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Pixelated Domes: Cinematic Code Changes through a Frank Lloyd Wright Lens

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PIXELATED DOMES: CINEMATIC CODE CHANGES THROUGH A FRANK LLOYD WRIGHT LENS

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ABSTRACT

Panoramic 360-degree documentary videos continue to saturate the visual landscape. As practitioners' experiment with a new genre, understanding meaning and making awaits the academic and marketplace landscape. The new media journey of 360-degree documentary storytelling is ripe for media archaeologist to explore. New media scholar Lev Manovich (2016) believes "we are witnessing the new emergence of a cultural metalanguage, something that will be at least as significant as the printed word and cinema before it" (p. 49) Considering the meta-development of this new media genre, my dissertation seeks to discuss the historical roots of the panoramic image, define 360-degree Cinematic Virtual Reality (CVR) documentary video, establish production distinctions between 360-degree CVR and two-dimensional documentary video, and reveal the spatial cognitive abilities of 360-degree documentary video.

The purpose of this dissertation study is to establish a media archaeological context of the 360-degree image and reveals the development of new cinematic code variations between 360 CVR modalities and two-dimensional documentary form. The theoretical framework developed within this study will inform current and future 360-degree documentary narrative engagement practices. Secondly, this project seeks to evaluate spatial cognition levels when viewing a Frank Lloyd Wright walking tour through 360 CVR modalities and examine the influence this has on narrative engagement comparative to traditional two-dimensional documentary form.

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CHAPTER 1: INTRODUCTION

Spaceship Earth is considered the flagship symbol at Walt Disney's Epcot theme park. With complex animatronics and iconic symbols, this gentle ride paints a historic media landscape offering an idealistic vision of innovation and progress. As the ride ends, participants build a Jetson's-like vision for their future. Regardless of intention from the ride's creators, most patron's get off Spaceship Earth with a perception that the Jetson-like future is never-ending and constantly changing.

Change is an inevitable human experience that functions within the relativity of time and space. New media scholar Lev Manovich (2016) believes "we are witnessing the new emergence of a cultural metalanguage, something that will be at least as significant as the printed word and cinema before it" (p. 49). Understanding this new emergence requires a focal adjustment away from the blurry flickering pixels of digital immersion. Media ecologist Marshall McLuhan (1967) states "all media work us over completely. They are so pervasive in their personal, political, economic, aesthetic, psychological, moral, ethical, and social consequences that they leave no part of us untouched, unaffected, unaltered" (p. 26). The pervasive nature of a medium is comprised of both the text and the technology. The capacity to refocus and reflect on these universal changes requires an understanding of previous media forms and its underlying operational mechanism.

Within the milieu of technological change, residue of orality continues to reshape new agreements and patterns forming a new text. Beyond the natural condition of oral communication, artificial technological transformations, such as 360-degree technologies, begin to saturate human experience with new agreements and patterns. These patterns form languages

that constantly move society further from the oral-based traditions to a new literate-based society conditioned on the formation of medium-centered writings. According to new media scholar David Bolter (2011), writing involves technologies that arrange "verbal ideas in a visual space" (p. 15). This method of arranging verbal ideas into a tangible space forms the concept of writing. So, whether ancient or modern, writing is constantly evolving based on the medium present within that culture. Currently, culture is in a constant "remediation" of the past (p.16). Bolter explains remediation as the new and old co-existing. New media technology, according to Bolter, is always "borrowing and reorganizing the characteristics of writing in the older medium and reforming its cultural space" (p. 23). Within this reforming lens, the panoramic 360-degree Cinematic Virtual Reality (CVR) continues to borrow residue from the past to shape the future.

Panoramic 360-degree CVR documentary videos continue to saturate the new visual landscape. As practitioners' experiment with a new genre, understanding meaning and making awaits the academic and marketplace landscape. The new media journey of 360-degree documentary storytelling is ripe for media archaeologist to explore. Considering the meta-development of this media genre, my dissertation seeks to discuss the historical roots of the panoramic image, define 360-degree video, establish production distinctions between 360 and two-dimensional documentary video, and reveal the spatial awareness abilities of 360-degree documentary video.

Purpose of this Study

The purpose of this dissertation study is to establish a media archaeological context of the 360-degree image and to reveal the development of new cinematic code variations between 360

modalities and two-dimensional documentary form. The theoretical framework developed within this study will inform current and future 360-degree CVR documentary narrative engagement practices. Secondly, this project seeks to evaluate spatial awareness when viewing a Frank Lloyd Wright walking tour through 360 modalities and examine the influence this has on narrative engagement comparative to traditional two-dimensional documentary form.

Research Questions

This research will first define the distinct narrative storytelling production characteristics that form Cinematic VR (CVR) documentaries comparative to two-dimensional documentary filmmaking. Secondly, beyond the foundational cinematic codes of CVR, this research will explore whether CVR documentary experiences enhance spatial awareness of users as it relates to informal learning environments at a Frank Lloyd Wright cultural heritage site in Lakeland, Florida. Lastly, this research wants to know the impact of spatial presentation of documentary content on perception of narrative engagement when viewing linear content in non-360 form displayed in a two-dimensional player comparative to linear 360-degree documentary content displayed in a 360-degree player. The following three research questions guided the current study:

RQ1: What are the distinct narrative storytelling production characteristics that form Cinematic VR documentaries comparative to two-dimensional documentary filmmaking?

RQ2: Can Cinematic VR documentary experiences enhance the spatial awareness of users as it relates to informal learning environments of cultural heritage sites?

RQ3: What is the impact of spatial presentation of the documentary on perception of narrative engagement when viewing linear content in non-360 form displayed in a two-dimensional player comparative to linear 360-degree documentary content displayed in a 360-degree player?

CHAPTER 2: LITERATURE REVIEW

This chapter establishes a short historical context of the 360-degree image while addressing structural forces influencing developments and uncovers the development of new cinematic code variations within 360-degree spaces through an active pursuit of authentic expression. Having a historical perspective of 360-degree technology helps understand the restructuring of this new writing space.

Within the idealistic vision of new "texts" and "technologies" connected to 360-degree CVR documentaries, endless possibilities of reshaping humanity exist. Seeing the relationship of both the technology and the text requires understanding the impact, both good and bad, on humanity. With increased reliance on the electronic grid weighing down the pursuit of individual balance, Birkerts (2015) explains how new technological languages "shatter old supporting structures," yet, at the same time fosters a "new model of disengaged engagement" (p. 13). Birkerts views this as a loss of "our sense of being grounded in our material reality" (p. 15). As the reconstructed hive identity takes hold, an active pursuit to blur the boundaries of place undermines locality. In *The Saturated Self. Dilemmas of Identity in Contemporary Life*, Kenneth Gerden (1991) explains biological "substitutions of self" are contributing factors to losing the "real person" (p. 140). Gerden essentially argues that the user has handed over their rights of vision to the technological machines. Although determining who or what vision the user invokes, Gerden (1991) believes this "consciousness of construction" receives "different implications" based on how that pseudo person is treated (p. 145). If so, does that reconstructed identity have any implications on how the user relates to the content? As the user is placed in a different

locale, what language allows a new sense of narrative engagement? This breakdown within the text and technology of 360-degree CVR may reshape the user.

As technology alters cultural groundings with new texts, having an appreciation and understanding of technological changes yields awareness. Coupled with this awareness is a responsibility to value the past and recognize the constrained power of new 360-degree technologies. This perspective allows the content and context of Spaceship Earth to continue on into the future.

Context of a New Frame

In 2016, VR Data Network reported over 6.3 million virtual headsets, a remediation of the Vaudeville peep show, shipped to users worldwide exciting new media artists to create new innovative interactive experiences (Durbin, 2017). Being at the forefront of a new medium harvests an idealistic vision generating new discoveries which work to reshape society. These new discoveries "are not isolated events but extended episodes with a regularly recurrent structure" (Kuhn, 1962, p. 53). With heightened awareness, 360 content creators are striving "to see nature in a new way" through new technology and artistic practices (Kuhn, 1962, p. 53).

With so many mesmerizing calls to adopt shiny new technological tools, our current technologies continue to remediate the past. New media scholar Jay David Bolter (2001) explains remediation as the new and the old co-existing. For example, moving into the digital distribution domain, Vimeo streaming just released support for 360-degree videos on March 8th of 2017 spring-boarding 360 content into mainstream media consumption (Vincent, 2017). Yet, domed visual spaces distributing 360-degree images embrace a long history dating back to

Aristotle. Pre-cinematic technology, such as the peep-show, panorama, and panstereoramas, provide inspiration for new developments within our technological paradigms. Both examples note the progression and conflict faced within current 360 trends. The panorama was the first of its kind to place the user's consciousness at the center of the rotunda. This reflects current virtual reality (VR) environments. Along with that, the panstereorama was the first environment to allow a user to be on the outside of a full-scale 3d model depicting a new space. Currently, Google Maps 3D view is a reflection or remediation of the panstereorama. Seeing the past in a rear-view mirror perspective shapes the artistic endeavors of today.

Panorama and the Panstereorama

Engaging scientific discovery, seeing the unusual can be the anomaly needed to further cinematic knowledge and artistic practices. 360-degree CVR as a medium reaches further than the panorama or panstereorama. Bolter (2001) suggests cultures wrestle with a constant dichotomy between seeing through the medium, "transparency", or desiring "hypermediacy", an intense awareness of the form (p. 25). Historically, within cinema, this bout was demonstrated through Vertov's monumental work *The Man with the Movie Camera*. Disenfranchised with Hollywood's idealistic narrative structures, Vertov drew attention to the filmmaking process by breaking the fourth wall allowing the audience to see the experience as unreal. Today, VR content creators wrestle with the complexities of transparency. For example, tethered Head Mounted Displays could cause users to break their presence within the 360-experience due to cabling issues. This break draws attention to the medium.

The Frame Anomaly

As the anomaly of knowledge and artistic practice continues to unfold, constant readjustments through new code changes and structural elements initiate paradigm changes. In this slight shift, Kuhn (2012) believes "a new vocabulary and concepts for analyzing events" are needed to undermine the "questionable concept of seeing" (p. 55). For example, VR manufacturers and filmmakers are working towards understanding new concepts of cinema such as camera movements as it relates to nauseousness, composition, edit pacing, choreography and staging, lighting, and spatialized sound. These categories are yet to be defined in the 360-degree cinematic language. Currently, seeing and touching invoke an immediate reality of discovery. This is reflected in the pursuit of more sensor-based technologies within CVR. However, Kuhn (2012) says "discovering a new sort of phenomenon is necessarily a complex event, one which involves recognizing both that something is and what it is" (p. 55). Language development seems to restrain the act of categorizing the discovery by an individual or by a cultural timeframe. Yet, Kuhn notes the value of discovery incited by the violation of previous paradigms dictates the categorical progression. Once categorical assimilation occurs, which is essential, the anomaly can then be explored to determine the possibility of paradigm change. 360-degree CVR documentaries are in the middle of this paradigm occurrence.

New Medium Constraints

As the paradigm change occurs, structural forces and the lack of scientific discovery limits may undermine the development of artistic ideation. In his seminal essay entitled "The Work of Art in the Age of Mechanical Reproduction," Walter Benjamin (1936), states,

> "the authenticity of a thing is the essence of all that is transmissible from its beginning, ranging from its substantive duration to its testimony to the history which it has experienced. Since the historical testimony rest on the authenticity, the former, too, is jeopardized by reproduction when substantive duration seems matter. And what is really jeopardized when the historical testimony is affected is the authority of the object." (p. 221)

Known for his significant contributions to aesthetic theory and literary theory, Benjamin's choppy writing style establishes the limitations associated with authenticity. Using a media archaeological lens, Benjamin (1936) reveals a slow progression of reproductive processes, such as coin production and bronze statue replication, were used to springboard the art culture towards mechanical reproduction techniques. Benjamin excuses the reproduction of print as a special situation and was not as critical to this mechanical process. However, he expressed disdain with the medium of photography because of the power to move the artists hands away from the canvas shifting the sensory to focus more on the eye and the mechanical reproduction of the real. Targeting lithography, photography, and film, Benjamin feels the reproductive art cycle is having dramatic effects on aesthetic value. By extending the art process to other senses, it basically diminishes the "aura" or genuine authenticity. Authenticity is not diminished. However, speed and efficiency are something that should be avoided when it comes to art. It takes time to create.

Beyond the transition of mechanical art processes, new media art creation faces deeper constraints behind the curtain of front-end design. In *Software Takes Command*, Lev Manovich (2013) addresses previous physical mechanical forms and methods as singular in nature, he builds an argument that current new media materials and environments become data structures built on a set of algorithms. Manovich (2013) injects biological metaphors to address "temporal development and increased variability and speciation" (p. 237). Basically, an emergence of new

species evolves creating new software variations. Using After Effects as his launching pad, Manovich (2013) believes "deep remixability" (p. 248), or the sharing of common DNA amongst various platforms, reshapes visual aesthetics, methods, ways of representation and expression, spatial dimensions (3d space), and amplification of cinematic techniques (DOF). Moving away from the mono-medium, this remixability seeks to replace the previous tactile forms with algorithmic substitutions. The once mechanical and analog process of content creation now is stamped into limited frameworks. Manovich (2016) notes the struggle as cultural interfaces work to accommodate the necessity of "consistency and the demand for originality" (Manovich, 2016, p. 48). This demand forces software developers into a homogenization of data structures undermining the integrity of pure art. Manovich describes this process as the principle of variability.

Similar to Manovich (2016), David Berry (2016) also addresses the issues surrounding contemporary content creation. On the subject, Berry posits that stamping content creation into limited framework creates "a tangle, a knot, which ties together the physical and the ephemeral, the material and the ethereal, into a multi-linear ensemble that can be controlled and directed" (Berry, 2016, p. 3). Berry (2016) further states

> "Due to improvements over the last forty years or so, programmers can now take advantage of tools and modular systems that have been introduced into programming through the mass engineering techniques of Fordism. This means that software is written using other software packages." (p. 37)

Throughout his text *The Philosophy of Software: Code and Mediation in the Digital Age,* Berry (2016) reinforces Manovich's (2016) position on "remixability" as well as Douglas Engelbart's (1995) vision of Bootstrapping, the concept of building on top of previous workflow. When viewed as a holistic whole, these three works reveal how digital environments have the

potential to excite the possibilities of content creation through enhanced hypertextual symbolized interface design reinforcing augmentation. Functioning within these deep remixed software environments, the user works through spatial patterns engaging multi-media tools allowing layers of artistic construction. The semiotic/semantic relationship software users develop within hypermedia environments augment the flow of problem solving.

As technological change alters ideation practices within artistic environments, finding strategic unrestrained innovative exercises generates a truly authentic refocus away from constrained limitations of the medium. Despite structural forces limiting operational mechanisms undermining artistic development, new media content creators strive to reshape artistic variations prompting an emergence of a new "kind of cultural configurations," (Hayles, 2008, p. 285) which remediates the physical form attached to previous mixed reality experiences. Finding the right balance is key towards developing the craft of art making within Cinematic VR documentary storytelling.

Development of the Equirectangular

Panoramic 360-degree videos continue to saturate the visual landscape of digital immersion. Considering the meta-development of this new media genre, this chapter seeks to discuss historical roots of the panoramic image, define 360-degree video, establish distinctions between 360 and non-360 video, and reveal the importance of 360-degree video.

Historical Roots of 360-degree Video

Digging into our past, pre-cinematic technology, the panorama and panstereoramas provide inspiration for new "idiosyncratic invention and artistic production" (Hosterman, 2010,

pg 46). Having a historical perspective helps to understand the distinction between 360 video and non-360 environments. Restructuring of the 360-degree pixelated dome is not effortlessly placed in this optimistic linear narrative of technological progress. The clean slated linear film history fails to include the juxtaposition of early electronic media. The respected critic Jean Douchet fears "the loss of the indexical link with the real in the digital image presents a major threat to mankind's pictorial patrimony" (as cited in Elsaesser, 2016, p. 22). This next section explores the history of the equirectangular image and the history of the technology used to wrap the 360-degree image.

History of the equirectangular

Trying to establish some contextual grounding within this genre, VR filmmaker Chris Milk (2016), who produced breakthrough virtual immersion projects *Sound and Vision* and *The Wilderness Downtown*, reinforces the 360-degree chant prodding a look into his rearview mirror stating:

> If we go back to the origins of mediums, by all best guesses, it starts around a fire, with a good story… But where are we now? What is the current state of the art? Well, we are here. We are the equivalent of year one of cinema… Similar to this early stage of this medium, in VR, we also have to move past the spectacle and into the storytelling. (Milk, 2016)

Readjusting Milk's perspective, Thomas Elsaesser (2016) contests the historical perspective that VR film was logically conceived. Seeking to reinforce alternative film histories regarding VR and taking a sharp turn away from Muybridge's "persistence of vision" linear narrative, Elsaesser (2016) suggests a more nuanced look at Messter's Alabastra projections, the panorama, and the phantasmagorias. Elsaesser (2016) questions the "intellectual sleight of hand"

used to censor the full range of anomalies existing in the virtual reality historical cinema magic bag sensing they are only to be “forgotten” (p. 32).

Drawing attention to the forgotten movement of 360-degree images through a more nuanced look reveals the variation between the panorama, a term established in 1792 by Robert Barker, and the panstereorama which gained traction in the early 1800s. Although both forms desire to represent the real through exact duplication, the panorama used “perspective” while the panstereorama used “miniaturization” (Momchedjikova, 2017). Heavy painted panoramas established a sense of “being there” (presence) allowing viewers to stand in the center of a rotunda-like structure. It’s important to note this development happened before the image was captured through mechanical devices or before illustrated newspapers (Wray, 2017).

The first panoramic camera was not patented until 1843. From here, the golden-age of panoramic photography began to take hold as the United States Geological Survey (USGS) worked to establish topographical maps of the US territory (Schneider, 2017). Lastly, rather than “seeing the real” from the first-person point-of-view through the panorama, panstereorama placed the user outside the miniaturization confirming what they “are observing in the replica, by identifying known places from the real world” creating a sense of authenticity (Momchedjikova, 2017). Both perspectives mirror the current development of trends happening within the 360-degree video community. For example, Insta360 video technology allows users to swing the 360-degree video camera around the subject using a selfie-stick or a string tied to the camera, called the bullet-time shot, capturing not only the subject in 360, but the space in 360 as well, mirroring a technique captured in the Wachowski brothers film *The Matrix* (“How to Shoot Bullet-Time

Shots with the Insta360 One," 2017). This effect emulates the intent and purpose of the panstereorama.

History of the wrap-around

Understanding the panstereorama and panorama, society was ready to move beyond the static frame to experience new situations. A frame-filled image provided a secondary window to reality separating the four corners within another space. As the "persistence of vision" early film experiment took shape, a new image filled the frame. This image was clocked at 24 frames per second. Along with that, the moving image continued the progress of "being there" as early filmmakers strive "for complete illusion and visual plenitude, while the viewer is asked to suspend disbelief and to identify the image" (Manovich, 2016, p. 96). The aggressive movement of the image was bound to face disruptions. By the mid-1960s, Ph.D. student Ivan Sutherland, under the direction of Claude Shannon, created the Sketchpad (Manovich, 2016). Not only did this mathematical experiment create the first vector graphics, but it also opened the lines of communication between humans and machines through the first graphical induced interface. As screen-based interactivity increased, Sutherland extended his research by initiating the first prototype of VR. In 1968, Sutherland said "the fundamental idea behind the three-dimensional display is to present the user with a perspective image which changes as he moves" (as cited in Manovich, 2001, p. 102). Although the technology was not sufficient to support commercial progress, this was the beginning of the end of the frame as users began to situate themselves within a frameless environment.

Working out the what

Immersive experiences using a head-mounted device (HMD) have a short fifty-year history. In 2012, with a goal of 100 backers, Oculus launched the official Kickstarter campaign. Within 24 hours, they raised over $670,000 (Kumparak, 2014). Two short years later, Facebook purchased Oculus and helped move the VR genre to main street. In 2018, untethered standalone VR headset sales grew by over 400 percent and snatched 20% of the headset market (Graham, 2018). Recognizing the potential for storytelling in this medium, artists continue to migrate to this genre. As new software and hardware devices germinate, different approaches to the medium occur. For example, narrative, experimental, and documentary serve a distinct purpose within film history. The genre of 360-degree video falls in the middle of traditional VR and two-dimensional film storytelling. Using two of Lev Manovich's new media principles, this next section seeks to describe 360-degree video through modularity and variability.

Modularity

The principle of modularity allows for media elements to exist on their own, yet, have the capacity to combine into larger objects. 360-degree video is a repackaging of previous forms to capture and translate immersive stories. Berry (2016) claims that "programmers can now take advantage of tools and modular systems that have been introduced into programming through the mass engineering techniques" (p. 37). Using modularity, 360-degree video hardware combines two to six lenses to capture images. Just recently, camera manufacturers are able to internally seamlessly stitch theses separate cameras to create one large equirectangular image. This form of modularity increases image resolution dramatically. At this point, most HMDs fail to reproduce

or match the resolution captured by professional 360-degree cameras. Beyond the modularity of camera acquisition, audio is captured using an omni-binaural microphone. This is a rebuild of traditional stereo recording. For example, in traditional film, sound is captured using a left and right channel. Accounting for the complexity of the ear, 360 filmmakers strive for the full-spectrum of sound. 360-degree video continues to build towards larger modularity.

Variability

360-degree video differs in terms of format and distribution methods. This ever-changing dynamic continues to challenge the classification of 360-degree video versus traditional VR. Within the principle of variability, Manovich (2001) feels "a new media object is not something fixed once and for all, but something that can exist in different, potentially infinite versions" (p. 36). Both traditional VR and 360-degree video continue to reshape into new forms due to the advancement of both hardware and software environments.

Defining 360-degree Video

With the constant presence of modularity and variability at play, fixation of thought constrains the complexity of defining new ecosystems. Vandendorpe (2009) says "thought is as hard to hold on to as smoke" (p. 10). Striving to find a working definition for documentary, film historian Bill Nichols (2017) says it "can be no more easily defined than 'love' or 'culture' (p. 20). With these elements in play, contemporary video filmmakers and academics loosely defined 360-degree video practices as Cinematic Virtual Reality (CVR). According to Mateer (2017), CVR is a type of immersive VR experience where individual users can look around synthetic worlds in 360-degrees, often with stereoscopic views, and hear spatialized audio, specifically

designed to reinforce the veracity of the virtual environment. (Mateer, 2017) Although the definition seems to infringe on traditional VR, key distinctions between the practices are staging, mobility, platforms, and acquisition.

When setting up the post-production staging environment, VR developers tend to build experiences in Unity or Unreal. The production approach allows the user to freely walk around when using an HMD and interact with choice-points. CVR approaches the post-production process via a linear timeline using the video editing tool Adobe Premiere Pro. At this point within the software, editors can apply motion graphics and other cue points. However, the user receives the content in a linear path. As noted above, CVR is a very fluid genre. Recently, as 360-degree camera technology increases, game engines are integrating more tools and prefabs to accommodate this market. With this in mind, 360-degree artists can now implement choice-points and other augmentations to increase interactivity similar to traditional VR.

Beyond staging within post-production, CVR and traditional VR approach the concept of mobility quite differently. Depending on the length of cabling, traditional VR allows the user to freely move around within the virtual and physical space. At this point, most CVR experiences are static, yet allow the user to look around in 360 degrees. Again, as untethered HMD's continue to increase the flexibility of space, 360-degree artists have room to innovate within this category.

The platform neutral craze, which is prevalent in today's gaming culture, is quite relevant to CVR and VR creators as well. When creating content in CVR, platform options are quite limitless. Traditional VR requires a high-end headset which is usually tethered and requires a separate computer system. Beyond traditional social platforms such as YouTube, Vimeo, and

Facebook, open source developers have created unique CVR web players. For example, creators can add unique pop-out windows, interactive navigation, and hotspots to their finished product. Along with that, the untethered Oculus Go provides a high-resolution truly immersive experience for CVR content.

Lastly, image acquisition is a primary area of distinction between CVR and traditional VR. Most content in the traditional VR environment goes through a rigorous process to digitize and construct visual spaces. Most content created for traditional VR is fully computer-generated imagery. This allows for the highest quality content. CVR artists capture mostly live action content. As noted above, the resolution for CVR cameras continue to exceed expectations and reach beyond high-res cinema.

Distinctions of 360-degree Video

Today, CVR artists strive to reshape cinematic code variations within 360-degree spaces prompting an emergence of a new species which draws a distinction from the physical form attached to previous mixed reality experiences. As CVR filmmakers begin to shape fully immersive stories through grammar of filmic language, new expressions through cinematic code variations begin to emerge. This next section seeks to explain the distinction between 360 and non-360 video.

Simulation of physical media

Insta360 was founded in 2014 and continues to establish market-place standards and protocols for cinematic VR. Along with that, they just won the 2018 Consumer Electronics Show innovation award in virtual and augmented reality category (“Double Take: Insta360 Pro,

Insta360 ONE Cameras Win CES 2018 Innovation Awards," 2017). On the Insta360 corporate website, the company claims that Insta360 experiences "transport people into places and moments they've never before imagined" ("Insta360 Cameras Empower Creators," n.d.). Along with that, Insta360 claims a software using a "proprietary interpolation algorithm" and existing in Shenzhen, a city that provides an "incomparable hardware ecosystem" enables leading-edge products. ("Insta360 Cameras Empower Creators," n.d.). A common tagline used to promote the Insta360 line of cameras is "a camera crew in your hand."

Basically, the physical is now simulated through numeric data. In *Software Takes Command*, Manovich (2013) notes the "loss of the physical and the replacement through simulation" (p. 200). Simulation enables varied data structures and materials that combine to generate a "new hybrid medium" (Manovich, 2013, p. 205). Although Manovich addresses previous physical forms and methods as singular in nature, he builds an argument that current materials become data structures built on a set of algorithms. This reinforces the "camera crew in your hand" tagline for Insta360 is using to push for the elimination of the need for physicality. For example, the Insta360 flowstate algorithm is a move to eliminate physical stabilization devices used in traditional non-360 filmmaking. Along with that, Insta360 encourages video artists to "shoot first and point later." Traditionally, in a two-dimensional video, variable focal lengths were accomplished through physical lens changes. If a close-up shot is needed, the 85mm prime lens provided that composition. On a larger film set, at least two individuals, the first and second camera assistant, were needed to address these physical changes. With the Insta360, the 360 image is captured and video artists can select 2d angles within the post-

production environment. These physical simulations continue to disrupt and distinguish 360 workflow from non-360 video.

Deep Remixability

Along with the elimination of physical structures through internal software algorithms, 360-degree camera technology continues to mash-up other forms creating new aesthetic forms that distinguish from non-360 video. The acceleration of new media models through software hybridizations continues to share "common DNA" within 360 devices creating this "deep remixability" (Manovich, 2016, p. 267). This is another distinguishing factor of non-360 video. For example, Insta360 promotes its invisible selfie stick option as an alternative to drone technology. Extending their fishpole, they are simulating another physical device creating a new aesthetic choice for 360 filmmakers.

Importance

Paradigm manifestations are tightly interconnected and require acute observation to invoke perceptual changes. Kuhn (1962) uses a psychological study involving playing cards to demonstrate the need for scientists to conduct a perception examination. In this study, subjects were exposed to regular and abnormal cards with the intent to determine awareness of anomalies. The study noted that after forty times the amount of exposure needed to recognize a card, subjects failed to recognize more than ten percent of the abnormal variations. Kuhn (1962) reinforces that "novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation" (p. 64). This next section seeks to draw attention to the

importance of this new medium by addressing difficulties associated with 360-degree video and the expectations of this medium for the culture-at-large.

Unique challenges

Finding societal grounding inside the pixelated dome requires questioning reality within 360-degree virtual spaces in spite of the idealistic vision of hypermediation. Although the pursuit of representing reality by the 360-degree CVR community is admirable, the benchmark for new familiarities within transformative technologies is "the residue of earlier forms" (Hosterman, 2010). Hosterman (2010) believes that humans are only supplanting a narrow understanding of the real on a "select group of pixels" (Hosterman, 2010). By altering a grouping of pixels, the sign is manipulated causing the objective immovable reality to shift disrupting the "real," a task that he feels is too easily manipulated through digital environments. This seems to disrupt what he believes is real and seeks to draw the line between "that we know and that we think we know" (Hosterman, 2010). Although defining what is "real" is not possible in the scope of this paper, Hosterman addresses the concept of real and the pursuit within a society in flux as a way to establish a new foundation.

In the current VR platform, the user has handed over their rights of vision to a machine. As an experiment, VR creator Jak Wilmont spent 168 consecutive hours inside various HMD's experiencing 360-degree content. His intent was to reveal if humans can remain healthy and meet the needs of the whole person exclusively in virtual environments. His self-reflexive documentary premiered on March 7, 2019 to both critics and supporters. In his end credits, he states "I have never appreciated the smell of outside air so much" (Wilmont, 2019). As 360-

degree filmmakers shape content, understanding the limits and the responsibility to care for user's well-being should be of up-most importance.

Beyond the challenges of human factors, 360-degree video artists are faced with technical challenges. As cinematic VR continues to breed and spread within the global media landscape, perception change and disruptions of engrained expectancies gradually shift focal points towards a new ecosystem. CVR artists wrestle through market demands to create professional level virtual reality and augmented reality projects yet are faced with an unstable ecological environment due to the rapid evolution of this product. In frustration, Insta360 Pro user Jan Raiber states,

> We are doing their R&D and are losing clients over it. I don't care for a bug-report list. I want stable firmware. Insta knows whats wrong. And if not we are not going to solve their problems. They should do the testing in the field before they send a new firmware and then sit back and wait with whatever kind of problems we experience. And while we are doing this we lose clients trying to explain to them that our camera doesn't work.

The once mechanical and analog process of content creation is now stamped into limited software frameworks. This creates "a tangle, a knot, which ties together the physical and the ephemeral" (Berry, 2016, p. 3). This means that in most cases, we will no longer find any of the pre-digital techniques in their pure original state. Manovich (2016) notes the struggle as cultural interfaces work to accommodate the necessity of "consistency and the demand for originality" (Manovich, 2016, p. 48). This demand forces software developers into a homogenization of data structures undermining the integrity of pure art. As artists wrestle through technical limitations, it's important to recognize the constraining powers of protocols. For artists, finding ways to work around the system for the sake of aesthetic purity is critical.

Addressing new challenges through 360-degree video

Throughout history, new media discovery phases seek to see the unusual. New media discoveries can be the anomaly needed to further knowledge and artistic practices. Currently, the unusual is the fact that 360-degree as a medium may go deeper than traditional VR and two-dimensional video. Although most video platforms continue to march forward with resolution leaps, storytellers' and marketers value the opportunity to capture live-action 360-degree content. Along with that, the diversity of distribution platforms afforded to 360-degree video advances audience consumption and engagement. For example, National Geographic released an intimate 360-degree live action video of free solo climber Alex Honnold as he climbs Yosemite's El Capitan. The goal of this project was an added way for the "viewer to feel first-hand the dangers and excitement of climbing El Capitan without a rope" (Free Solo Climbing El Capitan 360 Video, n.d.). This live action project went on to win an award as one of the top VR videos of 2018 from *Forbes*. The knowledge and practices of 360-degree documentary video continue to address platform limitations, discovery and engagement, and provides new visual coverage for effective storytelling.

360-degree documentary video continues to saturate the visual landscape of digital immersion with frameless wrap-around live-action stories. 360-degree technology has a long history for media archaeologist to explore. With a wide field-of-view, this chapter discussed the historical roots of the panoramic image. Pushing towards a close-up, this chapter sought to define 360-degree video, established the distinction between 360 and non-360 video, and revealed the importance of 360-degree video.

Establishing a New 360-degree Ecosystem

With only a short history of fifty-years, VR persistently experiences evolution and revolution. Underneath the VR microscope, the new CVR sub-genre provides new interactive experiences for content-creators. These experiences have the potential to disrupt the present media ecological system. Media ecologist Neil Postman, defined media ecology as an academic pursuit that explores "ways in which the interaction between media and human beings give a culture its character and, one might say, help a culture to maintain symbolic balance" (Postman, 2000). Extending Postman's theory, game theorist Ian Bogost (2011) states the enthusiastic ecologist must be "concerned not only with the overall ecosystem but also with the distinctive functions of its components" (p. 6). These distinctive functions, considered nuanced technological changes, have the potential to alter the symbolic balance within an ecosystem putting at risk past experiences, perceptions, and behaviors. As CVR technologists add another specimen to the meta-media ecosystem, content creators grapple with finding symbolic balance. This following section in this chapter examines three keystone CVR species, the processes needed to maintain symbolic balance within the CVR genre, and broader implications for understanding this emerging space.

Foundation Species: How to Read within the System

The ability to read and write is critical to a literate society. Extracting these two elements undercuts the necessity of a balanced ecosystem. Lori Emerson's (2014) media archaeological analysis of ways in which a reader encounters texts states "the ability to 'read' a medium means you can access materials and tools created by others" (p. 57). Having access does not mean the

ability to use the tools. However, the ability to read and understand is within reach. As user's enter this 360-degree symbolic relationship with a machine, they are devoting time, in some cases extreme amounts, to "perceiving, comprehending, and interpreting signs organized in the form of a message" (Vandendorpe, 2009, p. 109). This next section seeks to explore textual elements, image elements, and audio devices which are three keystone species needed within Cinematic VR to maintain symbolic balance as meaning is transferred to this new media environment.

Textual Elements

The Apostle John states "In the beginning was the Word" (*New International Version*, John 1:1). Yet, Aristotle refutes this philosophical argument by declaring the foundational element of thought awakens from the image first (Caricato, 2000, p. 504). Examining the conventions of reading and writing, Christian Vandendorpe states "In the Beginning Was the Ear" (Vandendorpe, 2009, p. 5). Whether the image, word, or ear comes first, within the Cinematic documentary genre, textual elements are rarely discussed. Although society continues to gravitate towards the image, literate-based society is still conditioned on the formation of text. Within Cinema, opening title sequences accurately portray the film title. Not only that, lower-third textual elements establish place and space. Lastly, lower-third textual elements allow naming conventions to establish credibility of talking head characters.

With this in mind, textual elements are the first keystone species discussed. Just as the printing press dramatically changed the look and feel of the physical text, Cinematic VR has the potential to disrupt textual elements used in story development within the 360-degree dome.

Trying to address this issue, Adobe Premiere, the primary editing application used to create Cinematic VR experiences, enable users to convert two-dimensional textual elements to respond to a sphere. Basically, the vector text graphic is responsive when moving from the equirectangular image to a 360-degree spherical wrapped image. However, the practical prerequisite does not address the complexity of this new environment. When a user enters the cinematic space through a Head-Mounted Device (HMD), editors have control of the entry yaw. This basically serves as the starting field-of-view (FOV) for the user. However, where should the textual element be positioned within this space? For example, should the opening film title be placed in multiple locations around the sphere? Should textual devices be duplicated directly 180 degrees away from the main entry yaw so the user does not miss key contextual messaging? How far down should the text be placed beyond the typical gaze? What if the user is sitting or standing? What is best font style for legibility? Historically, the frame size serves as a key mechanism to control eye movement, initiate hierarchy, determine margins, establish axial alignments and other art principles that help shape legibility and readability. Effective textual elements within Cinematic VR present new challenges for designers/developers. Digital text is nothing new, yet serves as a critical species to insure a positive balanced user experience. Although text is a keystone species, more exploration when using Cinematic VR text is needed to formulate balance within this new environment.

Image Devices

Secondly, beyond the foundational necessity of textual elements within Cinematic VR, the image, which is the durable truth-telling mechanism, serves as another needed keystone

species to maintain symbolic balance. In 2018, untethered standalone VR headset sales grew by over 400 percent and snatched twenty percent of the headset market (Graham, 2018). Along with that, several head-mounted device (HMD) manufacturers, mainly Oculus and Vive, plan to release new untethered versions. On May 21st 2019, Oculus's new Quest untethered VR headset released creating a flurry of activity within the tech ecosystem. This constant evolution puts pressure on camera manufacturers to provide the highest quality image. The subjective experience of presence is directly related to the objective immersive factor. Slater states the "level of immersion is dependent only on the system's rendering software and display technology" (Kallioniemi, 2017, para. 9). As 360-degree documentary filmmakers shape immersive stories, image elements are paramount to servicing balance for the user experience. This section plans to address fundamental immersive image factors which include resolution and display technology.

Immersive Image Factors

First, the intelligibility of image resolution is a key component to the cinematic VR species. Having nearly a century to evolve, this image is transitioning from the frame-based "perceptual boundary," to a 360-degree wrap-around frameless environment. In the mid-1970s, French semiotician Roland Barthes (1978) asked: "can analogical representation produce true systems of signs and not merely simple agglutinations of symbols?" (p. 32). Barthes question echoes Walter Benjamin's seminal essay *The Work of Art in the Age of Mechanical Reproduction*. Known for significant contributions to aesthetic theory and literary theory, Benjamin answers Barthes question saying reproduction jeopardizes "the authority of the object"

(Benjamin, p. 221). Frustrated with the medium of photography, Benjamin felt moving the artist's hands away from the physical canvas creates a mechanical reproduction of the real. Adding to this conversation, Hito Steyerl explores the underlying economies of digital images. She states "the poor image is an illicit fifth-generation bastard of an original image" (Steyerl, 2016, p. 193). This pursuit of reproducing the real is directly tied to resolution factors. Insta360 continues to establish market-place standards and protocols for cinematic VR resolution. On the Insta360 corporate website, the company claims that Insta360 experiences "empower people to freely share experiences – full, immersive, lived experiences – no matter the time or place" ("Insta360 Cameras Empower Creators," n.d.). Insta360 Pro, one of the highest resolution Cinematic VR cameras, has six lenses with an instantaneous stitch producing 8k resolution. This constant battle to increase resolution is a core image element needed to meet the continual demands of user immersive experiences.

Second, the diversity of display technology is a core image element. Beyond the desktop, mobile and wired VR platforms, untethered immersive HMDs continue to push the boundaries for distribution. Senior writer at Fast Company Mark Sullivan says the Oculus Go failed to give you that full range of motion "making it more of a lean-back experience rather than an active one" (Sullivan, 2019, para. 3). With its recent release, the Oculus Quest reaches beyond the pan-tilt-zoom viewing option and offers the full six degrees of freedom. Along with that, the Quest's "graphics are a little gritty but far from janky" (Sullivan, 2019, para. 7). The resolution for each eye is 1,600 x 1,440, which surpasses the HTC Vive and Oculus Rift resolution.

As image resolution increases, display technology faces distribution obstacles. Filling the full 360-degree dome with fully immersive resolution is strenuous for untethered systems.

Within display technology, various video mapping techniques are used to reduce the overall file size. The pyramid approach works by "mapping an equirectangular onto the base of the pyramid" only displaying what the viewer sees in their FOV (Argyiou, Economou, Bouki, Doumani, 2016). The new Oculus Quest is beginning to roll out this technology through a "fixed foveated rendering" (Heaney, 2019, para. 1). Currently, the Lemnis HMD has fully adopted this technology. Basically, the headset is partially rendering the image within the immediate FOV. This reduces the processing power needed to reproduce the full equirectangular image enabling more pixels and resolution in the future. Both resolution and display technology are fundamental image elements needed within the Cinematic VR ecosystem to maintain balance. However, during image acquisition, content creators are faced with huge considerations. For example, where should the camera eyeline be placed to represent the character? Since most experiences in Cinematic VR include the first-person perspective, what is the ideal height for the best user-experience? Can the possibility of variable focal lengths even exist in this environment? As this ecosystem develops, the image needs a more careful look underneath the microscope.

Sound Devices

Lastly, beyond textual elements and the wrap-around fully immersive image elements, sound devices are critical to maintaining balance in the CVR petri dish. Quality audio can "reproduce the real world around the audience…in an artistic way that furthers the story" (Erkut, 2017, para. 4). Spatialized audio is critical when viewing 360-degree video experiences in HMDs. As the user moves within the 360 space, the audio rotates with the head movement. Beyond simple head rotation, sound needs to respond to the z-axis as well. With the six degrees

of freedom, sound devices are critical to reproducing authentic spaces. Audio is captured using an omni-binaural microphone. This is an 8-channel microphone that captures sound from four different directions. For example, in traditional film, the sound is captured using left and right channel. Accounting for the complexity of the ear, 360 filmmakers strive for the full spectrum of sound. One of the default VR experiences native to the new Oculus Quest is *Project Tennis Scramble. Project Tennis Scramble* demonstrates the Quest's six degrees of freedom permitting users to move around in an untethered three-dimensional space. Early reviewer Matt Cabral said "the spatial audio made the whole experience feel immersive" (Cabral, 2019, para. 4). This is a new species of creativity that requires Cinematic VR creators to reach beyond the remediation of two-channel filmmaking. Finding balance within the Cinematic VR petri dish requires effective textual elements, high-res immersive image elements, and spatialized audio devices. These are three keystone species needed within Cinematic VR to maintain symbolic balance as meaning is transferred to a new media environment.

Foundational Processes: How to Write within the System

Understanding how to read a medium is critical to finding balance within symbolic environments: however, the ability to write within this ecosystem is also critical. Marshall McLuhan states "societies have always been shaped more by the nature of the media…than by the content of the communication" (McLuhan, 2008 p. 8). Beyond observation and reading the media environment exists the possibility of writing within the media ecosystem. Emerson says "the ability to 'write' in a medium means you can generate materials and tools for others" (Emerson, 2014, p. 57). Cinematic VR continues to weave story elements into museums,

planetariums, medical, therapeutic, and entertainment spaces. This section seeks to examine three foundational process modes for constructing Cinematic VR experiences. Adapting Bill Nichols documentary modes of representation, the three foundational processes for constructing Cinematic VR include non-interactive, participatory, and longtail modes.

Non-Interactive Mode of Cinematic VR

The first foundational process for constructing Cinematic VR is the non-interactive mode. With the recent development of prosumer high-res 360-degree cameras, the possibilities to create new storytelling experiences in a frame-less environment continues to create curiosity. New discoveries and technologies within Cinematic VR continue to attract more frame-based storytellers. Most 360-degree films are non-interactive experiences told in a linear fashion. The film basically plays from start to finish with no sequential branching. Yet even non-interactive 360-degree linear experiences have the potential to reach beyond the passive observation provided by the two-dimensional frame. 360-degree Cinematic VR experiences turn users into "active observers" (Grammar of VR Storytelling). From a storytelling aspect, this mode matches Nichols (2017) expository mode which drives the story through "verbal commentary and an argumentative logic" (p. 33). For example, in 2018, Al Jazeera's immersive media studio created a unique 360-degree film entitled *Yemen's Skies of Terror* matching Nichols expository style. By placing VR technology in the hands of local Yemini journalists, they were able to "document the impact of 16,000+ air raids in an already devastated country" (Yemens Skies of Terror). This film helped reveal intimate representations of a new place and new experiences in 360 environments. The film found a unique storytelling angle. Yet, the content was presented in a

linear fashion minimizing screen interactivity. Cinematic VR filmmakers are still creating new ways to work within this non-interactive mode as the visual grammar continues to develop.

Participatory Mode of Cinematic VR

Secondly, moving beyond the non-interactive mode, the participatory mode provides a rich media environment that includes gamified experiences. These active interactive experiences trigger the user's cognitive thinking through higher engagement. Vandendorpe (2009) says "the richer the cognitive context, the stronger the possibilities for the production of meaning" (p. 111). Mirroring game elements, this mode adopts branching narratives invoking a more non-linear experience. Using game elements, the user "can select to follow different subplots of the game story which can lead to its success or failure at addressing a challenge" (Argyiou, Economou, Bouki, Doumani, 2016). The complexity of this mode increases because of the requirement for a user interface. This mode matches Nichols (2017) participatory mode which allows "more fragmentary…exchange between filmmakers and social actors" (p. 45). The applications for this mode are far-reaching. One example is the recent first-ever interactive national youth vaping campaign entitled *What's in a Vape* (Wirewax). This is an interactive 360 experience that requires the user to move around various spaces and collect evidence. Within the 360 experience, users can activate hotspots that trigger various two-dimensional videos and textual data. This web-based 360 experience can easily translate into most HMDs creating more meaningful engagement. The ability to move the audience inside the circle of action through a continual first-person point-of-view requires a fine balance of interactivity and engagement as

they interact with the content. This mode has the potential to create a new species through the mash-up of previous interactive forms.

Longtail Mode of Cinematic VR

Lastly, the longtail mode looks past the non-interactive and participatory modes to carve out a niche user experience. Historically, new art movements were a rejection of previous standardizations. Similarly, 360-degree artists take part in developing new forms to describe new spaces. This may include bootstrapping on top of previous forms. Manovich (2013) calls this process "deep remixability", which is sharing of common DNA amongst various platforms. He believes this has the power to reshape visual aesthetics, methods, ways of representation and expression, spatial dimensions (3d space), and create an amplification of cinematic techniques (DOF) (p. 248). Cinematic VR content creators continue to shape new expressions that may have a longtail effect. One example of this is the Oculus Wander experience. Using Google Street View 360-degree data, users can travel anywhere in the world within the HMD. Although Google was limited in some regions and far-off locations, user-generated Street View materials continue to rise. In April 2017, Google launched its Street View app permitting user-generated virtual representations of place and space through approved cinematic-VR technology expanding the pixelated dome database. As more geospatial data is collected beyond latitude and longitude, users may seamlessly walk through all Google spaces. Having six degrees of freedom while wearing a HMD creates niche experiences. This furthers the impact of Cinematic VR. This is a great example of the longtail mode which includes the process of building with smaller elements towards a larger impact.

Finding the Anomaly to Bring a Paradigm Shift

Looking beyond the foundational species and processes towards the broader implications, it is important to understand what restrains these symbols of meaning. Structural forces within 360-degree Cinematic VR software environments can undermine perceived freedom of power for content creators. Bolter notes interactive experiences can create this sense of flow which is "a state in which people are so involved in an activity that nothing else seems to matter" (Bolter, 2019, para. 4). Breaking the flow and bringing awareness to these limitations is critical to functioning within this ecosystem. For example, Insta360 video camera manufacturers claim a software using a "proprietary interpolation algorithm" and existing in Shenzhen, a city that provides an "incomparable hardware ecosystem" enables leading-edge products. ("Insta360 Cameras Empower Creators," n.d.). Just recently, this perceived freedom of power was undermined. On their official website, Insta360 spokesperson noted an extension created for Adobe Premiere "only works with footage from the Insta360 Pro because it uses a proprietary stitching algorithm that's tailored to the camera" (Insta360). Constraints like this continue to hinder the creativity and development of new species within the Cinematic VR ecosystem. GoPro recently countered this mishap and released an extension that allows more open-sourcing to undermine this proprietary mishap. Software openness is key to allowing more exploration within Cinematic VR.

However, in the fight for marketplace dominance through software standardization, Insta360 continues to drive competitors away through established partnerships with companies such as Google and Mistika VR. The Insta360 is considered the first Google Street View approved camera for user-generated Street View images. Along with Google, Insta360 struck a

partnership with Mistika to handle their complex stitching process. In *Protocol vs. Instituitionalization*, Alexander Galloway (2016) demystifies organized and controlled networks by addressing the germination cycle of protocol pioneers and offers a glimpse into the bureaucratic models behind the invisible technological curtain. Galloway (2016) moves to address "pseudo-protocological" behavior using a media archaeological approach through the VHS/Betamax narrative (p. 264). JVC was able to break through and gobble market share by sacrificing larger profits and accepting the idea that "giving out your technology broadly even if it means giving it to your competitors often wins out over proprietary behavior" (Galloway, 2016, p. 265). Galloway supposes these multi-levelled bureaucratic models, often reactionary due to market pressures to adopt standardizations, can lead to more control mechanisms, which could leave Insta360 Pro users in turmoil or chasing the next iteration because of the companies increased external partnerships. For example, after spending multiple hours curating and uploading 360-degree images for Google Street View, Insta 360 Pro user Rene Hormann felt aggravated when he had to pay for the 43.78 GB of imagery provided to Google maps undermining the monetization of his own creative work.

As the Insta360 Pro cinematic VR movement continues to breed and spread within the global media landscape, perception change and disruptions of engrained expectancies gradually shift focal points towards a new ecosystem. Beyond the vastness of bureaucratic network systems that invoke frustration, Anna Fisher (2016) uses biological metaphors offering inspiration on how to function within the closed systems and undermine "infrastructural vulnerabilities of host systems." (p. 299). Deflating the mantra of "an open system of exchange" exuding from the mouthpiece of new media giants, Fisher (2016) says "they have promoted the

lie of reciprocity in a neo-liberal system constituted by accelerating processes of uneven precarization" (p. 288). This lie is perpetuated through a coercive protocol which "claims to be nondiscriminating and welcoming to all" (Fisher, 2016, p. 289). Fisher draws a clear distinction between Galloway's (2016) idealistic vision of all protocol's "accepting everything, no matter what source, sender, or destination" (p. 271). Fisher (2016) challenges users to exploit and take advantage of "infrastructural vulnerabilities" which may come through third-party institutionalization or within the main host system (p. 300). These breaks in the system drive new discoveries within media ecosystems which has the potential to invoke more creativity. With a microscopic lens adjustment, user can be hopeful in what lies within and beyond the current Cinematic VR ecosystem.

Technological change continues to alter the symbolic balance within new ecosystems putting at risk past experiences, perceptions, and behaviors. As Cinematic VR technologists add another specimen to the meta-media ecosystem, content creators grapple with finding symbolic balance. Media ecologist Marshall McLuhan (1967) states that "environments are not passive wrappings" (p. 68). These are active invisible ecosystems that can be fragile at times. This paper examined keystone Cinematic VR species, processes and the broader implications needed to maintain symbolic balance within the CVR genre. As noted, in order to function within this new ecosystem, understanding how to read and write within this environment is critical. However, "you must have both to be literate" (Emerson, 2014, p. 57).

Cinematic Code Changes within 360-degree Documentary Storytelling

Though the conception of virtual reality (VR) is not new, emerging development around 360-degree documentary video has raised the productivity and distribution of new and engaging interactive experiences. New Media scholar Jay David Bolter inspects the transitional power of computer-mediated visual communication and the changes initiated by new forms. According to Bolter (2001), these new writing technologies invoke new "methods for arranging verbal ideas in a visual space" (p. 15). As 360-degree video technology begins its cultural march, content creators grapple with forming new design decisions. This section examines transitional choices that artists strive to construct. These design choices extend beyond traditional two-dimensional storytelling. Furthermore, the following sections also address the possibilities of creating fresh meaning through new user experiences.

Transitional Design Decisions

As the onslaught of new VR-based tools decreases in price point, the consumer demand for rich media increases. In 2018, untethered standalone VR headset sales grew by over 400 percent and snatched twenty percent of the headset market (Graham, 2018). Several head-mounted device (HMD) manufacturers, mainly Oculus and Vive, plan to release new untethered versions this year. This heavy demand puts pressure on software creators and camera manufacturers to provide user-friendly environments that allow content creators to experiment with new design decisions. Bolter (2011) claims 360 experiences continue to remediate classical film production stating "rivalry and homage seems always to be at work" (p. 25). This is demonstrated in the most recent release of various game engines as they implement cinematic

practices within design environments. This is a merging of previous forms into new forms. Within remediation, Bolter (2011) suggests cultures wrestle with a constant dichotomy between seeing through the medium, “transparency”, or desiring “hypermediacy”, an intense awareness of the form (p. 25). As 360-degree filmmakers begin to shape immersive stories through the grammar of cinematic language, transparency and hypermediacy are constantly battling. This section plans to address fundamental design decisions 360 filmmakers grapple which include story development and directorial choices, guidance cues for users, and balanced editing techniques.

Story Development

360-degree video narratives rely on the same mechanisms used for other media. However, user participation is dramatically increased changing the traditional two-dimensional story process. The ability to move the audience inside the circle of action through a continual first-person point-of-view and outside of the action as a mere spectator requires a fine balance of interactivity. In the seminal article for user-centered experiences, Nicholas Negroponte (2003) proposes “that a common oversight in the computer recognition and generation of visual material is the disregard for the intentions of the image” (p. 356). His approach moves interface development away from pragmatic development to considering user-needs first. He is asking questions that drive the developer to consider the complexity of the user thus moving away from the straight task-oriented design cues. 360-degree video storytellers script development moves away from the traditional model of straight descriptive language. Within 360-degree video story development, “action is driven by story characters who interact in ways controlled by the user”

(Dooley, 2017). This is a creative twist on the content created within this new form. Since most story received within an HMD is experienced from a first-person POV, the writing process adapts to more first-person perspective. Within the writing process, this creatively moves the artist from looking at to looking out which dramatically excites the developmental process for screenwriters.

Along with new story cues, 360-degree filmmakers take part in developing new story language to describe new spaces and new writing form. Although the captured video image is a massive equirectangular shape, the user experiences a frameless container and "the world of the project surrounds the viewer" (Dooley, 2017). Having no screen edge complicates the descriptions, dialogue, and placement of actors, actions, and props within the space. However, considering the lack of camera displacements, storytellers can pursue crafty shorter dialogue to accommodate the medium. Along with that, considering the frameless environment allows for artists to envision active engagement rather than passive observation.

Directorial Cues

Beyond elements of story development, 360-degree film directors are faced with new challenges as they shape story within the pixelated dome. Although 360-degree experiences are loosely defined, early experiments focused mostly on linear experiences. However, as the genre advances, engagement, along with augmentations, continue to shape these experiences. This increases the complexity of the story direction. Collectively, immersive VR experiences have a need for "deep structure" (Mateer, 2017). Typically, the director focuses on controlling the structural elements of the story as it relates to overall mood and tone. This type of oversight

helps shape the text invoking the user or viewer towards a "suspension of disbelief" (Mateer, 2017). In VR software environments such as Unity or Unreal, inputs and outputs tie together the "physical and the ephemeral, the material and the ethereal, into a multi-linear ensemble that can be controlled and directed" (Barry, 2016, p. 3). This type of control is not present in 360-degree video direction. For example, artificial lighting conditions are not available when shooting 360-degree content. Especially if the goal is to accomplish transparency. If the scene called for a suspenseful mood with heavy shadows, traditional film style could easily establish key light sources and bounce options and flags to control lighting conditions. The same applies in virtual software environments. However, what happens when the user begins to look around within the lit scene. The true "presence" is broken and the user is now aware of the medium breaking the suspension of disbelief. Although the limitation is present, 360-degree filmmakers continue to find new ways to work within their limitations. For example, new ring lights wrap around the tripod body dispersing unique lighting looks and are hidden from HMD users.

Beyond lighting and production design challenges, the director provides creative focus through "blocking, pacing and delivery of performances or portrayal of activity" (Mateer, 2017). After the standard call outs "quiet on the set, audio—speed, camera—speed, ACTION," the director concentrates on observing and shaping believable performances. Within documentary production, as the camera rolls, directors are searching and responding to events that unfold through effective observation with a goal of creative actuality. This craft shapes the users or viewers perception of what is real and unreal. Typically, comfort monitors or larger external screens are in place for directors to observe what happens in front of the lens. However, a 360-degree video is quite limited from a monitoring standpoint. For example, the Insta360 Pro, a

professional level 360-degree camera, has six lenses with an instantaneous stitch producing 8k quality. Transmitting file resolution with that capacity is quite challenging undermining the director's creative choices and screen observations of the scene. Yet, as this genre develops, the focus shifts to give more ownership and rights of the story to the audience. Character cues are important. However, improvisational drama and surprise can help transport the user deeper into the story.

Guidance Cues

Building upon directorial cues, working within the frame, artists are aware of principles that enable and manipulate user/viewer engagement. These serve as cues for guidance. For example, when designing on a grid pattern, whether its painting or web design, artists are aware of control mechanisms such as hierarchy, the use of lines, and rhythm cues to guide the viewer. Using remediation of these design elements, 360-degree video artists can shape new intentionality with beneficial outcomes.

On film sets, when the one-ton grip truck arrives, lighting directors are like little kids in the candy store. Film carts full of gels, diffusion, frames, flags, and rigging gear make way towards the circle of action. The combination of controlled artistic direction and eclectic tools, the scene has the potential to shift viewer eyelines through manipulating light and shadows. Moving into the cinematic virtual 360-degree space, limitations of transparency suppress the use of traditional lighting tools based on the inability to hide the massive amounts of light benders. Along with that, 360-degree video is faced with two-six lens cameras that only offer a great depth of frame. This means a sense of depth is minimized. Although these issues exist, 360-

degree videographers shift attention away from artificial lighting conditions to use more natural light to invoke "differences in visibility" such as the "use of chiaroscuro lighting" (Mateer, 2017). This style creates a sense of hierarchy within the HMD which directs the user's attention towards the primary subject. Using this idea, the first-ever panoramic video from space entitled SpaceWalk 360 captured the sunrise in a timelapse fashion during a spacewalk. The moving shadows on the ISS demonstrate this effect and the ability to direct users towards the primary subject. Allowing them to focus more on the story, this gives content creators a more natural experience rather than the use of mechanized instruments.

Not only can light create a cue for guidance in 360-degree video experiences, but the use of lines can create a sense of alertness for the user. In a frameless environment, the viewer has the potential to "feel distracted by the freedom to choose the viewing direction" (Rothe et al., 2018). This may cause the viewer to miss key plot points within the story. With this in mind, new design techniques require stronger user engagement. Since 360-degree practices eliminate the need to build complex set-up around the camera, subjects may feel more freedom to be more natural within their environments. Historically, as technology decreased in size, new techniques arrived. For example, the Cinema vérité movement was highly influenced by the portability of the 16mm camera. As 360-degree videographers place their oddly designed technology, the subject matter may experience more freedom to move around within their space. Launching on the same day as the theatrical release of Free Solo, a 2019 oscar-winning documentary, National Geographic released Free Solo 360. This immersive film takes a more intimate look as free solo climber Alex Honnold climbs Yosemite's El Capitan. The directional lines as the subject matter move towards the camera are strategic to help guide the viewer towards the sweeping landscapes

of the Yosemite National Park. This has the potential to eliminate distractions and serve as a strategic guidance cue.

Lastly, rhythm cues through effective sound techniques and film cuts are another element for artists to direct users within the 360-degree video experience. Traditionally, from a post-production standpoint, L and J cuts are used to help create a sense of story flow. As the story unfolds, audio cues or ambient noise may transition in earlier than the video cut in a "j" pattern. This technique eliminates a choppy story flow. Within the wrap-around 360-video experience, quality audio can "reproduce the real world around the audience…in an artistic way that furthers the story" (Erkut, 2017). Microphones are still in early development to further this area. However, spatialized audio is critical when viewing 360-degree video experiences in HMD's. As the user moves within the 360 space, the audio rotates with the head movement. With this in mind, 360-degree video artists use audio cues through spatialized sound to redirect attention and help the story flow. This is a new area of creativity as 360 artists utilize more sound cues to direct user experience.

Editing Techniques

Along with determining new techniques to shape the viewing experience within 360 spaces, content creators are exploring ways to manage story beats through balanced editing techniques. As early as 1910, American film moguls began shaping aesthetic agreements to wrap traditional storytelling inside cinematic practices. Continual development of the cinematic genre was "no trivial achievement of our visual system" (Hecht & Kalkofen, 2009). This stabilization of visual language, creating a sense of balance, established the foundation for continuity

storytelling without disorienting the viewer. Continuity editing allows the viewer to perceive action "in the face of considerable camera displacements" (Hecht & Kalkofen, 2009). At this point in the development of 360-degree video, continuity editing, as it relates to traditional filmmaking, is in its infancy. This matches the early development of cinematic practices. As content creators push for technological advancements, the story begins to take shape within the new medium.

Traditionally, camera displacements and various focal lengths create a perceptual continuity which is assembled around action within the frame. Hecht and Kalkofen reach further and establish that viewers "prefer a temporal gap equivalent to leaving four frames on the cutting floor of a movie presented in 24 frames per second" (Hecht & Kalkofen, 2009). So, as camera angles shift, continuity is achieved even with the slightest four frame pause in the action. Considering the development of 360-degree video techniques, the singular camera angle softens the need for continuity. Along with that, most 360 cameras have a fixed lens. So, lens changes and camera displacements are minimized based on current technology. This shift in creative thinking excites the idea of active character staging and demonstrates the need for understanding theatre stage craft to fully exploit the long video takes to create edit pacing balance. Currently, most 360-degree video experiences, especially using an HMD, are in the two to seven-minute range (Dooly, 2017). Without the necessity to service continuity within a fast-paced two-dimensional frame, 360 filmmakers can stretch the length of cuts and allow users to actively assemble space through their own engagement.

Beyond 360-degree camera experiments and pacing, a vicarious pursuit of "being there" or "being in" the first or third-person point of view through the illusion of virtual environments

requires an element of transparency (Marsh et al., 2001). However, currently, software bugs limit the ability of the six-lens stitched illusion to capture seamless content over long periods of time. This causes an awareness of the medium. Yet, continuity breaks are avoided in narrative and documentary work to enhance the voyeuristic elements of the plot. When that break occurs, viewers become aware and shift attention back to the real world. This oscillation breaks the illusion undermining the authentic experience. For example, in 360-degree video, some cameras allow for six separate cameras to stitch together the full 360-degree dome in ultra-high resolution. However, software limitations do a meager job of blending all camera edges creating a distorted image breaking down transparency. Since monitoring is limited, these issues are later discovered through the editing process. However, Marsh and colleagues (2001) note various movements, such as the French New Wave, that intentionally broke the fourth wall to pull the viewer out of the illusion. This correlates to continuity breaks in traditional film. For example, in 1929, Dziga Vertov opposed the escapism mentality of early films and broke away to create *Man with a Movie Camera*. In his film, Vertov intentionally breaks the fourth wall making the audience aware of the filmmaking process. The various categories of breaks help define weaknesses within the illusion of both traditional filmmaking and virtual reality. Milk says on "the first day in film school, they told me you have to learn every rule before you can break one. We have not learned every single rule, we've barely learned any at all, but we're already trying to break them to see what kind of creative things we can accomplish" (Milk, 2016). As editing software continues to advance, the combination of continuity and abstract work will help formulate balanced stories within this new medium.

The New New Experiences

As 360-degree video artists intentionally break previous rules, new creative experiences afford new layers of meaning for the user. In his text *Papyrus to Hypertext: Toward the Universal Digital Library*, Christian Vandendorpe (2009) states a "reader is in essence someone who devotes a certain amount of time to perceiving, comprehending, and interpreting signs organized in the form of a message" (p. 109). Although he was somewhat critical of new media technology, he echoes Bolter's (2001) lens around language to define writing spaces. As new writing spaces arrive, such as 360-degree video, they have the potential to be the authoritative voice for "reason and feelings" (Bolter, 2001, p. 2). This section explores three significant areas extended through the artistic development of 360-degree video content that create fresh meaning: spatial awareness, sensory vividness, and symbol recognition.

Spatial Awareness

In his seminal essay *El Cine del Futuro: The Cinema of the Future*, Morton Heilig (1992) seeks to explain the mysteries of the panoramic screen. He uses the terms "orientation" and "action" to address the continual shifts in society (Heilig, 1992). As the noise of advancement happens, an awareness prompts an observation. This awareness gives a new sense of orientation. Typically, as this happens, critical voices attempt to suppress progress and focus on the reversals. In his 1986 collection of essays entitled *The Whale and the Reactor*, political theorist Langdon Winner, bearing several elitist educational badges from the prestigious UC-Berkeley, seeks to trounce on the hi-tech optimism propagated in mass society. Undermining the techno-elites, Winner (2003) attaches a satirical voice to those that fail to "ponder the historical significance"

of the “sheer dynamism of technical and economic activity” created within their industry (p. 590). Coming on the heels of technological changes within the gaming industry, home computing, and digital distribution, Winner seeks to shift a societal focus away from the enhancements of the new technological apparatus. Winner (2003) emphasizes the “great tradition of optimistic technophilia, current dreams of a ‘computer age’ stand out as exaggerated and unrealistic” (p. 595). Breaking through the negative voices that oppose this current third wave of virtual experiences, Milk (2016) boldly proclaims “VR is going to play an incredibly important role in the history of mediums. In fact, it’s going to be the last one” (Milk, 2016). He goes on to say “it’s the first medium that actually makes the jump from our internalization of an author’s expression of an experience, to our experiencing it firsthand” (Milk, 2016). These are new spatial engagements that wrap around the whole person in a frameless embodied experience. Within cinema history, the first-person POV shot is a rare occurrence. This new spatial reorientation through a constant first-person 360 POV to new aural and visual experiences is very real and a new meaningful experience for users.

Moving beyond the reorientation of space, users are experiencing a keen sense of integration which can move them to action. Heilig (1992) states that as the “seat of consciousness”, the nervous system is contributing to the reception of the whole (Heilig, 1992). Heilig (1992) believes that the cinema of the future, beyond virtual reality, will “no longer be a visual art, but an art of consciousness” (Heilig, 1992). A major shift takes places as Heilig connects consciousness to sense impressions challenging cinema towards action. This transition requires active participation from the spectator. Milk (2016) echoes Heilig’s (1992) call to action and believes virtual reality can bridge the gap. As an individual is in the pixelated dome, Milk

says “you are on the tundra hunting with the clan leader. Or, you are the clan leader. Or, maybe you’re even the wooly mammoth” (Milk, 2016). This level of sensory engagement through creative 360 video experiences will invoke new meanings as consciousness is reoriented.

Symbol Awareness

As spatial awareness reorients the user and new senses are altered, active 360-degree video users learn new symbols that excite new categories and ideas. Historically, as new media enters the cultural mindset, new texts are created. For example, fluctuation between using numbers and graphs slowly appeared in the early seventeenth century due to Rene Descartes theory of coordinates (Headrick, 2000). This is an example of new creative explorations and discoveries which is very similar to the new 360-degree video experiences. Previous to Descartes theory, graphs and numbers held isolated and limited usage in scientific inquiry. As perceptual changes slowly moved forward, scientific invention began producing more numeric data. In *The Structure of Scientific Revolutions* Thomas Kuhn (2012), used the example of oxygen. Kuhn (2012) claims pneumatic chemistry was the “unsuspected phenomena” bringing awareness of an anomaly allowing scientists “to see nature in a new way” ushering in a new paradigm (p. 53). 360-degree video experiences are on the cusp of tapping into multiple disciplines as artists produce more content.

Ironically, in his text *When Information Came of Age Technologies of Knowledge in the Age of Reason and Revolution*, Headrick (2000) references Joseph Priestley, the “father of oxygen,” as the first scientist to represent humans through a juxtaposition of numbers and graphs ushering in a new phenomenon. This demonstrates the interplay between both the text and

technology. Questioning his own paradigm shift of representing people graphically, Priestley felt the need to respond to his critics through a lengthy essay. Priestley reinforces that "the mind retains graphical data more efficiently than lists of words and numbers" (Headrick, 2000, p. 125). This seventeenth-century mantra motivated William Playfair to move beyond linear graphs towards two-dimensional representations. Headrick notes Playfair as the first to graphically represent economic data. Again, this was uncharted territory that drove Playfair to address critics claims of "fallacious" representations through visual language (Headrick, 2000, p. 125). Playfair felt "knowledge increase amongst humankind" necessitates data efficiency (Headrick, 2000, p. 127). Along with the increase in data, Playfair observed a need for businesses to interpret data quickly through graphical representation. Priestley and Playfair's seventeenth-century contributions strike a familiar chord of technological idealism. The integrity of the artist to handle disruption of symbols was of utmost importance to Playfair and Priestly. As 360-degree video experiences move through new artistic experiences, symbol awareness can shape practices and user experiences through both the development of the text and technology.

Though the conception of virtual reality (VR) continues to reshape into innovative ecosystems, 360-degree video has raised the efficiency and distribution of engaging interactive experiences creating new meaningful experiences. This chapter examined transitional design choices, beyond traditional two-dimensional storytelling, that 360-degree video artists strive to construct and finished with the limitless possibilities of creating meaning through new user experiences. These alterations of the 360-degree text through the technology has created "new kinds of cultural configurations" (Hayles, 2008, p.285).

Gamifying the 360 Cinematic VR Space

With new cultural configurations, modularity continues to materialize. The fuzzy territory between two art forms, videogames and CVR, dissolves away as gaming marketers and users reach toward deeper content engagement. The relentless development of new experiences within the traditional movie palaces demonstrates the fight to increase traditional film audience's engagement level. New media theorist Jay David Bolter (2011) claims 360 virtual reality experiences continue to remediate classical film stating "rivalry and homage seems always to be at work" (p. 25). Within this rivalry, "Hollywood still offers catharsis, as it has for decades, but it is both intrigued and concerned that videogames offer something else, a different aesthetic experience with its own strong appeal" (Bolter, 2019, para. 2). Although classical film production techniques continue to spill over into both videogames and CVR, audience expectations crave more from their consumption habits. This rivalry mirrors the transformative progression of media history. Establishing the principle of variability, Manovich (2001) feels "a new media object is not something fixed once and for all, but something that can exist in different, potentially infinite versions" (p. 36). Due to the "the residue of earlier forms" of media and advancement of both hardware and software environments, videogames and CVR experiences continue to build deeper relationships. (Hosterman, 2010). This chapter explains the relationship between videogames and CVR and the persistent inspiration videogames places on CVR.

Relational Connections

Large corporate brands such as PlayStation, Xbox, Samsung, and Oculus continue their shift into the frame-less VR gaming market. However, because of slow customer VR hardware demands, outside game and Cinematic VR developers are hesitant to pour into the high cost associated with content creation within these spaces. For example, the Oculus Quest, which just released this year, launched with a meager fifty game titles in their store (Hopkins, 2019). Comparatively, the Oculus Go launched with one thousand games. Based on the lack of game titles and experiences within these new untethered spaces, potential VR users are still hesitant to purchase these hardware devices. However, recent untethered 360 hardware devices work to build new connections between videogames and CVR. This section seeks to bridge the relational elements of gaming and CVR through both hardware and software afforded to users.

Hardware Handshakes through Untethered Environments

Before capturing images through mechanical hardware devices or before illustrated newspapers, deeply painted panoramas established a sense of "being there" in the true presence of place (Wray, 2017, para. 1). This allowed viewers to stand in the center of a rotunda-like structure and experience the spectacle beyond the renaissance frame. Beyond "seeing the real" from the first-person point-of-view through the panorama, the panstereorama placed the user outside of the miniaturization confirming what they "are observing in the replica, by identifying known places from the real world" creating a sense of authenticity (Momchedjikova, 2017, para. 8). Both perspectives mirror the current development of trends happening within videogames and Cinematic VR. Using virtualized cameras, users can switch and have unique experiences

between a first-person point-of-view or third-person point-of-view. *Fortnite* and *Grand Theft Auto* demonstrate the ability to place the user outside of the model, whereas, games like *Overwatch* and *Doom* place the user only within the first-person POV.

This aggressive movement of the image as an art form was bound to face disruptions. As the image broke free from the framed environment to a larger more complex ecosystem, human factors began to seep into broader conversations. These large installations required large rotunda-like structures to handle the display. In his seminal text *Virtual Art: From Illusion to Immersion,* Oliver Grau (2003) states the "real bone of contention was its outstanding aesthetic feature: the character of the illusion" (p. 62). Opinion leaders grappled with the danger of too much immersion or the affectionate idealism created by the immersion. This is a similar construct attached to both the gaming industry and CVR experiences. As both environments strive for increased resolution and more immersive artifacts, the same argument applies today of whether users should grapple with the increased acceleration of graphics due to hardware devices.

Reaching beyond the painted panorama and pansteroramas, by the mid-1960s, PhD student Ivan Sutherland, inspired by Claude Shannon's essay *A Mathematical Theory of Communication*, conceptualized and implemented the first hardware device for displaying vector graphics (Manovich, 2001). This mathematical experiment opened the lines of communication between humans and machines. With screen-based interactivity increasing, Sutherland extended his research by initiating the first prototype of VR. In 1968, Sutherland said "the fundamental idea behind the three-dimensional display is to present the user with a perspective image which changes as he moves" (as cited in Manovich, 2001, p. 102). Although the technology was not sufficient to support commercial progress, this was the beginning of the end of the frame as users

began to situate themselves within a frameless environment. His discoveries continue to remediate in both videogames and CVR experiences.

The videogame and Cinematic VR community continue their march towards a mash-up of both the panorama and pansterorama. Users are interested in ease of use and portability afforded through new untethered hardware devices such as the Oculus Quest. Reviewing the new Oculus Quest, Fast Company senior writer Mark Wilson claims the "the ipod of VR is here" (Wilson, 2019). Again, this is nothing new. In his text *From Papyrus to Hypertext: Toward the Universal Digital Library* Christian Vandendorpe (2009) says "the emergence of writing freed communication from the real situation and the details surrounding it" (p. 8). Untethered head mounted devices (HMD) allow users to simply put the high-res mini-computer hardware device on without any complicated set-up or installation. This eliminates the need to connect to a VR-based computer freeing users from their situation and space. This mobility and portability are a direct influence of videogame hardware devices such as the Nintendo Game Boy or Nintendo Switch. However, within CVR, instead of sitting in front of a portable screen controlling your character, users can feel as if the game is completely wrapped around them, triggering a more immersive experience through portability.

Communicating through Software Interfaces

Beyond the relational hardware affordances, this section notes the comparative of gaming and CVR through software interfaces. In everyday face-to-face interpersonal environments, our non-verbal expressions serve as a primary interface between both the sender and receiver. However, within hypertextual environments, a more complex model is needed. This relational

aspect transfers to human and machine. In order for this dualism to function, an interface is required. Interfaces are “conceptual devices that enable us to think across and beyond such dualisms” (Gane and Beer, 2008, p. 52). Nonetheless, new media interface technology encourages videogame and CVR users to maneuver and probe by looking at and looking through various software applications allowing virtual conversations with a machine.

Browser-based Engagement

Working behind the technological interface curtain, the World Wide Web Consortium makes steady strides toward transforming the internet into a complex media ecosystem. Due to the continual development and adaptability of web protocols, videogame and CVR developers strive toward new platform experiences. Currently, gaming and Cinematic VR stretch the gamut of distribution platforms such as consoles, PC/laptops, smartphones, handheld devices, and any browser-based environment. With the influx of web protocols and browser-based delivery, platform neutral experiences continue to breed new friendship between both videogames and Cinematic VR. With this in mind, more browser-based games continue to trickle into VR experiences. For example, WebVR is a Java-based scripting that allows A-frame, a web framework built on top of HTML, to extract HMD sensor data (A-frame). This data feeds content into a virtualized camera displaying browser-based content within most HMD’s. Using this framework along with web interfaces, Supermedium created a VR kickboxing game entitled *Soundboxing*. Rather than strumming to the beat like Guitar Hero, users punch to the beat. By using simple HTML tags, these cross-over games move freely between browser and HMD experiences linking gaming and CVR experiences.

Secondly, beyond browser-based experiences, augmentations create another software-based relationship between videogames and CVR. Augmentations allow content creators to embellish "traditionally produced video material with interactive constructs that are exclusively realized using web technologies" (Wijnants et al., 2016, para. 3). These augmentations are considered hotspots. This serves as another indicator of the continued relationship between videogames and CVR. This has a direct correlation to early button development for browser-based interactivity. However, the states, rather than responding via mouse or gestural interactivity, are triggered through the eye gaze within the HMDs. Utilizing button interactions are a critical entanglement between new forms of content development such as videogames and Cinematic VR. In effect, by implementing button augmentations on top of passive 360-degree video content creates "a whole new breed of highly interactive, compelling and engaging video sensations in a myriad of application domains" (Wijnants et al., 2016, para 4). For example, in 2018, Sage Media created a learning experience for the Hershey Corporation. This interactive food training module moves between two-dimensional content and fully immersive 360-degree augmented dome content. As users wrap various scenarios within the two-dimensional frame, they are directed towards the 360-degree space. Here they have the option to look around to find clues to piece together elements of the investigation. After finding all the clues within the 360-degree space, the experience seamlessly transitions back to the two-dimensional story. This mirrors various cutscenes within the gaming environment.

Lastly, beyond hotspot augmentations, motion-tracked video overlays create another bridge to videogaming elements. Within the virtual 360 software environment, data points are gathered using interpolation mapped out by content creators. This data is attached to moving

objects allowing vector graphics to travel across the frame. Along with that, hyperlinks can be embedded inside tracked overlays. Using motion overlays hold "promise to prevent the consumer from losing interest in and focus on content" (Wijnants et al., 2016, para 3). For example, using the Unity game engine as it's backbone, 3dVista allows content creators to add hotspots to moving video. These motion-tracked overlays can be added to moving subjects with the 360-degree frame. This mirrors overlays attached to 3d characters or random 3d objects within the videogaming space providing an enhanced interactive experience for users.

Narrative Content Creation

Moving beyond hardware and software relational connections, videogame elements continue to enable complex narrative qualities within CVR that match videogame development. Game Design engines such as Unity and Unreal provide the necessary design space to service complex effective stories. These platforms have extracted previous physical elements such as lights, cameras, and characters and converted them into a simulation. Simulation enables varied data structures/materials that combine to generate a new hybrid medium servicing both the videogame and CVR development. In *Software Takes Command*, Manovich (2013) notes the "loss of the physical and the replacement through simulation" (p. 200). Basically, the physical is now simulated through numeric data. At times, this process can be daunting. For example, using photogrammetry techniques, the artist can extract absolute measurements to recreate objects or scenes. Although Manovich addresses previous physical forms and methods as singular in nature, he builds an argument that current materials become data structures built on a set of algorithms. Videogame and CVR Developers are pushing to eliminate the need for physicality

and adjusting development around modularity. For example, Quixel offers a tool called Megascans which claims to offer "every scan available" (Quixel). With the possibility to recreate photorealism through digital simulation, users can easily create a forest-like environment using Unity or Unreal under an hour. Other tools such as Mixamo promise the same kind of simulated speed and efficiency. Beyond building virtual environments, Mixamo, a recent 2015 Adobe purchase demonstrating their move towards game development, promises developers the opportunity to "rapidly create, rig and animate unique characters for design projects" (Mixamo). CVR creators are eager to blend both realisms captured through video capture devices with simulated ecosystems. This partnership is vital for pushing the envelope within Cinematic VR narratives.

Secondly, as new software and hardware devices germinate, unique approaches to the narrative within videogames and CVR occur stretching way beyond normal distribution models. The potential for storytelling within CVR continues to find inspiration from videogaming experiences. Hopefully, artists continue to germinate new experiences and ideas to build narratives in other storytelling environments. For example, the Weather Channel recently adopted game development principles and application to encourage more user engagement. As Hurricane Florence approached landfall, the Weather Channel utilized Epic Games' Unreal game engine to simulate the wall-of-water visual representing the potential storm surge. The main broadcast live video feed wrapped the host with a green screen. The alpha key allowed visual content, in game-like fashion, to demonstrate the power and realistic impact environment catastrophe. (Bullard, 2018). This unique storytelling approach blended videogame and CVR techniques into a traditional broadcast environment.

When developing narrative content for the 360-degree framework, VR developers tend to build experiences in Unity or Unreal. Extending this approach, CVR creators pull outside resources from 360-degree video cameras. The spherical content is added to the gaming ecosystem. From here, other assets are added to the developmental phase. At this point in the narrative journey, CVR and videogame creators have unique paths to build an immersive application. The production approach for videogame environments allows characters to freely walk around when using an HMD and interact with choice-points. CVR approaches the process via a stronger branching structure. However, a recent move has allowed 360-degree cameras to capture laser points of real spaces. From here, these spaces are converted into an .obj file. This file can easily move into a game scene for added fully immersive content. Scene design, gaming elements, and program game logic round off the implementation phase. As noted earlier, videogames and CVR are a very fluid genre. Recently, as 360-degree camera technology increase, game engines are integrating more tools and prefabs to accommodate this market. With this in mind, 360-degree artists can now implement choice-points, badge earning, trade options, various easter egg discoveries, clue points, and other augmentations to increase interactivity similar to traditional videogame experiences enhancing narrative play.

Lastly, the platform-neutral craze, which is prevalent in today's gaming culture due to Epic Games *Fortnite* experience, is quite relevant to videogame and CVR creators as well. When creating content in CVR, platform options are quite limitless. CVR storytelling continues to move into the desktop, handheld devices, and now untethered HMDs. Traditional VR required a high-end headset which is usually tethered and requires a separate computer system. Beyond traditional social platforms such as YouTube, Vimeo, and Facebook, open source developers

have created unique CVR web players. Recently, the untethered Oculus Go provided a high-resolution truly immersive experience for CVR content. However, the pan-tilt-zoom limited the mobility of gamifying CVR experiences giving more of the lean-back experience. The recent release of the new Oculus Quest should remedy the mobility limitation and continue to expand on platform neutral experiences for CVR developers.

Game Influence on Cinematic VR

Videogames are not new to the VR sector. Over the past three decades, approximately seven generations of video games have been created. Beyond early education, military and defense experimentations, videogames germinated from consoles to arcade games, to online-gaming and now CVR. All this happened in the background as cinema was the driving force of visual language. However, videogames and the world of gamification continues to evolve and spin-out new experiences beyond the "cathartic power of film" (Bolter, 2019, para 2). This historical trail offers plenty of insight and growth opportunities for CVR. Optimistically speaking, with everything gaming has already done for society as a whole, embracing gaming and the technology associated with it potentially affords the opportunity to make the world more diverse and friendlier. This section covers the two areas of influence that videogames have on CVR which include diversity and the social factor.

Diversity

From a diversity standpoint, gaming reaches way beyond the adolescent age range. As platform-neutral games enter the market alongside the assortment of screen-based devices, videogames continue to grab broader audience appeal. In fact, Bolter claims (2019) "31 percent

of all gamers are women, and the average age of women players is 37" (para. 7). As the videogame ecosystem domesticates into diverse platforms, the typical gamer classification reduces. In *How to Do Things with Videogames,* Bogost (2011) says

> There'll no longer be an oligarchy of videogame industrialist-god to whom all creators and players will pay homage. Instead, there'll be many smaller groups, communities, and individuals with a wide variety of interests. (p. 154)

As the CVR ecosystem develops, it may be considered the smaller group as referenced above by Bogost. Note that Bogost (2011) is quick to call out the elitism behind the term "gamers," a term he believes will dissolve in the future. Beyond diversity of the user-base, game titles such as *Assasin's Creed Origins* and the most recent *Fortnite* showcase more female protagonist characters. With this in mind, CVR is happy to take the reins and classification of gamification with a push towards non-discriminating content.

Secondly, beyond age and gender demographics, videogames have transformed from a primarily single-player experience to one of the most social experiences in the world. Videogames provide a complex platform for social engagement and play. McLuhan predicts a re-tribalized visual-centric society based on hyperconnectivity (as cited in Fruin and Montfort, 2003, p. 197). Videogames continue to reach way beyond the typical social media experiences and provide unique encounters as an incentive to gameplay. For example, earlier this year, *Fortnite* created a unique in-game performance for its massive 200 million plus user base. The famous DJ Marshmellow was invited and played to almost 10 million concurrent users. *Forbes* writer Dave Their (2019) said "this is a tipping point in games, entertainment, and the idea of virtual presence" (para. 10). Experiences like this continue to push the boundaries of social media engagement.

Social Factors

These somewhat new experiences are providing unique social engagement that has the potential to remediate within Cinematic VR environments. Currently, Cinematic VR experiences are reaching beyond the singular HMD experience to integrate more social engagement. For example, the new Oculus Quest offers game titles that allow external players to contribute to gameplay via an iPad or iPhone. This enhances the social aspect of these spaces. Along with that, the Quest allows users to cast your VR view to other devices promoting a more social media experience. AltspaceVR is the most-prominent social application used in VR space. Using a bodily avatar, users can attend free concerts, participate in various meet-ups and explore user-generated spaces. Just recently, AltspaceVR added collaborative game elements within the application. The audio chat mirror collaborative meet-ups afforded through traditional videogaming. This is another influence videogames continues to have on CVR experiences.

As "the residue of earlier forms" (Hosterman, 2010, para. 13) are brushed off the sleeve of new media practices, videogames and Cinematic VR experiences are spending more time shoulder-to-shoulder building a deeper relationship. The relationship between videogames and Cinematic VR and the persistent inspiration videogames places on Cinematic VR truly continues to shape new ecosystems. This lasting relationship continues to build stronger conversations enabling better practices within the Cinematic VR space bringing a "new emergence of a cultural metalanguage, something that will be at least as significant as the printed word and cinema before it" (Manovich, 2016, p. 49). Hopefully, something that excites and breeds a whole new family of videogames and Cinematic VR experiences.

CHAPTER 3: METHODOLOGY

The overall purpose of this study is to evaluate spatial awareness when viewing a Frank Lloyd Wright walking tour through 360 modalities and examine the influence this has on narrative engagement comparative to traditional two-dimensional documentary form. Guided by this purpose, the following research questions guided the current dissertation study.

Research Questions:

RQ1: What are the distinct narrative storytelling production characteristics that form Cinematic VR documentaries comparative to two-dimensional documentary filmmaking?

RQ2: Can Cinematic VR documentary experiences enhance the spatial awareness of users as it relates to informal learning environments of cultural heritage sites?

RQ3: What is the impact of spatial presentation of the documentary on perception of narrative engagement when viewing linear content in non-360 form displayed in a two-dimensional player comparative to linear 360-degree documentary content displayed in a 360-degree player?

Production Process

In order to answer these questions, viewing content for both 2d and 360 platforms were produced. Moving through the production process for the traditional 2d documentary, a Frank Lloyd Wright tour guide provided a short two-minute interview discussing the grid layout of the Danforth chapel located in Lakeland, FL. The composition was captured using the standard rule-of-thirds framing placing content within the quadrants of the frame. The traditional documentary opens with a wide-shot of the front stained-glass windows. The camera tilts down in a slow

pattern revealing the light pouring through the glass. From here, the camera is rotated 180 degrees to capture the layout of the pews. Along with that, a close-up shot helps demonstrate the intentional floor layout. The next shot captures a wide balcony angle helping the participant understand the column layout. Lastly, a short edit session adds needed cuts and music to the finished product. The film is exported and uploaded to YouTube.

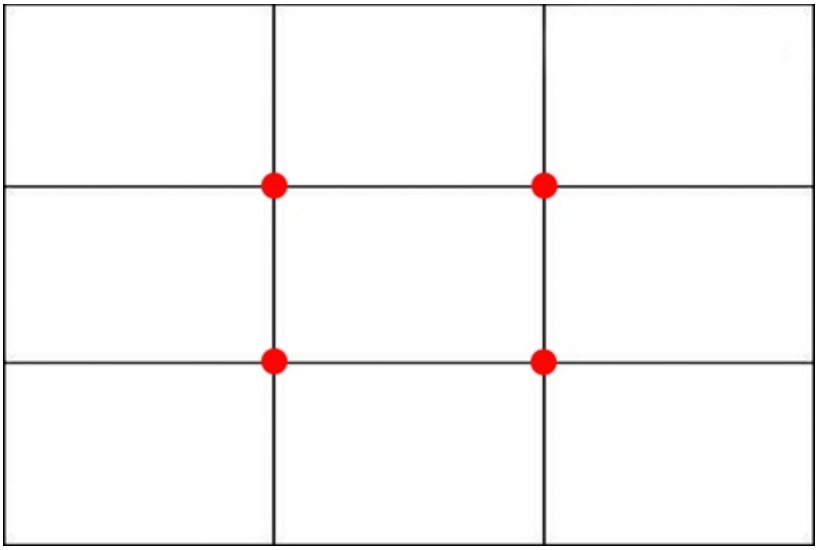


Figure 1: Rule of Thirds Grid

Mirroring the production flow of traditional documentary form, the same Frank Lloyd Wright short two-minute interview discussing the grid layout of the Danforth chapel was used as the basis for the 360 CVR documentary-style video. However, the image is captured using the Insta360 Pro 8k video camera. The 360 camera is placed in the same position avoiding data errors. Extra collective shots were captured in the exact same location as the traditional documentary. Each cut during the 360-editing process matched the traditional style documentary. Although the edit involves no extra cuts, the export is quite different and involves various standards that are still being determined. YouTube provides a third-party application that injects

needed metadata to recognize 360 video content. The content is uploaded and additional navigation options are included for the 360 video.

Script-Traditional Documentary Form/Script-360 Video

> "Frank Lloyd Wright, the architect is known for very strong geometry. In particular, Danforth chapel is one of the best places on campus to observe this. If you look down at the floor in the Danforth, as well as anywhere throughout Wright's campus, he designed it on a 6x6 grid. Wright always follows the rules of three in his design. In this case, the campus is on a 6x6 scale. Looking at the horizontal seams in the floor, you can see that it connects directly with the center of these columns that border the room. Meaning they were all center to center six feet apart. Looking up, you can see that they connect in a straight line as well to the lights on the ceiling, which are all also six feet apart from each other. And then, the lesser stained glass windows that border the room also connect to that line. Meaning that they too are six feet wide and three feet tall. Depending on how you look at those windows, you can see anywhere from two to four triangles. Those are 30, 60, and 90-degree angle triangles which are a staple of Wright's design."

Technology

Images captured for the standard documentary style were recorded with a Canon 5d (Figure 2) using an 85 millimeter lens at a 5.6 F-stop. Collective images are captured with the Sigma 12-24 millimeter super-wide angle lens. The resolution is 1920x1280 pixels with a frame rate of 24p.

Figure 2: Canon 5d

Images captured for the 360 experience were recorded with the Insta360 8k (Figure 3). The main image for the interview is captured at 60 frames per second with a resolution of 7680x4320. After capturing the five separate images, they were processed using a stitching software to blend all images into a single equirectangular image.

Audio was captured with the Tascam Dr-40 and recorded separately based on the limitations of the noted video technology.

Figure 3: Insta360 Pro Camera

Research Design

To investigate proposed relationships, this study targeted University of Central Florida undergraduate students currently enrolled in the course DIG3727C Game Level Design, as well as students that have already completed this course. The major pre-condition for research eligibility is not having exposure to the Frank Lloyd Wright Danforth chapel. IRB approval for this project was received in Fall 2020. Data collection started shortly after approval and continued through Spring 2021.

The study duration was approximately 30-40 minutes. The demographic pre-survey lasted 2-3 minutes. Each viewing experience was one minute and fifteen seconds. The qualitative question responses were approximately 10-15 minutes. The Transportation Short-Scale was 3-4 minutes. Lastly, the final sketch roughly took 10-15 minutes.

The Qualtrics survey collected key demographic information including age, gender, ethnicity, sexual orientation, enrollment status, class standing, major, and current knowledge of the Frank Lloyd Wright Danforth Chapel. Participants (n = 6) were presented a shared url to experiment with the assigned sketch tool. The goal was to allow participants to familiarize themselves with the tool. Participants were then randomly assigned either the 360 group or the 2D group before watching the film. The participants received either the traditional 2D version or the 360 version through an evenly split randomizer. Based on the UCF COVID protocols, participants engaged the visual content through the embedded YouTube player within the survey. Each participant received a UniqueLink based on their email which connected them to an individual external sketch tool. Using the sketch tool, each participant was asked to accurately represent an overhead perspective of the Danforth space.

After the sketch experiment, based on Bevan's (2014) method, each participant went through a prescriptive set of questions to determine their phenomenological attitude. The interview structure consisted of three sets of questions to allow the participant contextualization, apprehension of the phenomenon, and clarification of the phenomenon (Table 1). The seven qualitative questions were presented logically to each participant. Each text field was set as a forced response and received a 150 minimum character limit.

Table 1: Phenomenological Method

Phenomenological Attitude	Interview Structure	Method	Question Set-up
Phenomenological Reduction	Contextualization: (Eliciting the Lifeworld in Natural Attitude)	Descriptive/Narrative Context Questions	"Describe how you translated…" and "How much of the surroundings…"
	Apprehending the Phenomenon: (Modes of Appearing in Natural Attitude)	Descriptive and Critical Questions	"What in your opinion seems…" and "What did you like or dislike…"
	Clarifying the Phenomenon: (Meaning Through Imaginative Variation)	Imaginative Variation: Varying of Structure Questions	"Imagine if you were…" and "What additional visuals or features…" and "If you were to summarize…"

After taking part in the interviews, participants completed a matrix table with six questions which included the Transportation Scale-Short Form (TC). Historically, the TC is the primary instrument to test the experiential state of being transported into the narrative. Using the Transportation Scale-Short Form, participants (n = 6) answered a six-item Likert-scale questionnaire. The main focus of this data collection focused on the experiences of story or narrative. The data determines whether viewers that experience a 360-degree tour of Danforth chapel have a higher degree of narrative engagement than viewers of the two-dimensional viewing. Lastly, each participant answered a set of questions to determine their previous enrollment in DIG 3727C-Game Level Design and exposure to 360-degree video production.

Qualitative data was processed using an open-source data mining tool called Orange3. Each phenomenological question went through careful preprocessing within the data mining

software. Within the data mining software, a textual pre-process node was applied placing all text in a lowercase and removed frequent stopwords. Based on the most frequent text tokens, each processed blocks of text were converted into a word cloud. Along with that, the statistical analysis was processed using Qualtrics. The Sketch Maps were ranked for goodness on a scale of 1 (poor) to 3 (excellent). The map goodness rating is a subjective measure that determines how useful the map would be for game level navigation and judged on over-head accuracy and object placement. The primary overhead sketch evaluation is on room layout accuracy and object placement. The final goodness score is determined by the average of three graders.

CHAPTER 4: FINDINGS

Demographic Results

Brief demographics were collected to help define the audience. Though not directly related to a specific research question, each data set helped to better understand the participants interaction with the created content. Creswell (2017) notes three to ten participants are needed for an effective phenomenology study (p. 189). Six participants responded to the survey allowing a balanced analysis for both the 2d and 360-degree content experience.

Participants in this study were evenly split between age demographics. Approximately 50% of participants were in the 18-25 range. The other fifty percent were in the 25-30 category. Given the purpose of this study, age demographics is not significant to the findings of this study. Although the study targeted undergraduate game design students, future studies may consider differences between the varied age demographics in college programs.

The participant gender breakdown in this study is slightly above a third female (33%) and the remaining being male (66%).

In regards to class standings, this was a surprising result as the main study cast a wide net for undergraduate students within a particular major. However, all six participants classified as seniors. Out of the six seniors, there was an even split between participants that have or have not taken DIG 3737C-Game Level Design.

Participants were also asked about their knowledge of Frank Lloyd Wright's work at Danforth Chapel. Although Frank Lloyd Wright is a famous architect, having familiarity with this specific space would have a major negative impact on the study. As indicated in Table 7,

most participants reported a high level of unfamiliarity with the Frank Lloyd Wright Danforth Chapel (83.3%).

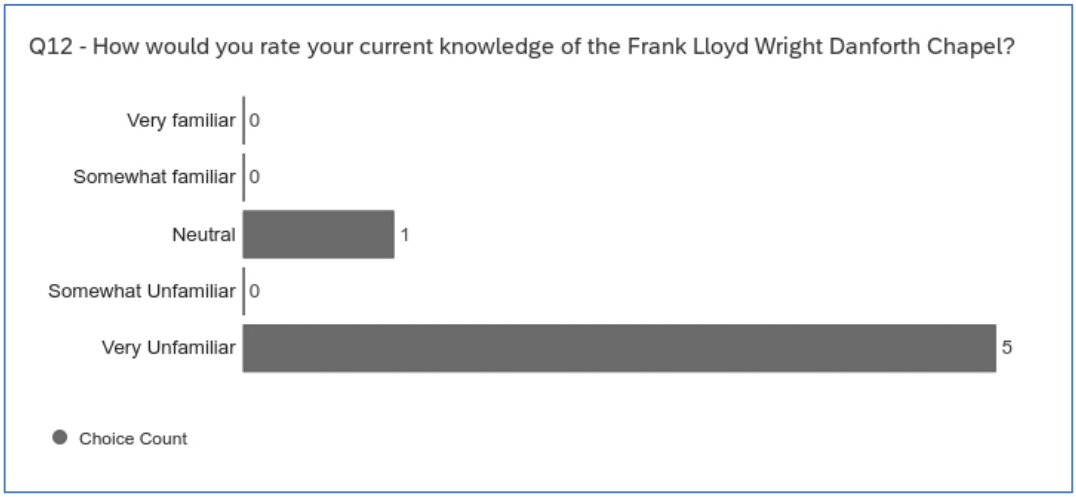


Figure 4: Results from the Danforth Chapel Knowledge

Sketch Results

Subjects were asked to accurately represent an overhead perspective of the Danforth space and to include as many details as possible. The blank sketch tool included labels on all four sides to create a container for each participant. The labels were entitled back, side, and front. Appendix F includes all participant sketches.

The Sketch Maps were ranked for goodness on a scale of 1 (poor) to 3 (excellent) by three researchers. Each of these researchers were accomplished artists who were knowledgeable about Danforth Chapel. The three researchers were blind to the participant identity and other observed demographics. The researchers were asked to ignore drawing ability. The map goodness rating was a subjective measure that determines how useful the map would be for game level navigation and judged on over-head accuracy and object placement. The final goodness

score was determined by the average of three graders. Overall, the 360 sketches scored higher than the 2D group as it relates to overall layout and details (See Figure 5). Based on the amount of lines created to represent the space by each participant, there was a 41.06% difference between the 2D and 360 sketches (see Figure 6/7). By far, the 360 group sketched with more precision and greater detail.

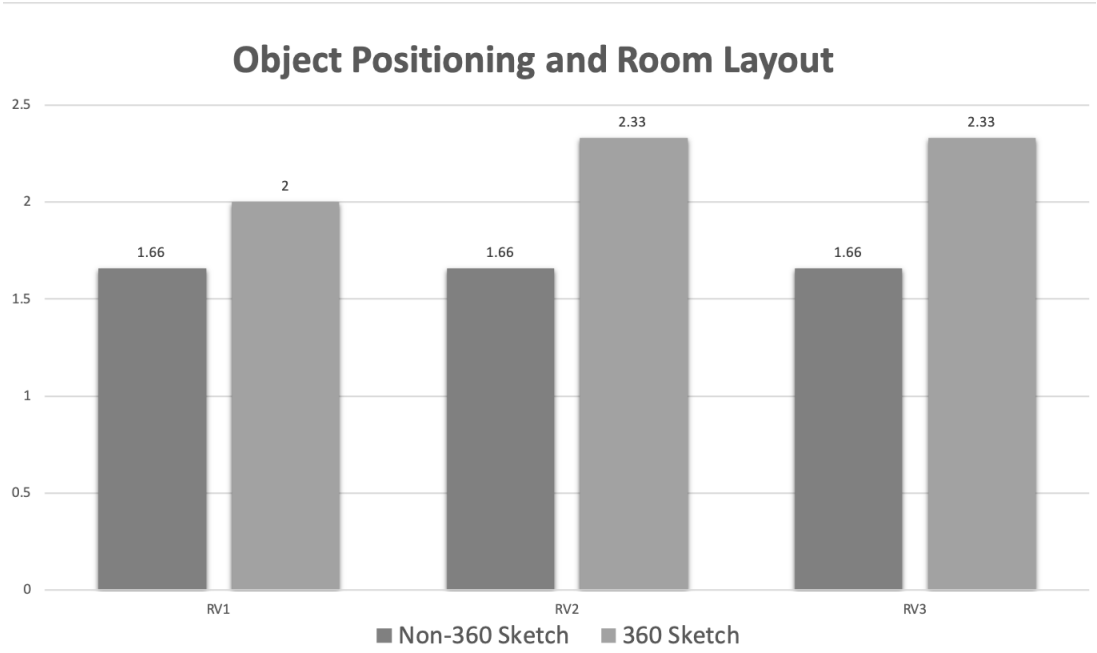


Figure 5: Whiteboard Sketch Results

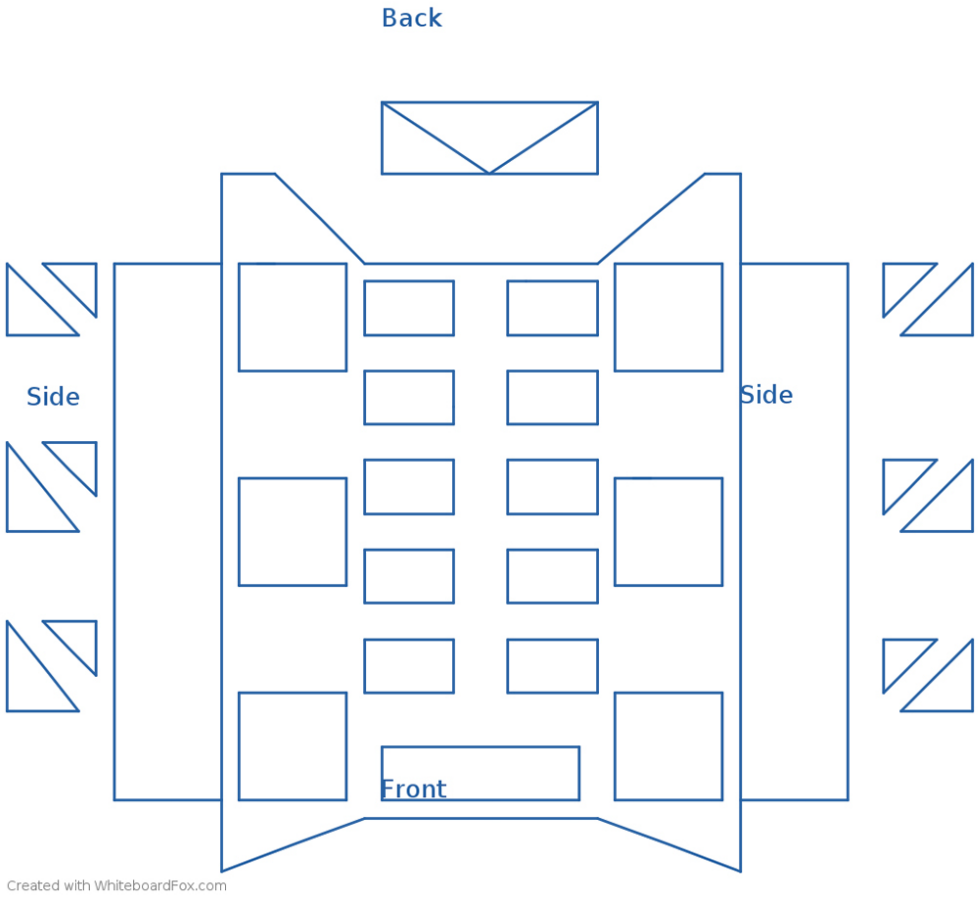


Figure 6: Sample Sketch from the 360-group

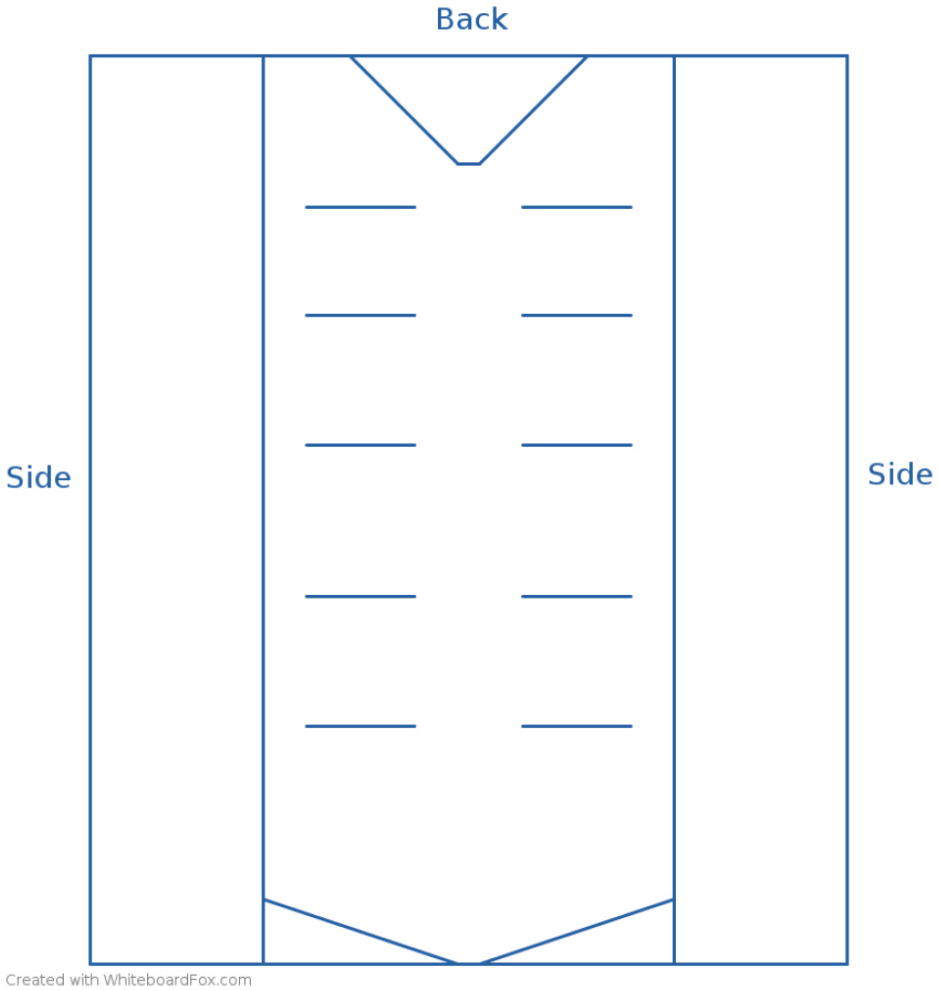


Figure 7: Sample Sketch from the 2D-group

Phenomenological Results

The human experience is a complex process. As it relates to informal learning environments of cultural heritage sites, this study examined spatial awareness of participants through a phenomenological method. As the researcher, I was interested in how the participant (n = 5) described their experience when viewing the selected content. After a thorough reading, five to six categories were chosen to represent the range of each response. Each response was then

coded for the presence or absence of the chosen topics. If present, a code of 1 was given to that topic. The counts for each topic were added and then segmented percentages were calculated for the following groups: 2D group and the 360 group. Each table includes the percentage of all participants that referenced the category along with a breakdown of each group. This section discusses the results and findings of three sets of questions answered by each participant which includes their contextualization, apprehension of the phenomenon, and clarification of the phenomenon.

Phenomenological Context Findings

The contextualization purpose was not to start with the narrative. This may have caused the participant to isolate the story from the context. Question 19 allowed the participant to focus on objects or experiences of their lifeworld to stand out against the narrative context. Each participant was asked to describe how they translated the Frank Lloyd Wright's Danforth chapel space from the video to the sketch map. Overall, as indicated in Table 2, the 360 group said they used a top-down view and symmetry to translate from the video to the sketch map (see Table 2).

The 360 degree participants contextual response demonstrates a higher separation of objects. One 360-degree participant stated:

> I translated the chapel space from the video in a top-down view. I thought about what I saw in the video rather than what he was describing. I tried to capture all of the details of the architecture and the items that were inside of the chapel.

Overall confidence from the 360 group to target specific objects from a top-down view was much higher. Also, the 360 group seemed to have a stronger grasp on symmetry when reproducing specifics items within the sketch. The 2D group struggled to translate and capture

the accuracy of the space. An element of doubt was very present in their word choices. As displayed in Figure 8 below, this was demonstrated in the textual analysis word cloud. For example, the 2D group used phrases such as “I wasn’t really sure,” “I kind of guessed,” and “I tried.”

Lastly, based on Figure 8, the 360 group used more reference points demonstrating a stronger aptitude of translation. Words such as “see” and “everything” show a greater sensibility to see multiple objects demonstrating a higher sense of awareness (see Figure 8). Collectively, the 360 degree group translated more object details within their sketches (See Appendix F).

Table 2: Phenomenological Context Results: Translation

Describe how you translated the Frank Lloyd Wright’s Danforth chapel space from the video to the sketch map?

Q19	Used top-down view	Used symmetry	Used walls and balcony	Used floor, chairs and steps	Used memory and imagination	Guessed dimensions
Counts (n = 5)	2	3	2	3	3	2
Score All Respondents %	40	60	40	60	60	40
Score 2D Group %	0	33	67	67	67	33
Score 360 Group %	**100**	**100**	**0**	**50**	**50**	**50**

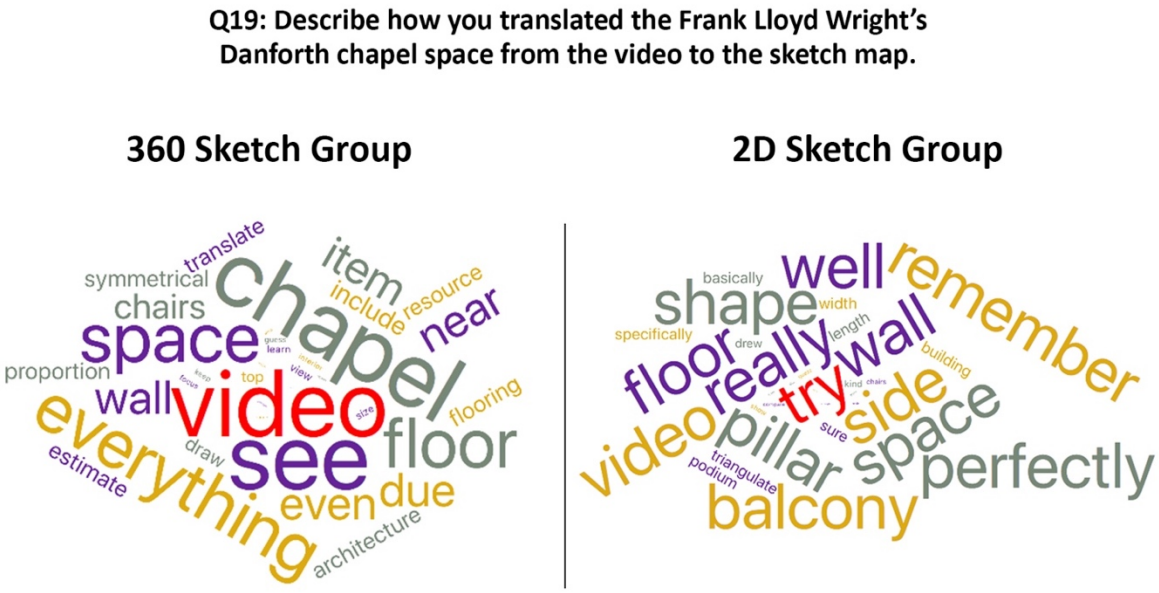


Figure 8: Textual Analysis of most used words in Question 19

Beyond the contextualization of Question 19, Question 20 was meant to show some complexity of experience and the significance of interrelatedness. Participants were asked, How much of the surroundings in the video were not represented? Most respondents commented on what they failed to sketch rather than what the video missed. For example, one 2D respondent stated:

> I know for a fact that I completely forgot to put the actual space in the back part where the podium is supposed to be. It looks like the back is just the stained glass window. I also did not draw the upper balconies.

As shown in Table 3, this underrepresentation was directly tied to their sketch and not the video content. The respondents did not build a strong interrelatedness to the limitations of the content within the form.

In relation to the back and balcony themes, the 2D group struggled representing these areas. Based on the textual word cloud, the 2D groups most used word was "back" (see Figure 9)

One participant "completely forgot to put the actual space in the back." This could be a limitation invoked by the production process. Evaluating the controlled angles within the traditional 2D documentary, the back spaces were underrepresented in video form. However, the 360 group had the ability to actively look around the space. Based on the survey, 60% of the respondents actively looked around the space.

Table 3: Phenomenological Context Results: Representation

How much of the surroundings in the video did you feel were not represented?

Q20	Significant portions	Back, balcony and sides	Elevation changes	Interior decorations	Walls, windows and lights	Other
Counts (n = 5)	5	3	2	1	3	1
Score All Respondents %	100	60	40	20	60	20
Score 2D Group %	100	67	33	0	67	33
Score 360 Group %	**100**	**50**	**50**	**50**	**50**	**0**

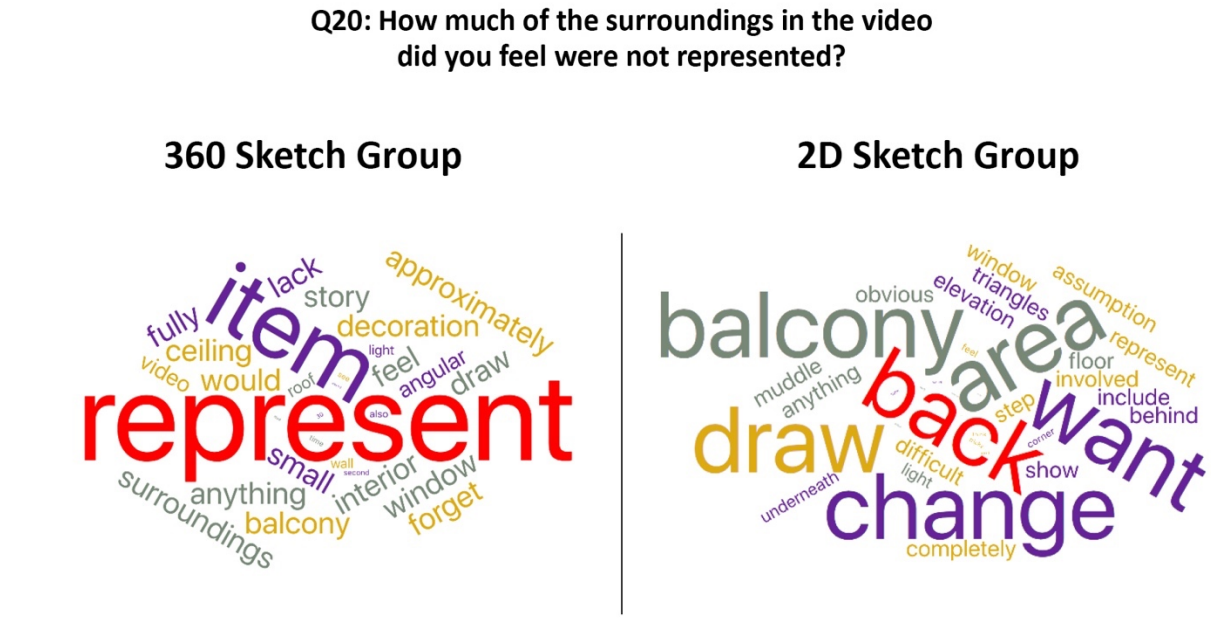


Figure 9: Textual Analysis of most used words in Question 20

Phenomenological Cognition Findings

Moving beyond the context, the cognition section seeks to apprehend the phenomenon. It's at this point where the study examined how participants interpret his or her experience through more descriptors. Participants were asked the following questions, Based on your viewing of the Frank Lloyd Wright space, what in your opinion seems to be the best of most desirable characteristic or feature of the Danforth Chapel? Portrayed in Table 4, the 360 group picked symmetry and shape as the most desirable characteristic or feature.

Table 4: Phenomenological Cognition Results: Descriptors

Based on your viewing of the Frank Lloyd Wright space, what in your opinion seems to be the best or most desirable characteristic or feature of the Danforth Chapel?

Q21	Symmetry and Shape	Stained windows	Podium	Colors	Altar Steps	Other
Counts (n = 5)	4	3	1	2	1	0
Score All Respondents %	80	60	20	40	20	0
Score 2D Group %	67	67	33	33	0	0
Score 360 Group %	**100**	**50**	**0**	**50**	**50**	**0**

This characteristic or feature proved beneficial for the 360 group within the sketch process (see Appendix F). Along with that, they were able to recognize other items such as the altar steps. This was a clear separation between the 2D and 360 group. 2D respondents may have referenced more than one feature but it was applied to a singular item. For example, one 2D respondent stated "I think the geometric stained-glass window at the forefront of the chapel is certainly the best attribute of the building." The participant noted the shape and the stain-glass window. However, it was applied to only one item. Interestingly, all 360 respondents focused on more than one feature or characteristic. For example, one 360 participant stated:

> In my opinion, possibly the best or most desirable characteristic of the Danforth Chapel would have to be the design itself, meaning the cut out shapes of the architecture and how the alter had very intricate looking steps, and an abnormal shape than most chapels may have. The fact that things were placed accurately apart from each other is also pretty unique, although it's not my favorite part about it.

This participant focused on the overall design, cut out shapes, and altar steps. These findings indicate that there was a difference in observing more spatial details of the Danforth chapel between a 360-degree viewing and traditional two-dimensional viewing.

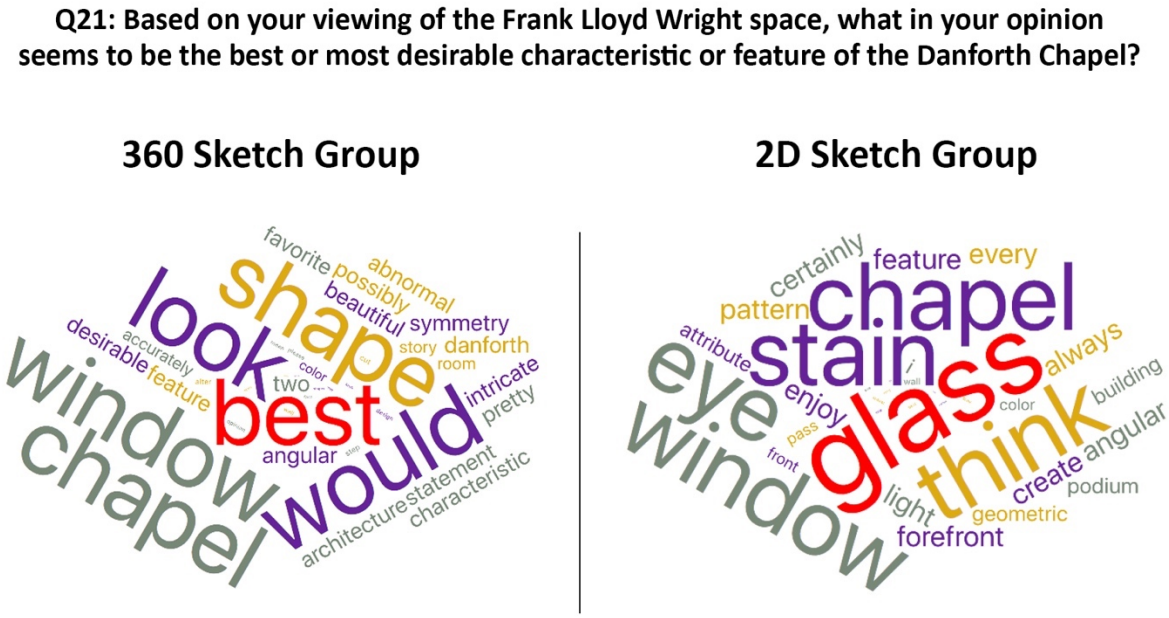


Figure 10: Textual Analysis of most used words in Question 21

Descriptive questions can be complimented with structural-based questions. Question 22 focused on the participant preferences by asking the participants, What did you like or dislike about the visual representation of the Frank Lloyd Wright space in the video? The goal was to add depth and quality to the information. Displayed in Table 5, data revealed that the 360 group

in general seemed to like what they saw more than the 2D group. One participant said it "looked like a really cool chapel."

Table 5: Phenomenological Cognition Results: Preferences

What did you like or dislike about the visual representation of the Frank Lloyd Wright space in the video?

Q22	Shape/Space like	Shape/Space dislike	Lighting dislike	Stained glass dislike	Nothing to dislike
Counts (n = 5)	3	0	1	1	2
Score All Respondents %	60	0	20	20	40
Score 2D Group %	33	0	33	33	33
Score 360 Group %	**100**	**0**	**0**	**0**	**50**

Additionally, 360 group members appreciated the accuracy of items within the space. In most responses, the 2D group focused more on the negative. For example, a 2D participant left feeling "dizziness." This is surprising since dizziness and nauseous feelings are synonymous with virtual reality. Although this study did not focus on the level of comfort for users, based on these structural responses, this may be an area for further research.

Lastly, portrayed in Figure 11, 2D participants used more emotionally-charged language. For example, the highest amount of word choice for the 2D group was "I feel." Interestingly, the documentary content did not intentionally seek to invoke emotion. From a documentary production standpoint, the goal was to inform the audience. However, based on the written comments, the 2D group disliked the camera work and lighting. Within cinema production, these two attributes have a great deal of power to invoke emotion. One 2D respondent felt "the lighting could have been more spiritual if the goal was to show the beauty of the space." Comparatively,

the 360 groups highest word usage was “like” (see Figure 11). Focusing mostly on the positivity of the overall space.

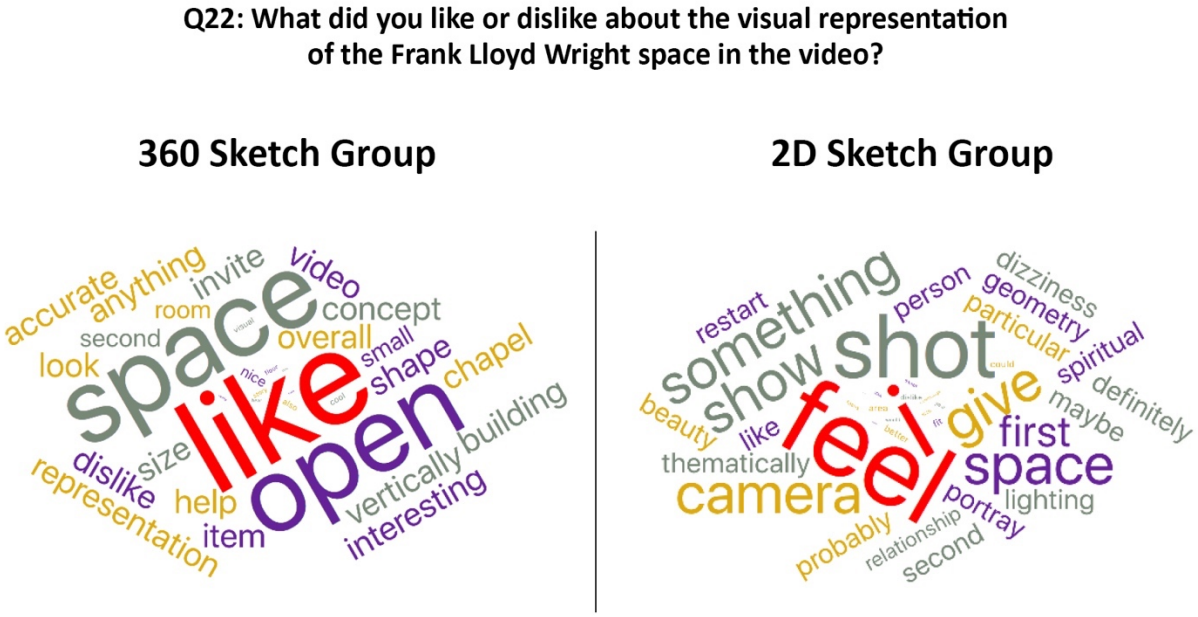


Figure 11: Textual Analysis of most used words in Question 22

Phenomenological Imaginative Variation Findings

Wrapping up this chapter, this section seeks to clarify the phenomenon of imagination variation. The goal was to allow participants to provide clarity around the presentation. For Question 23, participants were asked to imagine if they were in the place of the camera and describe what they saw. By far, data analysis of this question yielded the highest results in favor of the 360 degree group. The 360 group was able to describe what they saw more accurately and in greater detail, as indicated in Table 6.

Table 6: Phenomenological Imaginative Variation Results: POV

Imagine if you were in the place of the camera, describe what you saw?

Q23	Saw symmetry and patterns	Saw walls, pillars, and balcony	Saw floor, chairs and steps	Saw stained glass windows and ceiling	Saw accurate and finer details
Counts (n = 5)	4	4	3	4	2
Score All Respondents %	80	80	60	80	40
Score 2D Group %	67	67	33	67	0
Score 360 Group %	**100**	**100**	**100**	**100**	**100**

Qualitative data also emphasized this finding. For example, when recalling the process of choosing a camera placement in the balcony, one 360 degree respondent states:

> I saw below on the first floor a couple rows of chairs. Six pillars, with three on the left and three on the right. The pillars sit inward from the walls, allowing the second story to have a balcony that runs on each side of the room. Back to the first story, near the front, lies a pentagon shape on the floor, but the sides are straight. There are two pentagon shapes stacked on top of one another creating two steps. On the back wall lies floor to ceiling windows. The window panes are long rectangular shapes. They form a pentagon shape to, where the top point of the pentagon reaches the ceiling. As the sides of the pentagon point come inward the decrease in height and meet in the middle. So the top of the pentagon windows form a diamond shape on top.

This description provides the most detailed account by word count. This 360 respondent focused more on the overall shapes and patterns. From there, the respondent moved to more collective items within the space.

Comparatively, one of the 2D respondents used the form as the basis for their clarity of the space. Basically, their thoughts matched the context of the production technique. For example, the 2D respondent stated “I saw mid-range shots of all the important architectural characteristics of the building.” This may be an inhibitor of seeing the broader scale of the space.

Based on the word cloud for each group, the 360 group clearly touched more on the collective items within the FLW space than the 2D group (see Figure 12). Based on the word count alone, there is a 68.5% difference between the two groups.

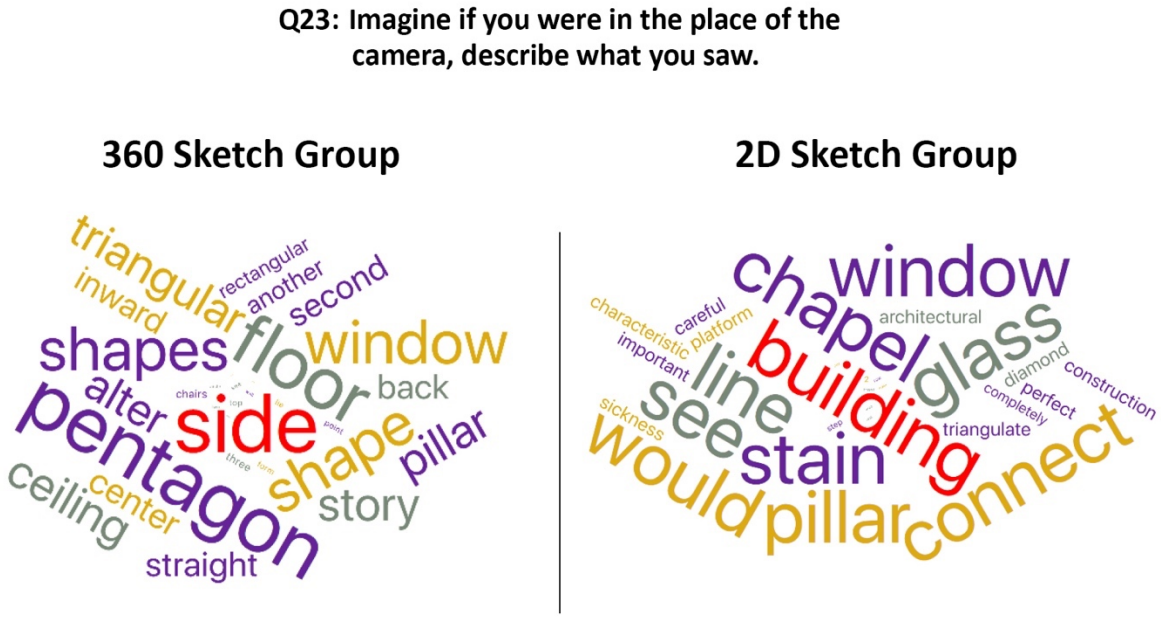


Figure 12: Textual Analysis of most used words in Question 23

Continuing to seek clarity, Question 24 asked participants, What additional visuals or features could be added to the video to allow them to gain a fuller understanding of the Danforth chapel? The goal of this survey question was to keep the participant grounded in the original context. Additional visuals or features included in the participants' responses are included in Table 7.

Table 7: Phenomenological Imaginative Variation Results: Additions

What additional visuals or features could be added to the video to allow you to gain a fuller understanding of the Danforth chapel?

Q24	Satellite view of exterior	Floor plan	Detailed camera shots	Walk through of the area	Other
Counts (n = 5)	3	1	2	1	1
Score All Respondents %	60	20	40	20	20
Score 2D Group %	33	0	67	33	33
Score 360 Group %	**100**	**50**	**0**	**0**	**0**

Regarding this question, the 2D group asked for more camera shots and a walk through. For example, one 2D participant wanted a camera to spend "more time to walk through the area in long shots, going down the halls or up steps to get a sense of space for the area." In regards to requests from the 360 group, they focused more on the exterior. This seems to demonstrate the 360 group's understanding of the interior spaces and desire to be exposed to the external structure. For example, one participant requested "a small drone or some other way to get a direct top down view of the area." Overall, the 360-group projected more confidence with the internal space whereas the 2D group sought more clarification.

Based on the word cloud and themes, the 2D group desired more camera shots. As indicated in Figure 13, this reflects more on the production value of that particular group. Again, 60% of the 360 respondents actively looked around the space. The 2D group had forced angles with a passive experience. Understandably, a desire, as stated by a 2D respondent, that the camera "show more in detail with several types of shots" matches the limitation of the traditional passive experience.

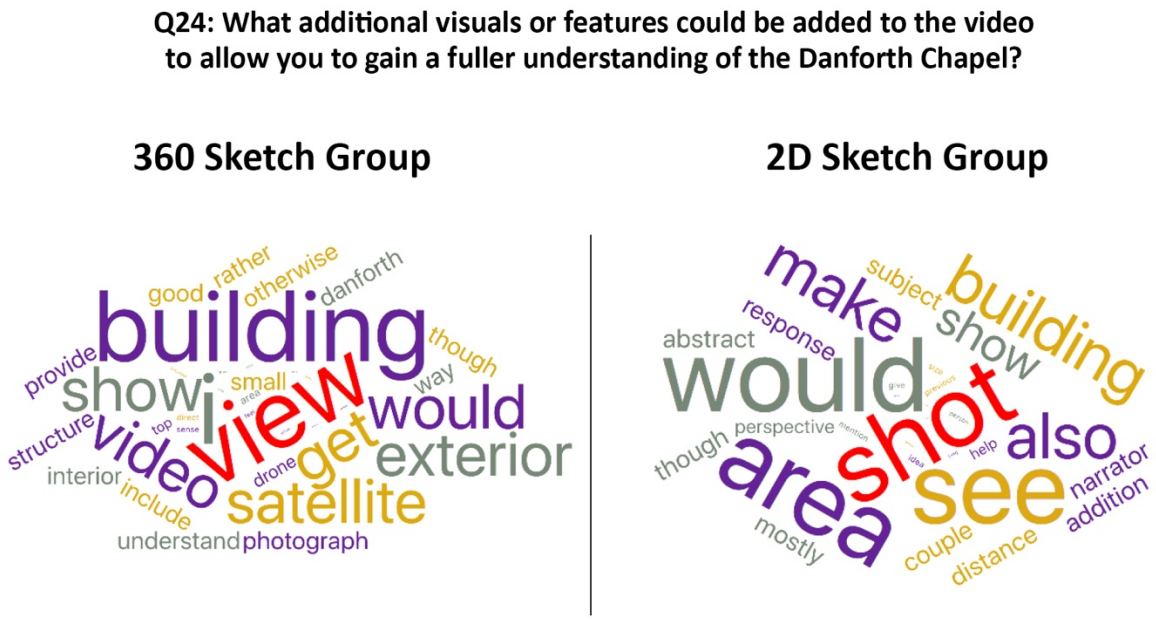


Figure 13: Textual Analysis of most used words in Question 24

The survey also provided a platform for the participants to offer clarification on if the phenomenon is an effective use of descriptors. This imaginative variation was framed within Question 25, which asked participants, If you were to summarize what this space is like to a friend who had never been there before, what would you say? Table 8 provides a breakdown of responses.

Table 8: Phenomenological Imaginative Variation Results: Descriptors

If you were to summarize what this space is like to a friend who had never been there before, what would you say?

Q25	Small size	Symmetry and space relationships	Stained glass windows	Open second floor balcony	Color, numbers and arrangements
Counts (n = 5)	3	4	4	3	2
Score All Respondents %	60	80	80	60	40
Score 2D Group %	67	67	67	33	0
Score 360 Group %	**50**	**100**	**100**	**100**	**100**

Overall, the 360-group described the chapel in greater detail. Based on the categories selected for this question, only one participant addressed every area, which was a 360 participant. Summarizing the space, this participant states:

> I would say the space is small and symmetrical. It's two stories, with large windows as the front wall. The second story is open, and has a balcony running down the sides of the chapel. There are a couple rows of seating, with more located under the balcony space.

It's unique that this participant actively engaged each category and stayed true to the original context.

As indicated in Figure 14, the 360 group maintained a higher degree of spatial awareness. The highest word choices for the 360 group touched on more attributes of the FLW chapel. For example, the 360 group noted the alter, aisles, and balcony as key attributes. Comparatively, the 2D group focused more on the space relationships and stained glass windows.

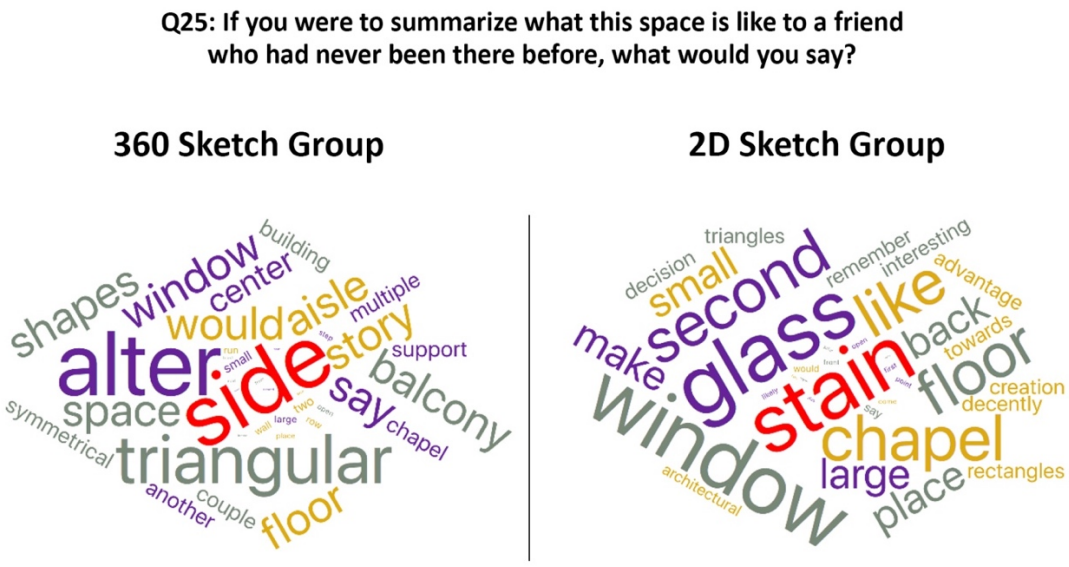


Figure 14: Textual Analysis of most used words in Question 25

Transportation Scale-Short Form Findings

As narrative form shifts into new media experiences, which disrupts our senses, there is an increasing curiosity of how those experiences shape story and impact audiences. This study examined the impact of spatial presentation of a documentary on perception of narrative engagement when viewing linear content in non-360 form displayed in a two-dimensional player comparative to linear 360-degree documentary content displayed in a 360-degree player? Research question 3 asked what is the impact of spatial presentation of the documentary on perception of narrative engagement when viewing linear content in non-360 form displayed in a two-dimensional player comparative to linear 360-degree documentary content displayed in a 360-degree player? Table 9 portrays results from the transportation Scale-Short Form (TC). Future investigation with a higher sample rate is needed to determine any statistically significant findings. The affective results created the most interesting findings that could prompt further study (see Figure 15).

Table 9: Results from the Transportation Scale-Short Form

Transportation Scale-Short Form
(range 1= Very Untrue to 7= Very true)
All= total respondents; 2D= non-360 video group; 360= 360 video group

Item		**2D**		**360-Degree**	
	n	***M***	***SD***	***M***	***SD***
I wanted to learn how the documentary ended.	6	5.00	1.00	5.00	2.08
I was mentally involved in the documentary.	6	6.00	0.57	6.00	1.00
I could picture myself in the scene of the events.	6	5.00	1.00	4.00	1.73
The documentary affected me emotionally.	6	3.00	0.82	3.00	1.52
I had a vivid image of the chapel windows.	6	6.00	0.57	6.00	0.57
I had a vivid image of the Frank Lloyd Wright Chapel.	6	6.00	1.52	6.00	1.52

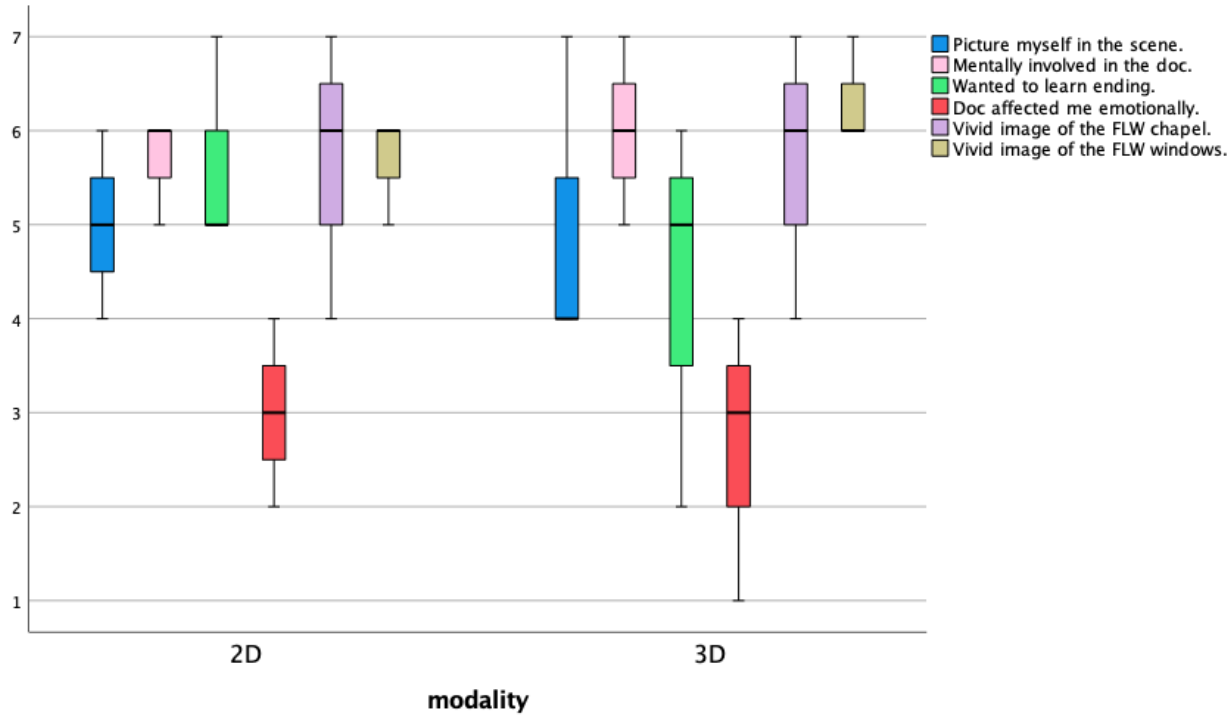


Figure 15: Boxplot Results from Transportation Scale Short-Form

When asked if they wanted to learn the ending and how engaged each participant was mentally with the created content, both groups felt the same. By far, based on the previous findings, the 360 group explained and sketched with much more detail. However, interestingly, the 2D group scored a bit higher on the first phenomenological context question within the used memory and cognition category. One 2D participant stated:

> I also remember that the floor, specifically the part where you have the two steps up to the podium, basically made a sort of M shape from what I remembered, so I wanted to capture that.

Language used in the above statement focuses on memory. However, the overall cognition for 2D users was minimized by their struggle to recall. For example, within the same set of responses, several participants noted how challenging it was to "try" and recreate the space (see Figure 15). Looking more closely at the text being used, the descriptors for the 360 group seem

to emanate more confidence in describing the context. This reinforces the mental engagement and involvement with the story.

Figure 16: Textual Analysis of most used words for 2d group in Question 19

In regards to placing themselves within the scene, the 2D group scored slightly higher. Based on the cinematic codes used during production within the 2D form, each group described their experience based on the form presented to them. Question 23 asked participants to imagine being in the place of the camera. Again, although the 360 group includes more details in both their sketch and written content, the 2D group used language to reinforce the production techniques used within traditional filmmaking. For example, one 2D participant stated "I saw mid-range shots of all the important architectural characteristics." This language does not demonstrate the potential of the first-person POV of 360-degree cinematic codes. Again, within cinema history, the first-person POV shot is a rare occurrence. This new spatial reorientation through a constant first-person 360 POV to new aural and visual experiences is very real and can create new meaningful experiences for the user. Overall, the form presented to each group shaped how they thought about themselves as a personified camera.

Next, the Transportation Scale-Short Form asked participants if the documentary affected them emotionally. This category had the overall lowest combined median. Understandably, the form and content did not intentionally seek to invoke emotion. From a documentary production standpoint, the goal was to inform the audience. With this in mind, the transportation scale did not determine whether the emotion was positive or negative. However, based on the written materials collected in Question 22, 2D participants used more emotionally-charged language (see Figure 16). For example, the highest amount of word choice in this question for the 2D group was "I feel." Overall, the 2D group wanted more from the content and form. One participant stated:

> The very first shot, where the camera pans down the stained glass at the back, *left me feeling something for about a quick second*. I want to say it was dizziness, but I'm not too sure. I had to restart the video to see what was happening, *but something about the first shot definitely made me feel odd*.

Based on similar responses, the selective angles used within the 2D form left the participants wanting more emotionally. The 360 group in general seemed to like what they saw more than the 2D group. In context of the room space, one 360 participant stated "it helps open up the small space vertically, while also making it inviting. So, overall, the positive emotional perspective is projected more often with the 360 group.

Figure 17: Textual Analysis of most used words for 2d group in Question 22

Lastly, the final set of Likert-based questions asked participants if they had a vivid image of the windows and overall space. The 360 group score was similar to the 2D group. However, based on the previous data, several factors reinforce some differences. Again, the sketch data notes a 41.06% difference between the 2D and 360 sketches. By far, the 360-group sketched with more precision and greater detail (see Appendix F). Along with that, the number of descriptors used within the imaginative qualitative category substantiates this finding as well. For example, in question 25, participants were asked to summarize what this space is like to a friend who had never been in the space. All members of the 360 group used descriptors related to symmetry and spatial relationships, the stained-glass windows, the open second floor balcony, colors, numbers, and detailed arrangements. This reinforces that viewers who experience a 360-degree tour of Danforth chapel do have a higher degree of narrative engagement than viewers of the two-dimensional viewing.

CHAPTER 5: CONCLUSION

This dissertation explored whether CVR documentary experiences enhance spatial awareness of users as it relates to informal learning environments of the Frank Lloyd Wright cultural heritage site. Having control of visual angles through 360 technologies achieved higher spatial awareness than traditional single angle documentary form. Overall, the 360 sketches scored higher than the 2D group as it relates to overall layout and details. By far, the 360 group sketched with more precision and greater detail.

Secondly, this dissertation explored whether there is a difference in observing more spatial details of the Danforth chapel between a 360-degree viewing and traditional two-dimensional viewing. Based on the amount of lines created by each participant to represent the FLW space, there is a 41.06% difference between the 2D and 360 sketches. Overall confidence from the 360 group to target specific objects from a top-down view was much higher. The 360 group projected more confidence with the internal space whereas the 2D group sought more clarification. Also, 2D respondents may have referenced more than one spatial detail but it was applied to a singular item. However, all 360 respondents focused on more than one feature or characteristic observing more spatial details.

Lastly, this dissertation wanted to know the impact of spatial presentation of documentary content on perception of narrative engagement when viewing linear content in non-360 form displayed in a two-dimensional player comparative to linear 360-degree documentary content displayed in a 360-degree player. Based on my findings, the 360 degree group actually trends towards a higher degree of narrative engagement from a qualitative standpoint. The descriptors for the 360 group emanate more confidence in describing the context. This reinforces

the mental engagement and involvement with the story. Future investigation with a higher sample rate is needed to determine any statistically significant findings.

Limitations of the Study

After completing this study, several limitations were discovered and could serve as areas of caution in the future. Due to the COVID-19 pandemic, the study was adapted to fit the required protocols. This forced the participants to a browser-based experience. Originally, the study was intended to test the 360 CVR documentary content using the untethered Oculus Quest HMD. For this study, all participants experienced both the 2d and 360 CVR experience on a desktop system. The browser-based experience limited collection of heat maps, eye-tracking data, and placing the user in a fully immersive space.

Secondly, the technology limitations of a browser-based viewing experience may have impacted the overall quality of the viewing content. Since the content was viewed in a YouTube embedded player, the compression schemes are automatically assigned based on the end-users bandwidth. As the study progressed, we had no way to determine what resolution the content was viewed in by the end user. This could have had a dramatic impact on the clarity of the content for the participants.

Lastly, beyond the required protocols and software constraints, the study process hindered the recruitment strategies. Since this study required a UniqueLink for each sketch, Qualtrics required an email be attached to that UniqueLink. Qualtrics recognized the email making the request and assigned a unique URL to a personalized sketch page with Whiteboard. Typically, a survey link is sent to a large audience with potential of a larger scale study.

Requiring a digital sketch added one more layer that had a negative impact on the potential size of the study.

Directions for Further Research

This study represents a first step in investigating Cinematic Virtual Reality (CVR) documentary experiences enhancement on spatial awareness. Utilizing various sketch tools is a highly unexplored topic from an empirical standpoint. Considering the work of previous studies on spatial cognition, pencil and paper were the primary media used for conducting sketches. Although COVID protocols added several barriers to this study, the forced implementation of digital tools revealed several possibilities. For example, within this study, by targeting Game Design students, it may have proved beneficial to utilize 3d sketch tools rather than the rudimentary online 2d sketch tool. The amount of detailed data could reveal new insights within 3d spatial cognition.

Secondly, future research should include a larger comprehensive study to have more influence on parameters. For this study, the number of participants exposed to certain conditions met the minimal recommendations for an effective phenomenological study (n=6). Although qualitative elements were foundational to the results of this study, using the phenomenological method as the sole measure has been brought into question. Although Creswell (2017) notes three to ten participants for an effective phenomenology study, he also recommends an investigator collect enough data until no new insights or properties occur, also known as "saturation" (p. 189). Expanding the saturation may reveal new insights into the various phenomenological categories and allow stronger quantitative results.

Additionally, utilizing more cinematic and gamified experiences to the Cinematic Virtual Reality documentary experience could provide more insight into the participants ability to follow complex instructional environments. By implementing button augmentations on top of passive 360-degree video content could create a whole new area of unexplored topic domains specifically related to gamified experiences within head-mounted devices. Future studies could benefit from the behavioral choices and the impact that has on spatial awareness as it relates to informal learning environments. For example, industrial repair and maintenance is a growing area that reimagines process-oriented instruction. By combining cinema, game, and interactive experiences, businesses can implement cost efficient training systems to increase spatial orientation for sophisticated maintenance techniques.

Lastly, enhanced film production techniques continue to spill over into CVR as audience expectations crave more from their consumption habits. For example, the content created for this study were fairly simple scenarios and involved a stationary camera. Although some camera movements were involved, overall the production process was fairly stationary. Future studies could explore more dynamic production techniques such as an observational style approach which includes more handheld and moving camera shots. Scholars could also utilize cutting ratios as an area of exploration. In the current dissertation study, the cut frequencies were very consistent across the two forms. However, the pacing could be altered to match the needs of each medium. For example, longer cuts in CVR allow the user to explore more detail within the scene. This would allow future studies to take advantage of more data points within new categories.

APPENDIX A: DEBRIEFING STATEMENT

UNIVERSITY OF CENTRAL FLORIDA

Debriefing Statement

For the study entitled:
"Pixelated Domes: Cinematic Code Changes through a Frank Lloyd Wright Lens"

Dear Participant.

During this study, you were asked to watch a 1:15 second video[1]. You were told that the purpose of the study was to study cinematic code changes[2]. The actual purpose of the study was to measure spatial cognition levels when viewing a Frank Lloyd Wright walking tour through 360 modalities and examine the influence this has on narrative engagement comparative to traditional two-dimensional documentary form.[3].

We did not tell you everything about the purpose of the study because knowing the cinematic modality and study purpose may have skewed the results [4].

You are reminded that your original consent document included the following information: You are free to withdraw your consent and discontinue participation in this study at any time without prejudice or penalty. Your decision to participate or not participate in this study will in no way affect your continued enrollment, grades, employment or your relationship with UCF or the individuals who may have an interest in this study.[5] If you have any concerns about your participation or the data you provided in light of this disclosure, please discuss this with us. We will be happy to provide any information we can to help answer questions you have about this study.

Now that you know the true nature of the study, you have the option of having your data removed from the study. Please contact the PI if you do not want your data to be used in this research and it will be withdrawn.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints or think the research has hurt you, please contact William Allen, Graduate Student, Texts and Technology program, College of Arts and Humanities, 763-744-8318 or Dr. Peter Smith, Faculty Supervisor, Department of Games and Interactive Media by email at Peter.Smith@ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

Please again accept our appreciation for your participation in this study.

APPENDIX B: DEMOGRAPHIC QUESTIONNAIRE

1. Age: What is your age?
    a. 18-25
    b. 25-30
    c. 30-35
    d. 35 or older

2. Ethnicity (or Race): Please specify your ethnicity:
    a. Hispanics of any race
    b. American Indian or Alaska Native
    c. Asian
    d. Black or African American
    e. Native Hawaiian or Other Pacific Islander
    f. White
    g. Two or more races
    h. Race and Ethnicity Unknown
    i. Other(please specify)
    j. Prefer not to respond

3. Gender: What is your gender?
    a. Male
    b. Female
    c. Transgender
    d. Other
    e. Prefer not to respond

4. Sexual Orientation
    a. Bisexual
    b. Gay
    c. Lesbian
    d. Straight/Heterosexual
    e. Queer
    f. Questioning
    g. Prefer not to respond

5. What region of the United States were you born?
    a. Northeast
    b. Northwest
    c. Southeast
    d. Southwest
    e. Midwest
    f. Far West
    g. Far East
    h. Outside the United States

6. Are you a Transfer Student?
    a. Yes
    b. No

7. Enrollment: What is your enrollment status?
    a. Part-time
    b. Full-time

8. Class Standing: What is your class standing?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Masters/Doctoral
    f. Professional Student
    g. Continuing Education Student
    h. Non-degree seeking

9. What is your major? (Short Answer)

10. Tuition Status: Are you considered an in-state or out-of-state resident for tuition purposes?
    a. In-state
    b. Out-of state
    c. International (Non-resident alien)

11. Housing: Which best describes where you currently live?
    a. On-campus(Residence Hall)
    b. Off-campus housing (within 5 miles of campus)
    c. Off-campus (farther than 5 miles from campus)

12. How would you rate your current knowledge of a Frank Lloyd Wright Danforth Chapel?
    a. Very familiar
    b. Somewhat familiar
    c. Neutral
    d. Somewhat Unfamiliar
    e. Very Unfamiliar

APPENDIX C: DOCUMENTARY VIDEO CONTENT

Video Content Being Viewed by Participants:

Traditional 2d Documentary
https://www.youtube.com/watch?v=lp--aZ3DbFk

360-degree Documentary
https://www.youtube.com/watch?v=4tK6BbRkNhg

APPENDIX D: IRB PERMISSION

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

November 23, 2020

Dear William Allen:

On 11/23/2020, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study
Title:	Pixelated Domes: Cinematic Code Changes through a Frank Lloyd Wright Lens
Investigator:	William Allen
IRB ID:	STUDY00002410
Funding:	None
Grant ID:	None
Documents Reviewed:	• HRP-251- FORM - Faculty Advisor Scientific-Scholarly Review fillable form.pdf, Category: Faculty Research Approval; • 01_Demographic-Questions-for-Survey.docx, Category: Survey / Questionnaire; • 02_Qualitative_Questions.docx, Category: Survey / Questionnaire; • 03_Transportation Scale.docx, Category: Survey / Questionnaire; • 04_Final Quantitative Questions.docx, Category: Survey / Questionnaire; • 05_Video_Content.docx, Category: Other; • 360_Video, Category: Other; • HRP-509 -Debriefing Statement_allenw.pdf, Category: Consent Form; • IRB Allen 2410 HRP-255-FORM Request for Exemption_11202020.docx, Category: IRB Protocol; • IRB_Allen_2410_HRP-254_11202020.pdf, Category: Consent Form; • RECRUITING SCRIPT_Update.docx, Category: Recruitment Materials; • Traditional_2d_Video, Category: Other;

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please submit a modification request to the IRB. Guidance on submitting Modifications and Administrative Check-in are detailed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

Due to current COVID-19 restrictions, in-person research is not permitted to begin unless you are able to follow the COVID-19 Human Subject Research (HSR) Standard Safety Plan with permission from your Dean of Research or submitted your Study-Specific Safety Plan and received IRB and EH&S approval. Be sure to monitor correspondence from the Office of Research, as they will communicate when restrictions are lifted, and all in-person research can resume.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Kamille C. Birkbeck

Kamille Birkbeck
Designated Reviewer

APPENDIX E: PHENOMENOLOGICAL QUESTIONNAIRE

Phenomenological Context:

1. Describe how you translated the Frank Lloyd Wright's Danforth chapel space from the video to the sketch map. (context)

2. How much of the surroundings in the video did you feel were not represented? (context)

Phenomenological Cognition/Critical:

3. Based on your viewing of the Frank Lloyd Wright space, what in your opinion seems to be the best or most desirable characteristic or feature of the Danforth Chapel? (cognition)

4. What did you like or dislike about the visual representation of the Frank Lloyd Wright space in the video? (critical)

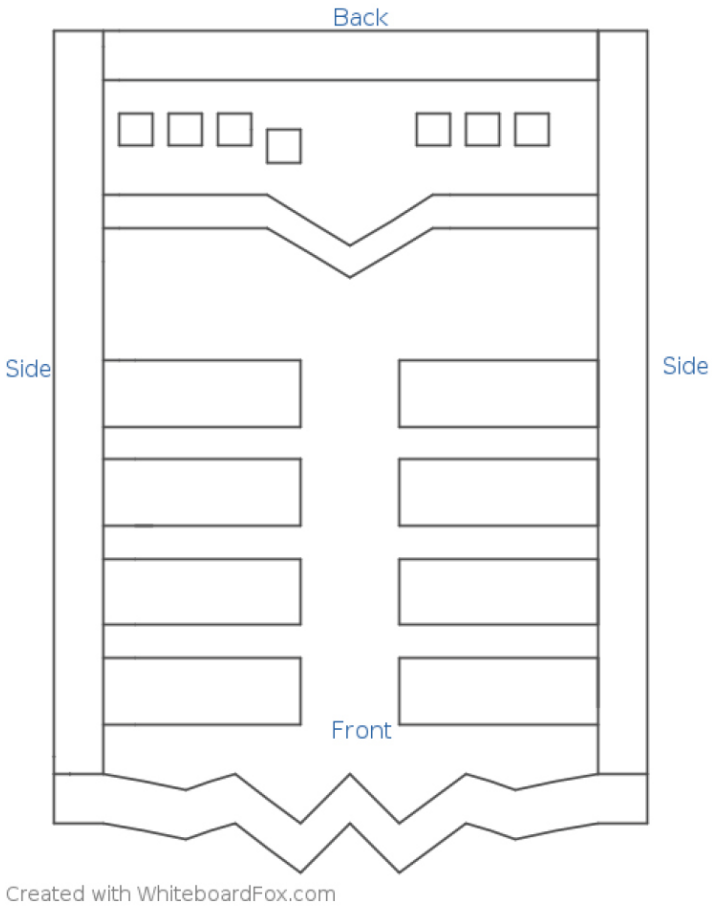
Phenomenological Imaginative Variation:

5. Imagine if you were in the place of the camera, describe what you saw. (imaginative variation)

6. What additional visuals or features could be added to the video to allow you to gain a fuller understanding of the Danforth Chapel? (imaginative variation)

7. If you were to summarize what this space is like to a friend who had never been there before, what would you say? (imaginative variation)

APPENDIX F: SKETCHES



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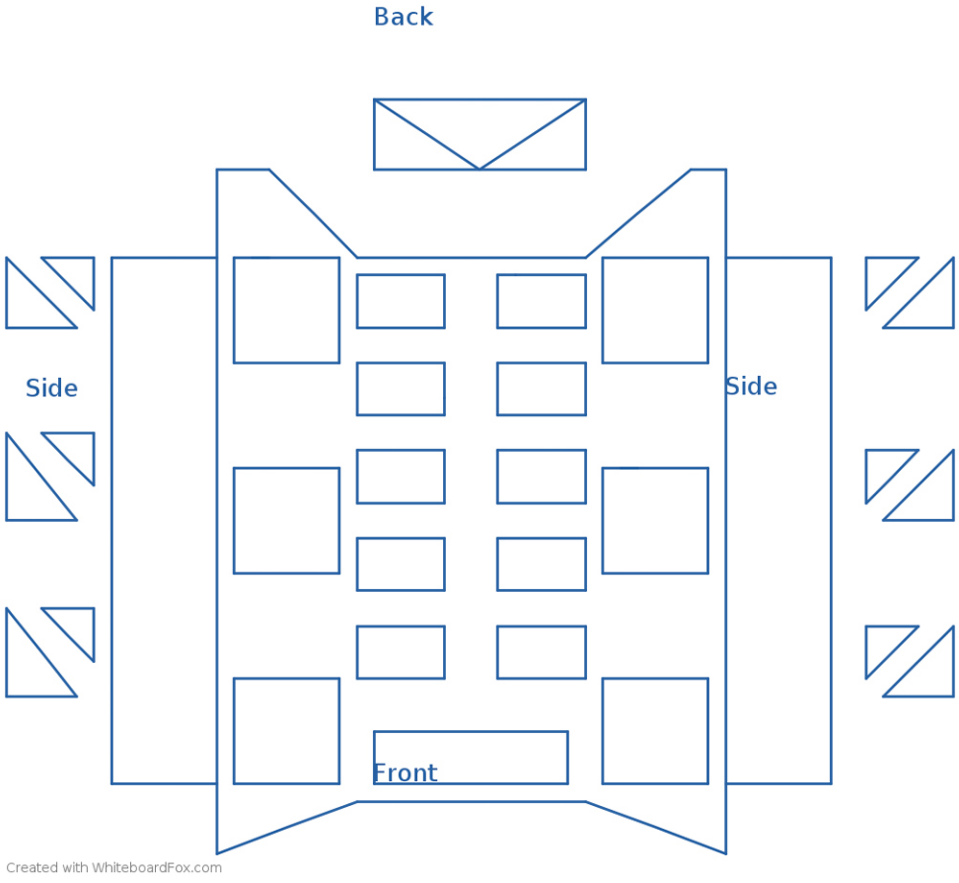

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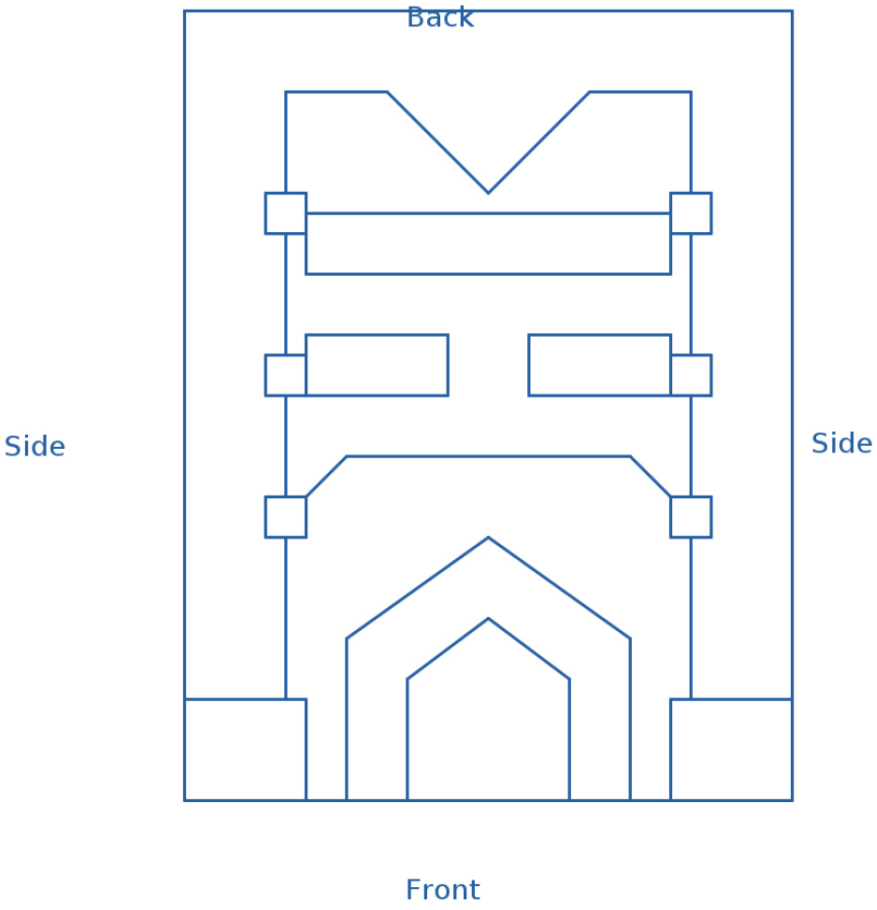

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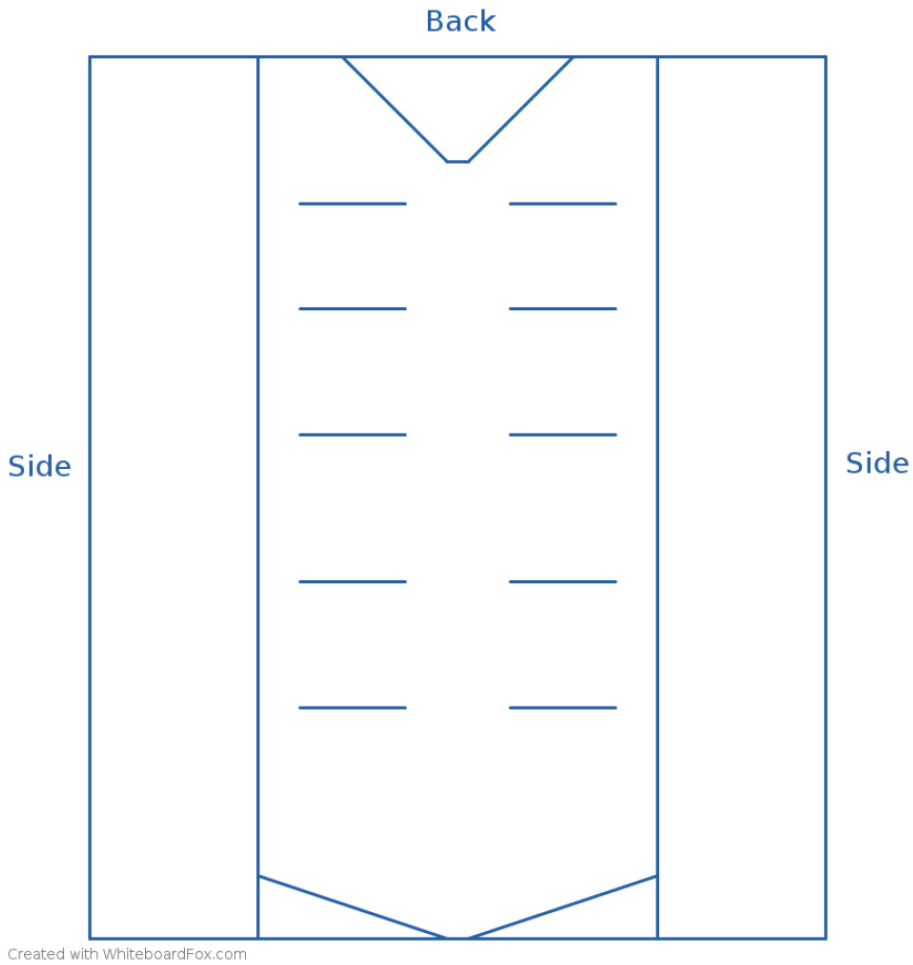

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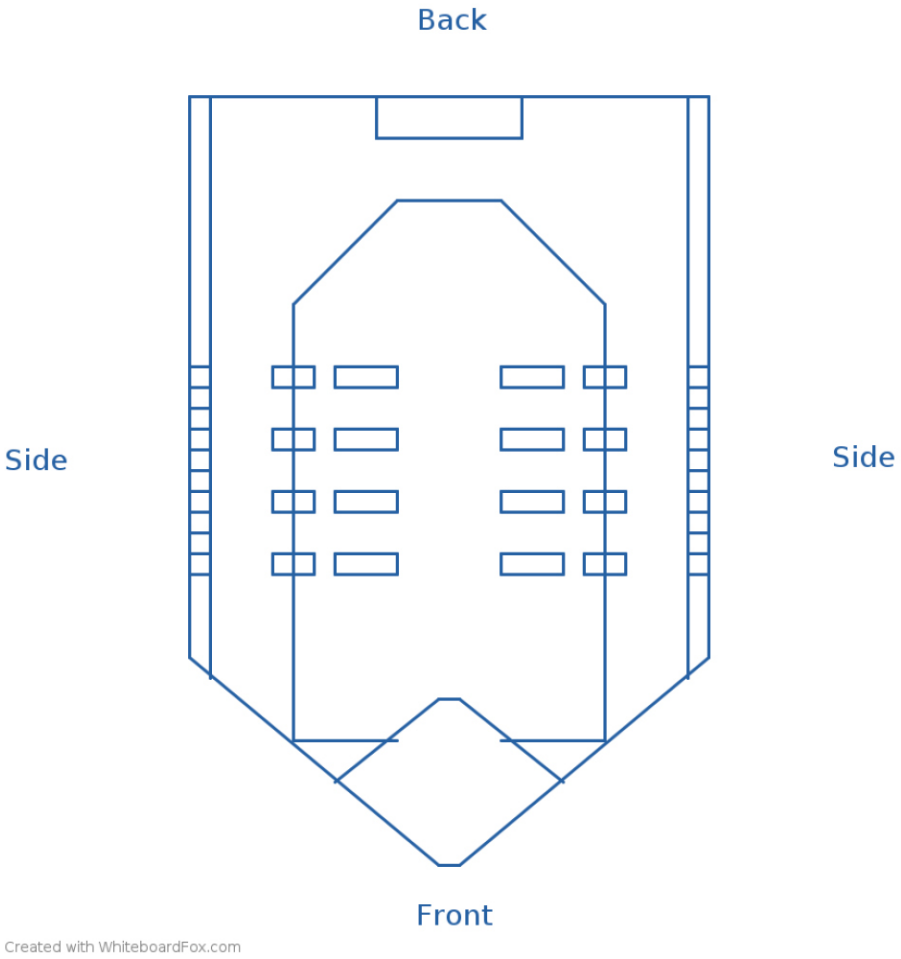

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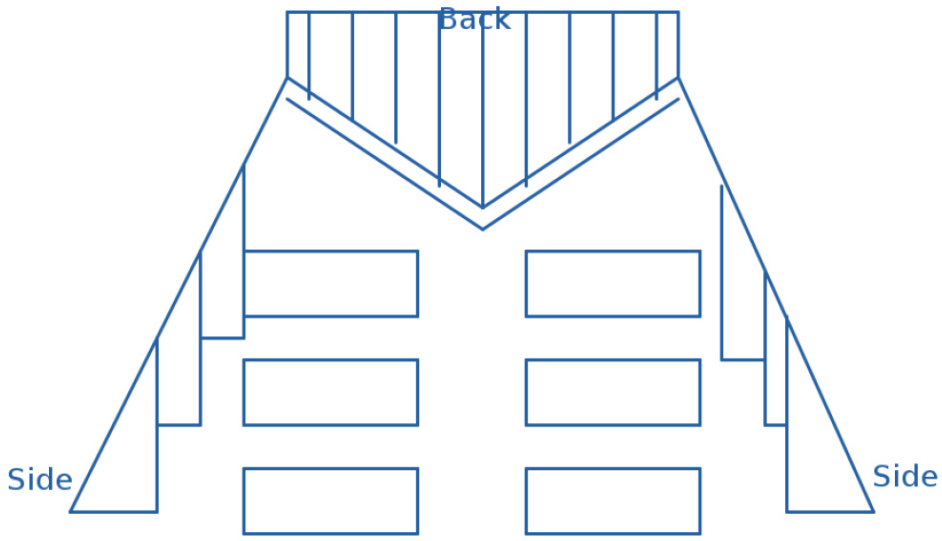
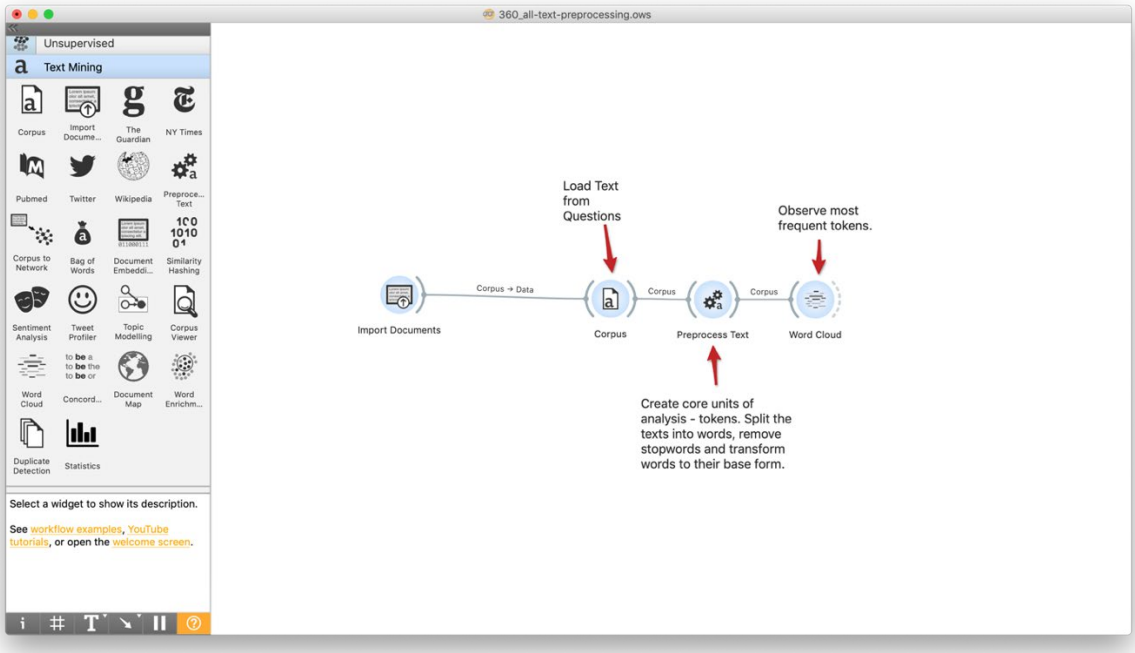


Non-360 Viewing
883349-3081-0721

APPENDIX G: TEXT PROCESSING SOFTWARE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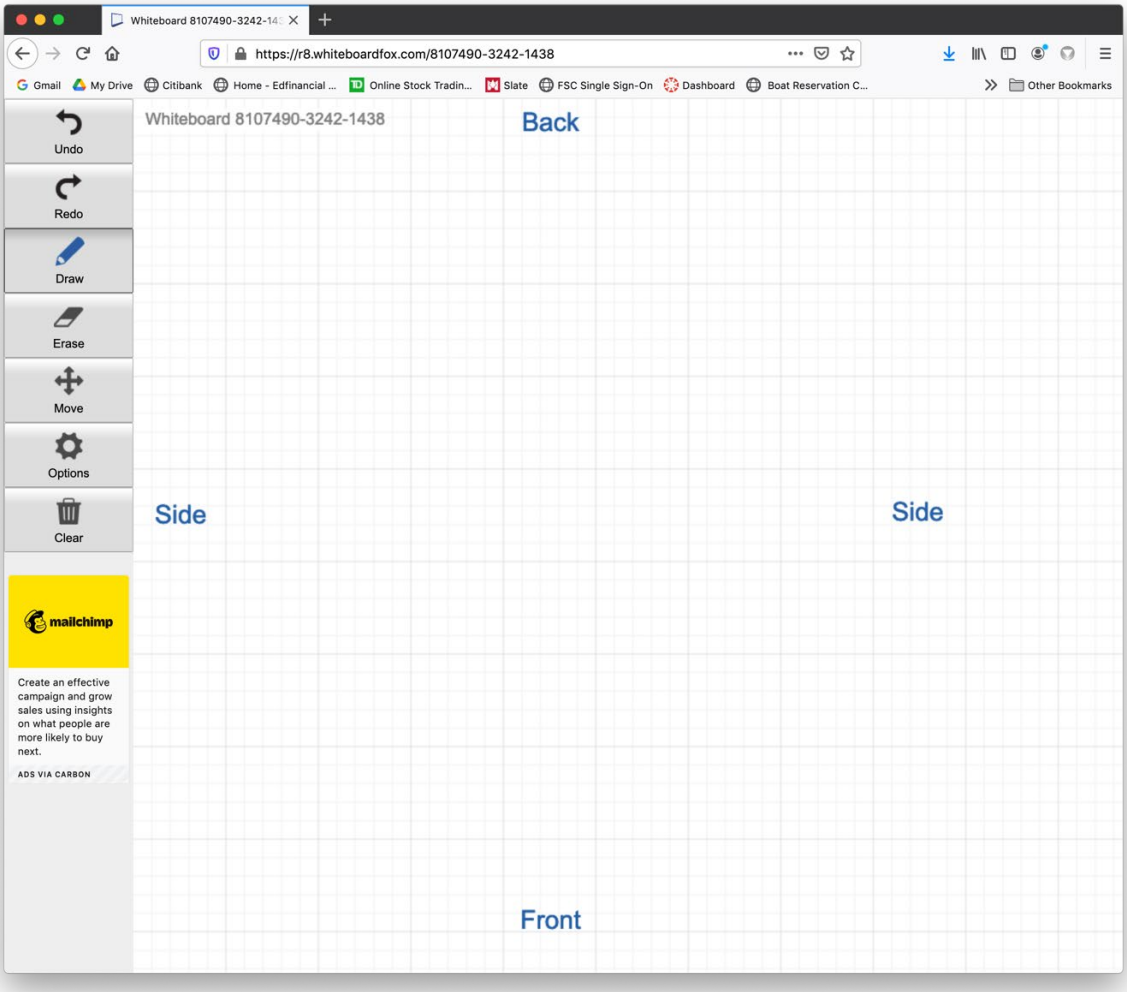
Unsupervised
Text Mining
Corpus
Import Docume...
The Guardian
NY Times
Pubmed
Twitter
Wikipedia
Preproce... Text
Corpus to Network
Bag of Words
Document Embeddi...
Similarity Hashing
Sentiment Analysis
Tweet Profiler
Topic Modelling
Corpus Viewer
Word Cloud
Concord...
Document Map
Word Enrichm...
Duplicate Detection
Statistics
Select a widget to show its description.
See workflow examples, YouTube tutorials, or open the welcome screen.
Load Text from Questions
Observe most frequent tokens.
Corpus → Data
Corpus
Corpus
Import Documents
Corpus
Preprocess Text
Word Cloud
Create core units of analysis - tokens. Split the texts into words, remove stopwords and transform words to their base form.

APPENDIX H: TRANSPORTATION SHORT SCALE

Survey questions are presented with a seven-point response scale from 1 (not at all) to 7 (very much)

1. I could picture myself in the scene of the events described in the documentary.
2. I was mentally involved in the documentary while watching it.
3. I wanted to learn how the documentary ended.
4. The documentary affected me emotionally.
5. While watching the documentary, I had a vivid image of the Frank Lloyd Wright chapel.
6. While watching the documentary, I had a vivid image of the Frank Lloyd Wrights windows.

APPENDIX I: WHITEBOARD SKETCH TOOL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My Drive
Citibank
Home - Edfinancial ...
Online Stock Tradin...
Slate
FSC Single Sign-On
Dashboard
Boat Reservation C...
Other Bookmarks
Undo
Redo
Draw
Erase
Move
Options
Clear
Whiteboard 8107490-3242-1438
Back
Side
Side
Front
mailchimp
Create an effective campaign and grow sales using insights on what people are more likely to buy next.
ADS VIA CARBON

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