

BEYOND CONTINUITY WITHIN THE FRAME:
EXPERIMENTS IN 360 DOCUMENTARY

by

Richard Dozier Barker

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TABLE OF CONTENTS

1. INTRODUCTION	1
Definitions and Key Terms	2
2. HISTORICAL PARALLELS IN TRADITIONAL FILM AND 360 VIDEO	4
3. 360 COLLAGE	10
Case Studies: Taking a Walk in Someone Else’s Shoes	10
4. <i>DARKER WATERS</i> AND USING 360 VIDEO FOR CONSERVATION	14
5. EXPERIMENTS IN STORYTELLING WITH 360 DOCUMENTARY	17
Collapsing the A-roll and B-roll divide	17
Orienting and Anchoring the Viewer	17
Optimizing Information Distribution for 3 Viewing Devices	20
Headset Viewers	20
Handheld Viewers	24
Traditional Screen Viewers	25
Directing Viewer Attention	25
6. AVENUES FOR AUDIENCE EXPANSION	29
Recreating the Common Experience of the Movies in 360 Video	29
Synchronized Headset Showings	29
Habitat XR	30
Mainstreaming VR	30
REFERENCES CITED	34

LIST OF FIGURES

Figure	Page
1. A still frame from <i>Darker Waters</i> with measurements demonstrating.....	3
2. The two vertical lines dividing this frame form one circular seam	6
3. <i>Mixed Pickles</i>	8
4. <i>Violin and Pipe</i>	8
5. <i>Untitled (Celestial Fantasy with Tamara Toumanova)</i>	9
6. <i>Schizophrenia: A Broken Mind</i> 360 layers hallucinations	11
7. A screenshot of <i>Anxiety</i> from within YouTube player	12
8. The stage layer	19
9. Regions of visibility to a headset viewer staring straight forward	20
10. Regions of visibility to a headset viewer with eye mobility	21
11. Regions of visibility to a headset viewer with eye and neck mobility	22
12. Suggested content placement zones.....	23
13. A view of the then-recently constructed	31

ABSTRACT

360 video is a new medium, with different opportunities than traditional film and a need for new conventions. In a traditional film, the typical HD resolution contains about 2 million pixels spaced over a screen which fills only a portion of the viewer's full range of vision. The filmmaker must squeeze all of the information they are trying to convey into that small space and direct the viewer's attention within the frame. In 360 video, the lowest resolution in frequent use contains about 10 million pixels, over 8 million more than the traditional HD standard and distributed over a range that fills the viewer's entire vision in every direction. Similarly to how the advent of traditional film gave photography the use of motion and time, the challenge and opportunity of 360 video is to effectively direct attention while making full use of the extra space. This Master of Fine Arts thesis is an exploration of potential avenues for making use of those extra pixels in documentary film, the immersive aspects of the 360 medium, and maintaining the editorial agency of the filmmaker while taking advantage of new opportunities for collaboration with the viewer.

CHAPTER ONE

INTRODUCTION

360 video appears at first glance to be an ideal medium for verité filmmaking. If, as the saying goes, traditional film can provide “a window on the world”, it seems at first glance that 360 video might skip the window and provide the whole world itself, complete with the freedom amongst viewers to dictate where to look within the frame. Viewer mobility dramatically increases the task of directing attention, but in reality this does not spell an end to editorial agency on the filmmaker’s part. Instead, the openness of 360 video to viewer-driven exploration necessitates even more decision making and creative choice by content creators. 360 video and VR technologies promise the viewer freedom through interactivity and transportation by immersion. Without an exponential increase in editing and design, however, every degree of extra space spells confusion or, even worse, boredom for the viewer. Despite its appearance as a more objective means of sampling reality, engaging 360 video actually necessitates even more influence on the filmmaker’s part than traditional film. Interactivity without carefully structured content creates an empty room. Because the lenses of 360 cameras point in all directions, viewer immersion is reliant upon editing by content creators to hide themselves and the camera itself, which would otherwise constantly be present in the frame.

Though the necessarily-heavy editorial influence of content creators might seem to take away from 360 video’s promise, embracing subjectivity in 360 video does not invalidate the medium. While there is value in the verité style, as well as in choice-oriented virtual reality video games as a genre, deliberately constructed 360 video environments have their own incredible

potential for storytelling. Instead of negating 360 video's value, editorial necessity opens new possibilities to convey subjective experiences.

If 360 video is a new medium in search of conventions, it helps to look to the past at the path of development that its predecessor, traditional film, took. It also necessitates a large amount of fresh experimentation and willingness on the part of content creators to try out new ideas. This paper covers the parallel paths taken by traditional film one hundred years ago and 360 video today as a means of looking for directions 360 video could go next. On the technical and artistic side, it covers techniques used in recent 360 videos and in my thesis film, *Darker Waters*, their potential utility to the medium, as well as some limitations and possibilities created by 360 video and the various viewing devices by which people experience it for documentary filmmakers and conservationists.

Definitions and Key Terms

The term "360 video" can sometimes refer a wide array of media formats. For the purposes of this discussion, 360 video will take the Wilkian definition, referring to minimally interactive immersive video formats as can be found on major video hosting websites, in which the viewer is simply surrounded by a sphere of footage within which they can turn up to 360° laterally and 180° vertically, but cannot alter or interact with the image contents themselves as in virtual reality media and video games (Wilk 3). In practical terms, this means that a viewer may turn in a full circle horizontally, and look from straight down to straight up on the vertical plane, without leaving the bounds of the frame (see Figure 1). Non-360 or interactive film and video, as is most commonly watched today, is referred to here as "traditional film" for the purposes of distinction.

Three of the major means of watching 360 videos are referred to here respectively as “headset viewing”, in which a viewer consumes a 360 video by wearing a headset which is fixed to their face and covers their full range of vision; “handheld viewing”, in which they navigate a 360 video by holding their phone in hand and looking through it as a mobile window into the video sphere; and “traditional screen” viewing, in which they watch the video through a fixed screen, such as a computer monitor, and navigate within the 360 environment using a mouse or touchpad.



Figure 1: A still frame from *Darker Waters* with measurements demonstrating 360° of lateral view and 180° of vertical. Note that messages which appear cut off on right “side” of frame here continue seamlessly to left “side” in practice.

CHAPTER TWO

HISTORICAL PARALLELS IN TRADITIONAL FILM AND 360 VIDEO

360 film is following a similar progression in the development of conventions, subject matter, and creative possibilities to that followed by traditional film a hundred years ago. Traditional film started with single-shot films like *Arrival of a Train at La Ciotat* and *Bicycle Trick Riding*. These early films were characterized by a lack of significant plot or structure and were primarily demonstrations of the then-novel technology of motion pictures. Over the next decade, the medium progressed to films which included multiple shots. As it did, filmmakers began arranging shots in a manner which used continuity editing to minimize the viewer's perception of the filmmaker by making use of fades and dissolves and by matching action across cuts. At the same time, many Silent Era filmmakers experimented with discontinuous scenes and extra-narrative elements in their work. *The Great Train Robbery*, an early heist film, includes examples of both. The film is not presented in completely sequential time: as the offending bandits run away there is a cutaway shot to a dance hall from which a posse is gathered to hunt them down, introducing a new setting and set of characters which play out a scene before being united with the main story. Later, in a fourth-wall breaking, almost interactive clip, one of the (now vanquished) bandits raises his gun and shoots towards the audience.

These non-continuity uses of film allowed traditional filmmakers to play with time and to interact with audiences more actively than they might have otherwise. Montage films like *Man with a Movie Camera* went even further, sometimes fully abandoning narrative and instead

ordering shots in ways designed to create mental associations in viewers beyond simple causal or spatial relationships, or as Eisenstein put it, creating meaning through “the collision of independent shots” (Eisenstein 49).

Likewise, early 360 videography includes single shot videos intended to transport the viewer to an individual place or event, as exemplified by *Under a Train, 360 Interactive on the Tracks, Look Around and Listen!* and sports videos like *360 Perspective Rundown of Red Bull Rampage With "The Claw"*. Sports video’s role in both mediums’ first stages of development provides an interesting parallel: Edison’s *Bike Tricks* series made up some of the earliest traditional film, and 360 film equipment is largely designed with sports in mind today: action camera company GoPro is an industry leader in 360 camera production.

Documentaries like *Free Solo 360* take the next step from single shots to fully fleshed out stories. *Free Solo 360* is a companion piece to the widely known traditional film *Free Solo*, both of which follow famed rock climber Alex Honnold as he performs the first free ascent of El Capitan. *Free Solo 360* includes multiple shots, tells a story, and, like in many narrative traditional films, it seeks to minimize the filmmaker’s presence. Where traditional films sought to convey continuity in time (or to hide discontinuity) by minimizing viewer perception of cuts, 360 videos do the same in their extra space within the frame by painting out otherwise ever-present seam lines and the camera itself using programs like Adobe Aftereffects.

Seam lines in 360 video are linear discontinuities in the visual environment which typically bisect the frame and result either from the use of footage which was not captured in full-360, or from differences in settings between lenses (see Figure 2). For example, some early “360” cameras like the Nikon KeyMission 360 only captured 360° by 170°, instead of 180°,

leaving a 10° blind spot between its lenses (*Keymission 360 Tech Specs*). This space was instead filled by stretching the captured footage and leaving a seam line at the border. Even devices which fully capture the 360° by 180° sphere still show discontinuities between footage captured by each lens due to variability in factors like light levels. A 360 capture of a sunset, for example, requires the lens or lenses which face the sun to be set to a relatively high aperture, and those facing away to be set to a relatively low one, and these settings rarely align perfectly.



Figure 2: The two vertical lines dividing this frame form one circular seam when projected to a sphere for playback. The seam is the result of a blind spot of about 10° on the camera rig.

The purpose of minimizing these discontinuities in films like *Free Solo 360* is to create the illusion of a completely captured viewpoint in space, mentally transporting the viewer to the alien environment and attempting to convey some of the actual feeling of being present in a place they might otherwise never go. Nothing is added to the image with the intention of attracting

notice, but rather all postproduction work applied to the frame has the intent of obscuring limitations of the captured image.

While this practice of spatial continuity editing within the frame has enormous potential to boost immersion in a simulated experience, it isn't the only option for 360 content creators. The addition of motion and time allowed the eventual creation not just of observational film and continuity narrative sequencing but of montage, in which shots unrelated in space or time are shown in sequence to elicit associations in the viewer beyond simple temporal relationships. Likewise, the expansion of the frame in 360 video allows for a similar expansion of the spatial dimension beyond primarily spatial relationships: 360 collage.

Outside of film, modern collage-style art rose in popularity during the 19th and 20th centuries (Playing with Pictures; Richman-Abdou). Artists would combine cutouts from unrelated photographs and drawings to create strange and often humorous juxtapositions, like that seen in the Victorian era piece *Mixed Pickles* (Figure 3). Notable works also include those of cubist artists Braque and Picasso, who constructed images like *Violin and Pipe* (Figure 4) from newspaper and magazine cutouts, and surrealists like Joseph Cornell, who used cut-and-pasted, ordinary imagery to construct dreamlike, impossible scenes that could only exist in the artist's mind (Richman-Abdou). Collage-like techniques have been used in combining animation with traditional film, one lighthearted example being children's movie *Who Framed Roger Rabbit*, but the extreme spatial expanse of 360 video lends the medium added possibilities for combination and juxtaposition of images within a given frame.



Figure 3: *Mixed Pickles* by Victoria Alexandrina Anderson-Pelham and Eva Macdonald. Watercolor and ink Published by Scholastic. Accessed at <https://archive.artic.edu/victphotocoll/artwork/201517>

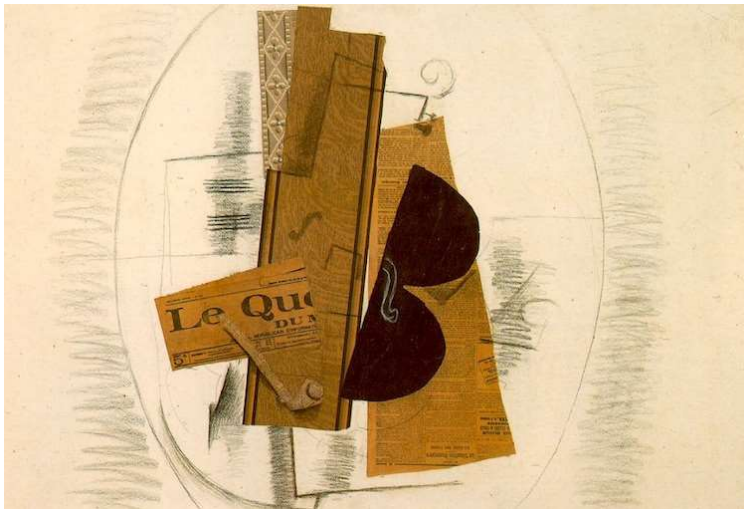


Figure 4: *Violin and Pipe* by Georges Braque. Accessed at <https://mymodernmet.com/collage-art-collage>.



Figure 5: *Untitled (Celestial Fantasy with Tamara Toumanova)* by Joseph Cornell. Accessed at <https://mymodernmet.com/collage-art-collage>.

CHAPTER THREE

360 COLLAGE

360 collage, the layering of multiple, independent images within the single 360 frame, makes literal Eisenstein's statement that the emergent meaning in montage films arises as if "each sequential element is perceived not *next* to the other, but on *top* of the other" (Eisenstein 49). 360 content creators can gain agency and flexibility over their work by abandoning the illusion of continuity within the frame, as montage filmmakers did between shots, for the greater freedom of arranging images by meaning rather than actual orientation and association in space. Instead of attempting to recreate the illusion of a one-to-one recorded experience, 360 collage filmmakers seek to inhabit an unabashedly virtual space.

Case Studies: Taking a Walk in Someone Else's Shoes

Many 360 collage videos use the medium's immersive quality to portray life from the perspectives of people suffering from mental illness. These films typically spend a significant amount (though not necessarily all) of their runtime in a first-person perspective. They fall somewhere around the edges of documentary and avante-garde self-expression, with realistic scenes overlaid with images representing mental associations and events in the subjective experience of their subjects.

Schizophrenia, A Broken Mind 360° is an early exemplifier of this aesthetic. The video is a first-person perspective artist's impression of what it is like to suffer from different types of severe schizophrenia made by layering visual and auditory hallucinations layered over the base, "real" environment. After an initial section of text which prompts the viewer to place their phone

into a 360 viewer and provides a basic introduction to the idea of schizophrenia, the film begins with an animated scene in which the viewer is positioned in the first person perspective, sitting at a desk in a dirty brick room with shoulders, arms and body visible beneath (see Figure 6). Visual hallucinations are layered over this base, including distressing text, apparently written on the walls, Heath Ledger's costumed face from *The Dark Knight* floating in the air, and spiders which appear to crawl up the viewer's simulated arms. Auditory hallucinations, such as a child's laughter and machine gun fire, are similarly layered over the room tone. In a traditional film, stereo audio would provide the most complete transportation to the viewer. The presence of viewer mobility and peripheral vision in 360 video allows the visual environment to match the immersive quality of the auditory environment.



Figure 6: *Schizophrenia: A Broken Mind 360* layers hallucinations over a simulated body and base environment. In this frame, filmmaker Ethan Cohen uses an exaggerated light flare, Heath Ledger's costumed face, and spiders to represent sensitivities and hallucinations as they might be perceived by someone suffering from schizophrenia. *Schizophrenia, A Broken Mind 360°*. Directed by Ethan Cohen, 2016.

Other examples include *Inside Anxiety - A 360 Degree VR Video Drama* and *The Party: a virtual experience of autism*. Where *Schizophrenia* uses overlays and discontinuous elements within the frame to demonstrate hallucinatory experiences, *Inside Anxiety* and *The Party* use 360 collage to effectively convey the feeling of stress. *Inside Anxiety* takes a second person perspective. The protagonist, a woman who suffers from severe social anxiety, directly addresses the audience and invites them into her mind. Viewers watch text messages and social media posts wash over her as she attempts to go about her day (see Figure 7). The messages and posts create a claustrophobic effect by their simultaneous representation in all directions, simulating their effect on her within the viewer. In *The Party*, information overload experienced by the autistic protagonist is represented by motion blur corresponding with amplified ambient noises, crescendoing with the activity of the room until the film cuts to black.

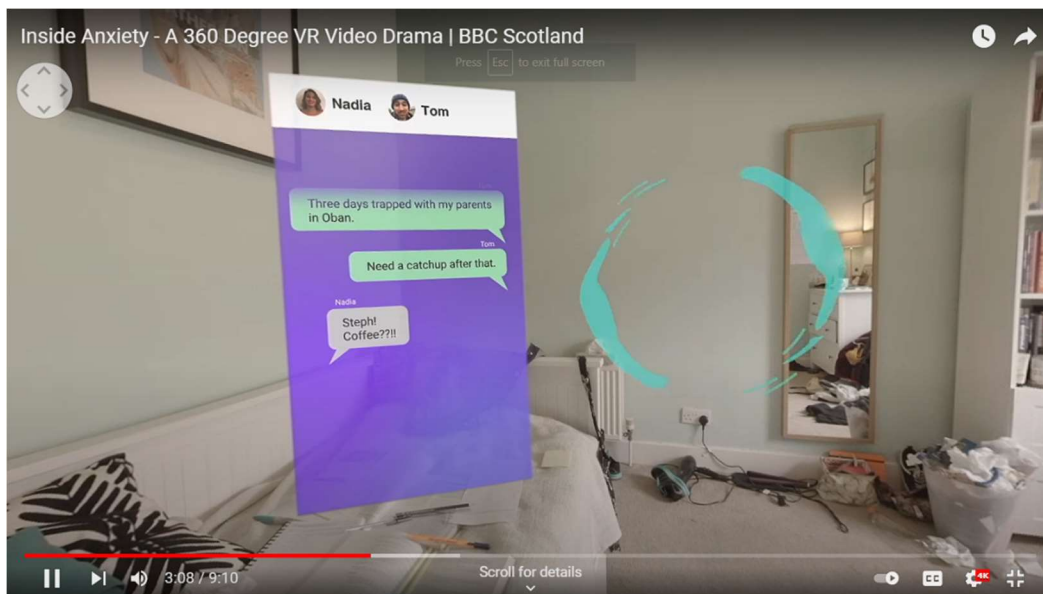


Figure 7: A screenshot of *Anxiety* from within YouTube player. Note the use of discontinuous overlays to simulate the protagonist's subjective, rather than literal, experience. Directed by Ethan Cohen, 2016. Accessed at: <https://youtu.be/Pa7eX5BPt3Q>

These videos' creative use of overlays and blatantly unrealistic visual effects to convey subjective experience represents a break from continuity editing within the frame and demonstrates the genres' potential to expand the possibilities of documentary film in general. Though these three share a common subject matter, 360 collage has the potential to communicate a wide variety of stories and experiences. By creating a shared meta-space for filmmakers, their subjects, and their audience, 360 collage films provide possibilities for conveying previously incommunicable sensations; not just of hallucination and mental illness, but of remembrance and thought as well.

CHAPTER FOUR

DARKER WATERS AND USING 360 VIDEO FOR CONSERVATION

Northern Florida has a higher concentration of freshwater springs than anywhere else on Earth (Florida Springs Conservation Plan 3). Clear, 72-degree water flows from the deep Floridan aquifer to create entire river systems. Spring-fed rivers are worlds unto themselves. Shimmering eelgrass beds and gigantic gar (a large, primitive-looking type of fish), manatees and abundant turtles fill these waters to the brim. A space that appears limited from the two-dimensional surface becomes an expansive and complex volume the moment one enters the water. This explosion of dimension, combined with the shock of the temperature difference from the often-90-degree-plus air, creates an experience which is at once extremely impactful and difficult to communicate. I wanted to further elevate the public profile of this place for the typical reasons that people make nature documentaries: it's an incredible natural area, and its existence is threatened by human shortsightedness. The eye-popping color and dense life of these environments lend themselves well to image capture of any type, but the experience of instantaneously feeling as though one has been transported to a complete and distant world is very difficult to convey through traditional film. Interested parties could, of course, lead tours and encourage as many people as possible to experience the springs and rivers for themselves, but many people are unable to participate, both due to economic and physical limitations. Visitor count is also susceptible to ecological limits, regardless of personal limitations or the lack thereof.

I began experimenting with 360 video in this environment as a scalable means of overcoming the immersion barrier in public understanding of this place and its value. 360 video

might act as a means of lowering the barriers to entry for many who would otherwise be unlikely to experience the springs for themselves, further building the constituency of those who care beyond the lucky ones who can routinely spend time in these environments. Similarly, in providing an alternative to physical visitation, it eliminates some of the human impact that tourism creates.

Leveraging 360 video's immersive aspect for environmental advocacy is an emerging practice. One major conservation NGO, Conservation International, has heavily used 360 video for that purpose over the last few years. Referring to *Under the Canopy (360 Video)*, one of a series of meditative, narrated 360 video-documentaries which each tell the story of a different region where the organization works, Conservation International CEO M. Sanjayan has said, "This film gives you a sense that this is a real place, it has real communities, whose lives matter. And it's got amazing wildlife. And that if we can protect it, we are not only protecting an incredibly important landscape, but we are also protecting our own future." (*Under the Canopy* 3:02-3:19).

The nascent state of the medium could also lend an advantage to content in the attention economy. As 360/VR media expands in audience but before it becomes mainstream, 360 video's novelty could be used to garner greater interest in the topics of 360 documentaries, and in this case serve as a tool for bringing stakeholders together around the challenges of protecting the Floridan aquifer and its spring systems. With all this in mind and an early-generation 360 camera in hand, I began the 6-year process of filming what would eventually become *Darker Waters*.

Darker Waters is a documentary depicting the strange events that occurred in the Santa Fe river and spring system during the 2010's and their implications. The film is presented and

narrated by Dr. Jerry Johnston, the herpetologist whose research explained them. It relies heavily on archival photographs from the events as well as modern aerial and 360 underwater footage of the river system. The challenge of depicting Johnston's story was to effectively tie together a single storyteller, footage of many different formats, aspect ratios, and resolutions, and visualizations of a half century of data collected in the region in a way that would flow smoothly and engage the viewer. It also had to convey this information without confusing the viewer, regardless of which parts of the frame they viewed at a given point in the story.

CHAPTER FIVE

EXPERIMENTS IN STORYTELLING WITH 360 DOCUMENTARY

Collapsing the A-Roll and B-Roll Divide

In many traditional documentaries, screentime is split between A-roll, typically “talking head”-style footage of the interviewee, and B-roll, which does not contain the interviewee and comprises shots of landscapes, subjects, or events relevant to the information being presented. One technique I experimented with in *Darker Waters* that became central to the film’s structure collapses the temporal barrier between A-roll and B-roll. Instead of alternating between the interviewee and footage of the subject matter, I placed the interviewee into the constructed 360 environment and layered B-roll around him. When Johnston is speaking about a particular event, relevant footage can be seen around him and in different parts of the frame. The freedom to distribute and time archival footage to surround Johnston as he speaks about it allows the creation of a planetarium-like experience, but instead of stars or planets, viewers watch a simulated, shared memory.

This freedom, however, led to an unwatchable mess in early cuts of the film. Viewer attention was largely undirected amongst the swirl of footage, and Johnston’s presence was split inconsistently between a full, seated depiction and a 16x9 head-and-shoulders shot within a virtual frame. In order to represent experiences in this way, it was necessary to create a basic visual grammar to structure viewer expectations by.

Orienting and Anchoring the Viewer

The first piece of structure I used throughout the film took the form of a foundation or “stage layer.” The stage layer is a recurring base layer used throughout the entirety or a section of the 360 video which provides a stable backdrop for the interviewee and various independent elements that comprise the collage to be layered over. In the opening shot of *Schizophrenia*, the stage is the room the character sits in, and over which hallucinatory images are layered (see Figure 6). The stage layer in *Darker Waters* was a shot recorded in full 360 from a relevant environment, the bottom of the Santa Fe River. It primarily acts as the rearmost layer of footage whenever Johnston is visible, and serves to provide the viewer with a means of orienting themselves within the otherwise chaotic environment. The stage layer occupies 360° of lateral space, and about the upper 120° of vertical space within the frame. The unfilled 60° can be structured to appear like a deep void, a space for supplemental information, to give the 360 environment a geometry similar to the inside of a snow globe or planetarium, or to provide a flat floor upon which the interviewee sits. Johnston sits in a chair, placed in this lower space and rising so his face aligns with the headset viewer’s neutral starting view in the vertical center of the frame.

I used alternative approaches to orient the viewer in some sequences where Johnston was off camera. In those shots for which the 360 camera was attached to the bottom of a kayak and taken through the springs systems, the footage is displayed in full 360° x 180°, without the 40 degree stage floor or void. Instead of anchoring the viewer with the stationary background shot that makes up the interview stage, in these shots the camera moves as the kayak coasts through the springs. Though the main portion of the visible range was moving, the kayak itself provides

an apparently stationary anchor point for the viewer, and takes the place of the stage floor as an area to display supplemental information. At another point, a simulated computer screen is used as an anchor point during an otherwise abstract data analysis visualization. Graphics and footage begin on the stable image of a computer screen and are pulled off with a cursor as new information appears. Viewers can see where information is coming from, and by extension spreading to, and they have a stable anchor point to return to if they become lost.

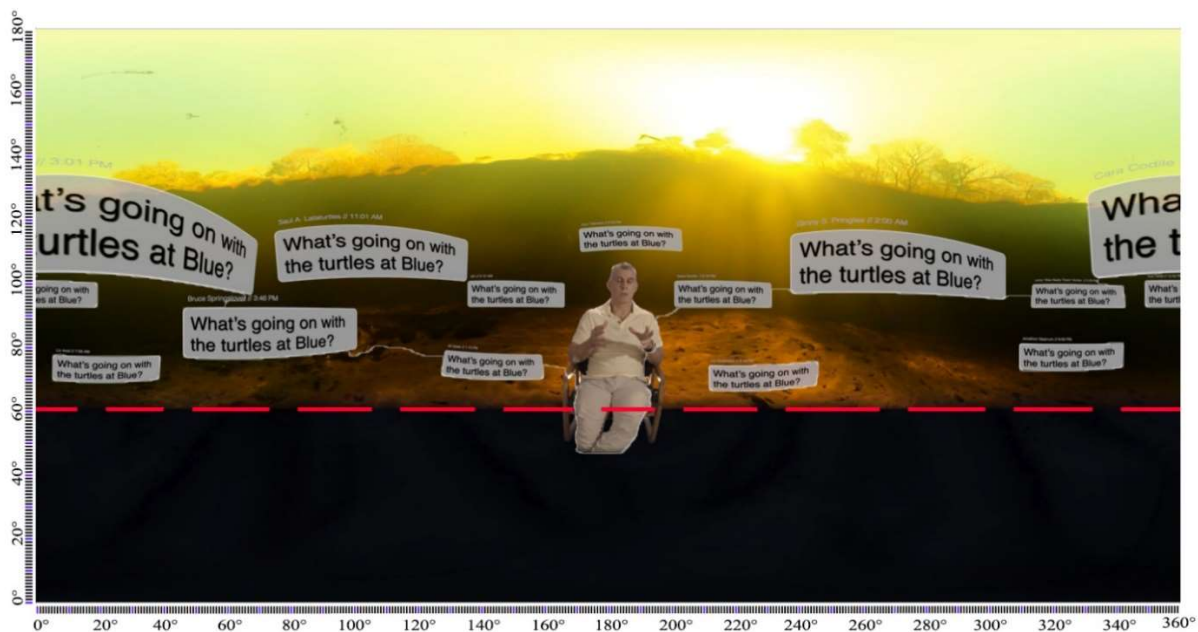


Figure 8: The stage layer comprises the upper 160° of vertical space (represented here as the area above the dashed line) and is the stable base over which graphics, footage, and the interviewee are primarily layered. Supplemental information, or in this case an animated void, occupies the lower 60° of the frame.

Stable anchor points and background stages are important to keeping viewers oriented within the 360 -environment, regardless of desired end-user viewing style, but the variety in devices and formats through which viewers can be expected to experience the 360 video play a significant role in information distribution within the frame, regardless of anchoring.

Optimizing Information Distribution for 3 Viewing Devices

Headset Viewers

Watched through a headset, like an Oculus Go or Google Cardboard, 360 video is at once most immersive to the viewer and most limited in what they can easily see. With a headset attached to their face, the viewer's range of vision is most fully taken up by the 360 environment, but their range of motion is limited to that of their eye, neck, and body.

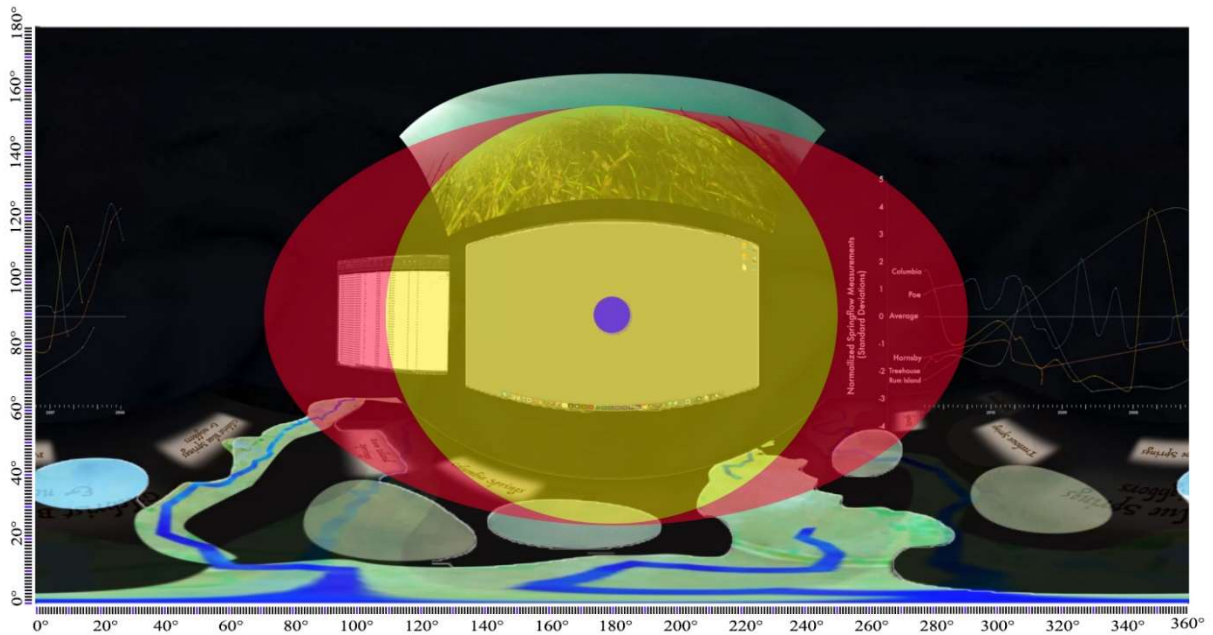


Figure 9: An approximate representation of the regions of visibility within the 360 environment by a completely stationary headset viewer. The blue circle extends roughly 6° in each direction from the center point and covers the region within which text can be distinguished. The yellow area highlights the region in which viewers can positively detect the presence of an animal in the image with an accuracy of 60% or greater and extends from the blue circle's boundary to approximately 71° laterally and 65° vertically from the center point. The red represents the area in which some light is detected, but with much lower useful image fidelity. Unhighlighted areas are not visible to this hypothetical viewer's stationary eye.

Healthy adults can at furthest distinguish letters around 6° from their fixation point, the point at which the view is centered, without turning their eyes (Traxler). They can roughly

distinguish between images at 60° but are often unaware they are actually seeing anything (Thorpe et. al., 2001). In studies, test subjects could only tell there was an animal in a picture presented at 70.5° from the fixation point a little over half the time (Thorpe et. al., 2001).

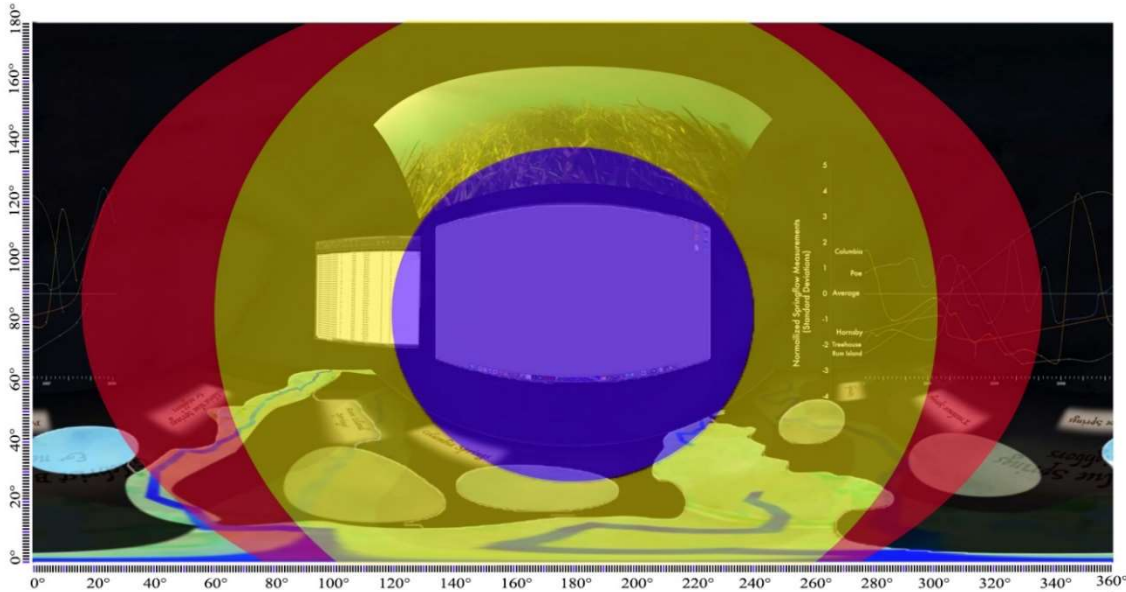


Figure 10: An approximate representation of the regions of visibility within the 360 environment by a viewer with the ability to move the fixation point by rotating their eye, but not by moving their neck from the fixed, forward looking position. Each color represents the same qualities as in Figure 9, but the boundaries have shifted. Text can be read up to about 60° to the left and right, 52° above, and 58° below the center point (blue area). Animals are detectable with at least 60% accuracy to about 120° to the left and right, 107° above and 113° below the center point (yellow area), extending in some regions to the vertical boundaries of the frame. Some light can be detected up to about 160° to the left and right of the center point (red area).

Without moving their eyes, people are unable to see anything beyond approximately 130° from the fixation point vertically and 220° horizontally (Kemeny et. al. 34; Szinte & Cavanagh, 2012).

The visual field is not completely symmetrical, and people are capable of seeing ten to fifteen degrees further down than up (Savino & Danesh-Meyer 12). The approximate range viewable by the average person without turning their head or eyes is visualized in Figure 9.

Without turning their head, people can move their eyes about 50° horizontally in both directions, 42° up, and 48° down (Adler 208). This extends the viewable range roughly to that depicted in Figure 10.

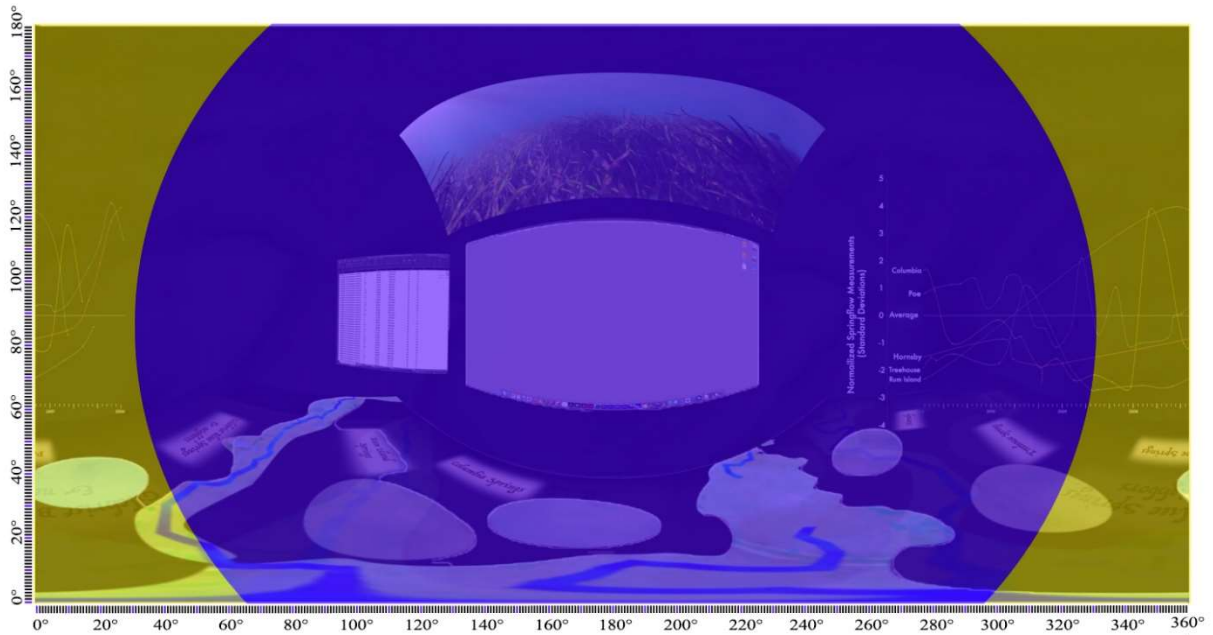


Figure 11: With the addition of eye and neck rotation, the area which can be viewed with some accuracy is greatly expanded. The area in which text can be read extends up to about 150° horizontally from the center point (blue area), and the region in which animals can be detected with over 60% fidelity has expanded to fill the remaining bounds of the frame.

The typical range of motion in an otherwise stationary, able-bodied adult's neck is about 180° on the horizontal plane and about 150° to 160° on the vertical plane (Swartz et. al., 2005). These additions further expand the region viewable from a seated position as demonstrated in Figure 11.

When viewed through a headset, these motion and visual limitations might be seen to divide the 360 space into zones like those depicted in Figure 12. The primary zone comprises the area around the center point of the frame within which a viewer could read text without turning

their head. In 360 videos intended for seated headset viewings, this zone provides the best area to place A-roll and important B-roll because it is the area in which the viewer has to expend the least effort to watch. The headset viewer must turn their neck to focus fully on the secondary zone. In a collage video, this area is ideal for more B-roll and supporting information, such as a map or graphic.

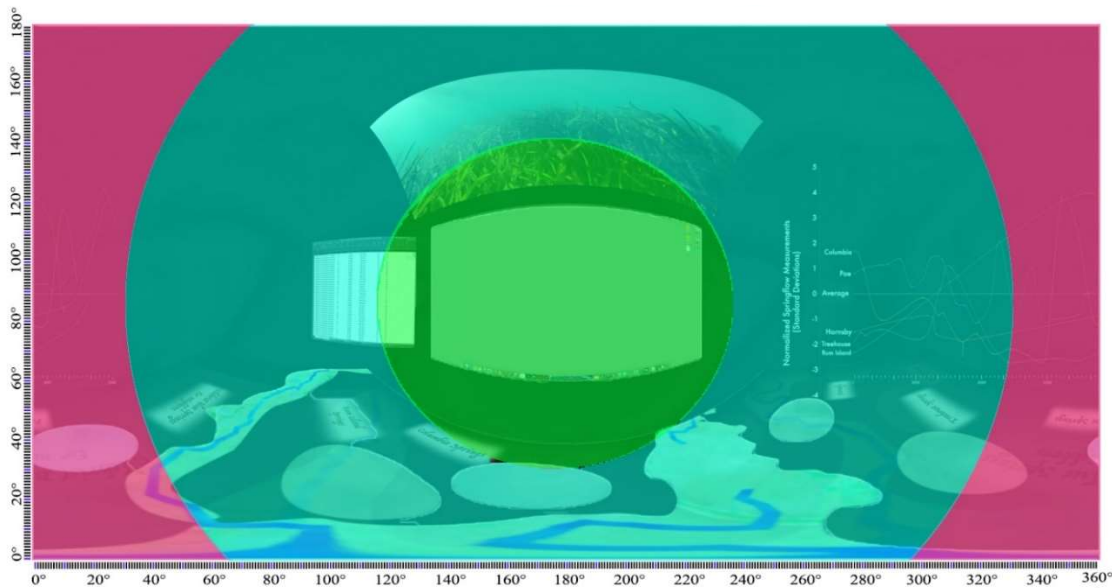


Figure 12: Suggested content placement zones. Green highlights Zone 1 and corresponds to the area in which a healthy adult can read without turning their head from the center point (highlighted blue in Figure 10). Cyan highlights Zone 2, the region in which people are capable of reading with neck rotation (highlighted in blue in Figure 11). Magenta highlights Zone 3, the area in which viewers cannot fully focus without physically rotating their bodies.

Beyond the secondary zone lies the tertiary zone, an area which viewers will only be able to access through their peripheral vision or by physically rotating their body from the neutral, seated position. Without greater viewer mobility, this area's primary purpose is to allow for greater immersion using the peripheral vision to illustrate physical continuity of B-roll or non-collage, full 360 shots. While this region has the least potential to convey information to the

seated headset viewer, its use as an immersive layer provides the illusion of transportation to the viewer in a way that is impossible outside the 360 medium.

Greater mobility adds value to the otherwise worthless region directly behind the viewer and necessitates even more content to fill the extra observable space. Viewers who are mobile, either by standing or by sitting in a rotating chair, gain the ability to fully shift the center of their viewpoint beyond that of their comfortable neck rotational range, potentially shifting the primary, secondary, and tertiary zones over any particular region of the frame. This presents a challenge to the filmmaker. As the viewer gains more agency over their viewing experience, the filmmaker is required to take greater care in distributing content and directing their attention to ensure they do not become lost or miss vital information. Content across the full range of the frame must convey sufficient information for viewers to follow the narrative, while still providing a satisfyingly immersive experience when viewed through peripheral vision.

Handheld Viewers

The handheld viewer loses the immersive effect provided by peripheral vision but gains even easier mobility and choice over where they are looking. The secondary and tertiary visual zones are completely lost, and wherever the viewing device is pointed becomes the primary zone. Some immersive effects are maintained despite the loss of peripheral vision because, like the headset viewer, handheld viewers are required to physically shift to change where they are watching around the frame. Division of information into primary, secondary, and tertiary zones can still provide a useful structure. For example, A-roll placed in the viewer's starting view can be bordered closely by supporting footage, and at the periphery by maps or data visualizations. Viewers will know where to look for the kind of information they need at a given moment as

long as the distribution of these information types is consistent throughout the 360 video. This allows them a greater ability to follow the story than would be provided by a traditional film, in which information missed at one point might be impossible to revisit or rediscover without rewinding.

Traditional Screen Viewers

The opposite end of the spectrum from the headset viewer is the traditional screen, such as a television or computer monitor. 360 videos viewed through fixed devices like these are least immersive but provide the viewer with the easiest means of navigating the 360 environment. Through a traditional screen, the viewer entirely loses the immersion provided by peripheral vision and the necessity of physical motion. Instead, they are able to use a mouse or touchscreen to rotate their view in any direction. All that is left of the medium's immersive effect is the choice over where to look and the requirement that, to shift from one region of the frame to another, viewers must pass through the intermediate areas as they go. This gives them the greatest agency over where they are looking of all the viewing devices and places the greatest demands on the filmmaker to deliberately direct attention. Like in 360 videos intended for handheld viewing, filmmakers creating 360 videos for traditional screen viewers can still benefit in some cases from consistently distributing content of different types across the frame, allowing viewers to efficiently self-direct when it might otherwise be difficult to consistently guide them.

Directing Viewer Attention

Whether creating a video for a headset or a traditional screen, directing viewer attention is a primary challenge of the 360 medium. Current 360 videos frequently experiment with the use of written instructions and arrows to tell viewers where to look. These 4th-wall-breaking forms of communication effectively communicate the location of important information but do so at the cost of immersion and the viewer's sense of agency. Potential means of avoiding either a confusing, undirected viewing experience or one which is guided to the point of tedium include the use of motion to guide viewer attention, visually diverse repetition of the same information across the frame, and the use of auditory cues in a 360 audio environment.

The first, most natural form of direction I experimented with in my film, *Darker Waters*, was using motion as guidance. I overlaid swimming fish and turtles on the existing footage layers and arranging them such that their starting position in the frame was where viewers were likely already looking, usually near the interviewee. From there they cross the frame, finally arriving and fading into the collage piece to which I was directing viewer attention. An example of this technique can be found at timecodes 4:48-4:52 in the video, when a bass appears behind the interviewee and swims through the frame to the simulated "archival" footage opposite to him. This technique provides the highest level of immersion and viewer agency out of those listed here, along with the corresponding weakness that some viewers may decide not to follow the animals' motion or may be looking in an entirely different direction than anticipated at the start. One potential solution is to place guide animals in starting positions around the entire 360 environment, and to make them converge from there to a specific spot, as is done at timecode 0:32 in the video.

An alternative approach to guiding viewers' attention through motion is to build the collage in a format for which rotation is natural. In these "mobile" sections of the film, such as at timecode 1:29, I placed rectangular photos and videos at regular intervals around the frame in a layer behind Johnston but in front of the stage. The mobile would rotate, either from the start or beginning at a logical moment in the narrative, ensuring that most viewers will see the relevant media, no matter which way they are looking.

Another solution avoids directing viewer attention entirely, and instead makes use of the boundaries to a given device's viewing area. Rather than placing different information in specific parts of the frame and encouraging viewers to navigate it in a specific way, the filmmaker can place repeats of the same information across multiple sections. When done too directly, this can squander the potential provided by the 360 medium. *Schizophrenia*'s weakest points, for example, are those moments where it most directly seeks to convey information by placing the same text in multiple locations around the frame. The point isn't just to make four or five angles to watch the same traditional-style film projections. The medium's potential is also squandered to an extent by guiding arrows and text placed in deemphasized regions. The same information can, however, be presented in several, simultaneous, complementary ways. Instead of placing symbols to guide viewers away from content-low areas, 360 content creators can utilize the whole available space by placing discontinuous, diverse images in these regions to convey the same useful information in multiple ways. I experimented with this in *Darker Waters* starting at the timecode 10:14, in a section which depicts the decline of freshwater springs across a river system over the course of several decades. In one region of the frame, the springs' progression is depicted via a map in which the springs turn from blue to brown over time as the actual data

shows them transition from healthy to lethargic flow rates. In the opposite region of the frame, “behind” viewers of the map, the same data is shown, but instead of taking the form of a map graphic the flow rates from each spring are charted over time via an animated line graph. No matter which side of the frame the viewer chooses to occupy, they still receive the same information, and if they switch sides during either animation, the two views supplement each other, rather than conflicting or creating a visually repetitive environment. This form of information distribution maximizes the viewer’s options while reducing the odds they will miss information vital to the narrative and become lost.

Alternatively, 360 content creators can rely on auditory cues to direct viewer attention. Rather than repeating information across the frame or guiding the viewer by written or motion cues, 360 audio is used to attract viewer attention to a specific location within the frame. This option has great potential to enhance the viewer’s experience by adding a second sense to the directional illusion created within 360 video, while providing compelling guidance for where to look, regardless of their starting orientation within the frame. While this option is currently restricted in many cases by playback device limitations, such as YouTube’s 360 player which lacks audio tracking, it seems like fertile territory for the development of standard conventions in the future and will become more useful as playback software improves.

CHAPTER SIX

AVENUES FOR AUDIENCE EXPANSION

Nearly a decade after VR headsets and playback devices reached widespread availability, VR and 360 video still sit outside of mainstream use (Isaac 2021). No matter the medium's artistic potential, 360 video's future is dependent on factors of demand, accessibility, and acceptance amongst the public at large. These are in turn dependent on technological development to increase the ease of use for the currently bulky, cumbersome, and sometimes nauseating headsets, as well as on economic factors and design in how 360 video is presented and used. The medium also requires buy-in from the creative community to make enough 360 content for widespread consumption. As with any new medium, success requires long term investment paired with many innovations.

Recreating the Common Experience of the Movies in 360 Video

One of the potential obstacles to widespread adoption of 360 style video is the loss of the common experience provided by traditional film showings. Whether a blockbuster film in a major theater or an indie production in a local film festival or brewery, traditional film is used as a means of bringing people together in a way that the highly individualized, blindfolded-and-headphoned experience of headset-based 360 viewing does not seem to lend itself to.

Synchronized Headset Showings

A potential avenue to circumvent this is synchronized, common-audio showings. Rather than starting each device independently and absorbing the viewer in an experience isolated not

just visually but auditorily and by timecode, devices can be synchronized to start at the same time, and sound can then be played for the entire room via large speakers, as in a traditional film showing, rather than headphones. Additionally, viewers with conditions that make them potentially queasy or otherwise uncomfortable with a headset viewer could watch, traditional-style, simultaneously on a big screen. The technical requirements for a showing like this are entirely software, and do not present a significant networking development challenge as demonstrated by existing technology like the “share screen” features on Zoom or FaceTime.

Artistically, the filmmaker who wishes to create a 360 video for this viewing method must meet two challenges: one, to direct viewer attention without the use of auditory queues, as viewers will be looking in many different orientations within the frame while subject to directionally identical auditory environments, and two, to create a 360 video in which all information needed for a satisfactory experience can be gained from watching a single 16x9 region within the greater frame while still providing additional experiential benefits to those watching through headsets.

This second requirement might be easier to satisfy than it first seems. In a limited showing of *Darker Waters*, only one viewer used a VR headset. Instead, the rest watched the film on a large traditional screen as that headset viewer was consuming it, following the images as they looked around throughout the 360 video environment. This provided a mobile, strangely first-person experience to the larger audience, despite the fact that they were not actually controlling where their headset-wearing guide looked. Hybrid viewings like this might provide a compromise between headset viewers and friends or family who experience motion sickness from VR devices or who otherwise might not want to wear one.

Habitat XR

Another potential avenue for expansion in immersive media is exemplified by the Dian Fossey Gorilla Fund Superpanoramic Theater, a recently constructed exhibit created by the Habitat XR production company (Habitat XR). The theater forgoes headsets altogether and instead uses laser projectors and massive, floor to ceiling screens to create a virtual room, allowing viewers to walk around the environment and observe the immersive content through screens which cover most of the walls (see Figure 13).



Figure 13: A view of the then-recently constructed Dian Fossey Gorilla Fund Superpanoramic Theater. Habitat XR. Description of immersive theater. Facebook, 4/11/2021, <https://www.facebook.com/habitatXR/posts/3044152985797036>. Accessed 6/12/2021.

Though it doesn't give a full 360° by 180° view, the lack of headsets allows for a common experience without the contrivance and adjustments otherwise required for the audience. The floor-level screens also have the advantage of proximity over traditional planetarium shows. Instead of staring, seated, at a faraway dome, visitors to the theater can observe content immediately in front of them and easily navigate between different areas of the environment. Exhibits like this may always be limited, however, by high installation costs and lack of standardization. As long as a theater is required to be molded to a particular room, and any films shown in it created or adapted for its specifications, it is unlikely that such creations will scale to use as a form of mainstream media.

Mainstreaming VR

At-home consumption provides another avenue to popular acceptance that the 360 video and VR mediums could take. Consumption of other forms of media, whether by playing a video game or watching a television show, is often a solo experience. Headset-dependent media might circumvent the problems of communal consumption by sticking primarily to content intended for independent viewing, or, like in multiplayer video games, for consumption by people physically occupying different places.

Investment from Meta, the corporate successor to Facebook, might provide an additional boost on this front. Meta's Reality Labs developed the Oculus Quest 2, a relatively cheap headset that met some commercial success, and is attempting to expand the market for at-home VR viewing devices beyond its current, limited reach (Isaac 2021). Meta might be able to accelerate the rate of their acceptance amongst the general population by creating public stores where potential consumers can familiarize themselves with the devices (Isaac 2021).

Whether Meta finds commercial success in the 360/VR domain, their investment may contribute to a needed kickstart to the cycle of content creation, technology development and distribution, and consumer demand needed for any new medium to flourish. A number of other companies, large and small, are making a similar investment into 360/VR-related technologies, and some, Snap prominent among them, are doing so with a heavy eye towards spurring early content creation (Heath 2021). If this cycle can become self-sustaining, a new language of 360 video will soon develop. Each advance in the requisite technology and device distribution will have corresponding expansions in the amount of content being made and consumed. This will in turn lead to further advances in the grammar and style of 360 video and to fascinating and unpredictable possibilities for the future of art and communication.

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