUED)
ADAM (WHISPERED)
Jesus ... I don’t know where I am.
I don’t know who I am. I’ve tried
to figure it out but I can’t. You
God are greater than I am. Lord
your ways are higher. Father have
mercy on me. Restore my joy.

JESUS (WHISPERED)
You are clean my son. I have come
to wipe away every tear, and
restore your heart. You have heard
my voice. Come dine with me in
paradise.

FLIGHT
A piercing light shines through the garments and they open
back up. Adam is floating through valley. Sounds of nature
surround him as he flies through beautiful vistas of nature.
The vistas open up into a white ethereal space, and Adam
floats down to a table. The table extends out in many
directions, branching out with a symmetric quality that
looks like a snow flake. Seated at the table are radiating
beings laughing and enjoying the company of one another.
God’s glory is at the center represented by flowing cloth
and light.

PARADISE
The sound of worshipers can be heard. There are beautiful
sounds emanating from God’s glory and the beings that are
worshiping.

WORSHIPER 1
Holy, holy, holy, is the Lord God
Almighty; who was and is and is to
come.

WORSHIPER 2
God, you are here now and forever,
you never leave the side of those
who love you. The great I am.

ADAM
Jesus, thank you. I was lost, but
now I am found. Lord I feel you,
and I know you. I will never be the
same.
Figure 16: Adam floats through a trippy landscape
Figure 17: Adam floats through a tree
Figure 18: Adam floats through a hall of doors
Figure 19: Adam’s bedroom
Figure 20: Adam meditates in a geometric kaleidoscope cathedral
Figure 21: Adam floats through outer space towards a building
Figure 22: Adam talks with his friends in his school cafeteria
Figure 23: Adam floats through a sequence of shutting doors
Figure 24: Adam writes in his journal
Figure 25: Adam floats down a spiral into a black chasm
Figure 26: Adam floats in darkness with lit towers in the distance
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