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TECHNOLOGICAL AFFORDANCES IN 360-DEGREE VIDEO VIEWING APPARATUS: A STUDY OF TECHNOLOGICALLY TRIGGERED HEURISTICS AND THEIR EFFECT ON USER ATTITUDES ABOUT 360-DEGREE VIDEO TRAVEL ADVERTISEMENTS

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TECHNOLOGICAL AFFORDANCES IN 360-DEGREE VIDEO VIEWING APPARATUS: A STUDY OF TECHNOLOGICALLY TRIGGERED HEURISTICS AND THEIR EFFECT ON USER ATTITUDES ABOUT 360-DEGREE VIDEO TRAVEL ADVERTISEMENTS

A THESIS APPROVED FOR THE GAYLORD COLLEGE OF JOURNALISM AND MASS COMMUNICATION

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Abstract

360-degree travel advertisement videos can be beneficial to destinations that are trying to showcase themselves to potential visitors. The various technologies used to view these videos have become more affordable and more accessible, allowing destinations to consider using these systems in displays at travel conventions as opposed to traditional videos on monitors. This thesis examined how different viewing systems could impact the effectiveness of a 360° video advertisement in changing a viewer's opinion of a destination and their desire to visit the destination. This thesis used the Main Model to measure the effects on viewers provided by different technological affordances of the viewing systems. The viewing systems being focused on for this study are a head-mounted display (HMD) and a motion-controlled tablet.

This study was a 2 (viewing system: HMD/tablet) x 2 (destination: butterfly garden/air & space museum) repeated-measures experiment, where the destination was the within-subjects factor, and the viewing system was the between-subjects factor. The destinations were 360-degree video advertisements with narrated audio elements lasting one minute. The viewing systems will be a Meta Quest 3 head-mounted display and an iPad 10 motion-controlled tablet. Participants were randomly assigned to the different viewing systems, and the order of their video advertisements was randomized. The two destinations that participants were shown ads for are the Tulsa Air and Space Museum and the Texas Discovery Butterfly Gardens.

Repeated measures and comparative mean analysis were run on the data in SPSS to answer the 10 hypotheses posed in this study. Results indicated a significant increase in the feeling of presence, the association of novelty to the viewing system, and the intention to visit. The outcomes, limitations, and conclusions are discussed in the corresponding sections of the paper.

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CHAPTER I

INTRODUCTION

The tourism industry is extensive, with prominent marketing and advertising agencies attempting to entice consumers to visit destinations or partake in experiences and events. In 2019, an estimated 10 billion dollars would be spent on travel advertising in the United States alone (Benes, 2019). However, the travel industry faces unique advertising challenges that most other products do not. Companies are tasked with selling their destination or experience rather than a tangible product (Hyun, Lee, Hu, 2008). As a result, the travel industry has employed many advertising strategies to entice consumers, such as travel brochures, radio and television ads, extensive web marketing, and travel-based conventions. When consumers research a travel destination, they use the information they can find to create a destination image. This destination image is their attempt to frame the destination and compare it to an experience they already have (Chi & Qu, 2008). Mcfee, et al. (2018) found that a positive destination image increased a consumer's intention to visit.

While these methods have had varied success, the decision to visit a travel destination is best influenced by firsthand experience. Gartner, (1994) discovered that consumers rely primarily on word of mouth, personal experiences, and travel history when choosing what destination to visit. These sources often serve as the most persuasive form of “advertisement.” However, if consumers do not have access to word of mouth from a trusted source or a personal experience with the location or an area very similar, they must rely on traditional advertising to

assist them when choosing a travel destination. However, a 360-degree video may offer an opportunity to present a consumer with a video travel experience to reference during their decision-making process.

360-degree video is a potential advertising medium that has been growing in use (Bevan, 2018). Previous research has found that 360-degree videos can capture the attention of the viewer better, leading to higher levels of engagement (Mcfee, et al. (2018). 360-degree videos can also provide a realistic view of a destination, which can lead to an increased positive opinion of the destination. There are multiple ways to view 360-degree videos. This experiment will focus on differences in viewing 360-degree video on a tablet computer that would be held by a participant and moved around to view the image, and viewing the same 360-degree video with a head-mounted display that allows a participant to look around the video with head and body movement. The study will look at the differences in the viewing systems to see if the technological affordances of the head-mounted display play a significant role in a viewer's perception of the travel destination while viewing a 360-degree travel advertisement, when compared to viewing an advertisement on a handheld tablet. The head-mounted display viewing systems have also seen an increase in sales over the last few years (Chauhan, 2022). This increase in customer usage may push this form of travel advertising further into the mainstream.

360-degree video is footage recorded using a camera with multiple lenses or a single lens with a 360-degree view. This footage plays linearly and allows a viewer to see 360 degrees from where the camera is located. There are multiple ways to navigate this 360-degree viewing experience.

A head-mounted display allows viewers to turn their heads 360 degrees while looking up and down. A viewer’s head becomes the method for controlling the viewing angle. 360-degree

videos may also be viewed on a tablet or smartphone, which uses its gyroscopic sensors to turn the screen into a picture window that a user can move around 360 degrees by hand to control the angle they are looking. These videos can also be viewed on a traditional two-dimensional flat screen like a computer monitor, where a mouse can click and scroll around the 360-degree viewing angle. However, the 360-degree video does not allow the viewer to navigate within a space like viewing a virtual experience over a head-mounted display would (Broeck et al., 2017; Beach & Mathende, 2021).

To better understand the effects that the different viewing systems have on the consumer while viewing a 360-degree video, this study will use some elements from the MAIN model (Sundar, 2008). The MAIN model is used to understand how technological affordances affect interactive media users' evaluations of media content. The MAIN model presents the four technological affordances: modality, agency, interactivity, and navigability. Within these affordances, several heuristics can lead consumers to assign qualities to the different technological affordances and affect a consumer's credibility judgment towards the viewed media.

This study will examine how the viewing system alters consumers' perception of the video and how perception can carry over to destination image and desire to visit a destination. Having a better understanding of how different viewing systems affect consumers while viewing 360-degree travel videos can help any destinations who are considering using 360-degree videos in their advertising to understand how consumers may be interacting with their content and responding to it. This information could be particularly useful for travel destinations that attend travel conventions. When designing customer experiences in their booths, how visitors to their

booth view advertisement material is often one of the major factors to consider (Yuksel & Voola, 2010).

CHAPTER II

REVIEW OF LITERATURE

It is essential to distinguish between the medium being experienced and the method of viewing when considering 360-degree video and virtual reality. 360-degree video can include natural images filmed by a camera system that allows all angles to be recorded from a singular point of view (Farmer et al., 2021). 360-degree videos can also be computer-generated images or scenes a user can view. 360-degree videos allow the viewer to control the viewport or area of interest and look around the video in all directions (Shafi et al., 2020).

Different viewing technologies can be used with 360-degree video (Broeck et al., 2017); it can be viewed on a standard video screen, using devices such as computer mice or joysticks to control where the viewer is looking. Another method for viewing 360 videos is watching on a smartphone or tablet with gyroscopic sensors. These sensors detect the angle and direction the device is moving, allowing a user to move the device around and reveal different views of the environment on the screen. Another viewing system would be a head-mounted display; these are head-mounted screens that take up most of the user's field of view and, when coupled with motion tracking systems, allow users to use their heads to change the viewing angle (Kang et al., 2021). These are three different methods of viewing the same 360-degree video content.

Past studies do not always use the same terminology to describe what viewing system they are testing; others interchange terminology that describes the viewing media and the viewing system. For example, Sundar et al. (2017) showed participants a 360-degree video on a computer screen controlled using a mouse and the same 360-degree video on a head-mounted display. The study would refer to the computer-viewed media as 360-degree video and the head-mounted display media as virtual reality when, in fact, they were the same 360-degree video content, just different viewing systems.

However, there are significant differences between virtual reality and 360-degree video. Virtual reality has been conceptualized as a sense of presence in an environment established by communication technology (Steuer, 1992). Steuer suggests that virtual reality relies on a combination of vividness and interactivity. While 360-degree video, when viewed on a head-mounted display, can have a high level of vividness (Van Kerrebroeck et al., 2017), the separation between VR and 360-degree video may be more evident when comparing levels of interactivity. Interactivity in media has been studied both from a functional and a contingency view.

Functional interactivity considers a medium's level of interactivity based on the medium's features, enabling interaction between the viewer and the media being presented (Sundar et al., 2003). Contingency view interaction describes a series of exchanges where continual messages will be based on information shared in previous messages, an exchange of information built upon two-way communication (Rafaeli, 1988). When considering the technological affordances in 360-degree videos vs. virtual reality, the functional view of interactivity better describes the viewer interactivity provided by the different media. This idea pairs well with Steuer's definition

of interactivity, which is the extent to which a user can participate in and modify a mediated environment's content in real-time.

A more detailed definition of virtual reality is an experience that enables users to interact with objects or situations in a computer-generated environment. For example, 360-degree videos allow the viewer to control the viewport and look around the presented space, allowing for some level of interactivity.

On the other hand, virtual reality allows the user to move directionally within the virtual environment, control where they are viewing, and in many virtual experiences, interact with objects placed within the virtual world (Estupinan et al., 2014; Gauguier et al., 2018). In virtual reality, the user controls the experience by choosing where to go and what to interact with; many virtual reality experiences allow the user to change locations. This level of interaction separates 360-degree video from virtual reality as a media format, regardless of the viewing system used.

To offer an example of how 360-degree video and virtual reality differ, consider a scenario that may exist in travel advertising and how these two systems would operate. A large aquarium is showcasing a new exhibit. A 360-degree video will be recorded near the exhibit. Viewers could look around 360 degrees from where the camera was placed but would do so from a fixed position. The viewer will not be able to move throughout the exhibit, nor will they be able to interact with any objects in the exhibit physically. A virtual reality experience viewer would be able to look around at their surroundings like the 360-degree video and move their point of view throughout the designated area. A virtual reality viewer would also be able to interact with other physical objects, such as turning a page on an information kiosk or picking up a ball to throw into the exhibit. The 360-degree video can be viewed on a tablet, a computer

screen navigating with a mouse, or a head-mounted display. However, everything will be fixed, and the user can only interact with the scene by moving and changing where they are looking. A virtual experience can exist on all the same devices but allows for movement within an area and more direct interaction with items in the area. A 360-degree video has a passive viewer, and a virtual reality experience has a more active participant.

To avoid confusing the type of video with the technology on which it is presented, the current study will examine 360-degree video filmed by a camera system recording a natural environment and capturing all angles simultaneously. The same video will be presented on a tablet or on a head-mounted display.

Travel

There are a few ways a 360-degree video might have a significant impact compared to traditional video ads in travel advertising. This difference could be due to potentially increased immersive properties. Gartner (1994) found that consumers rely heavily on word of mouth, personal experiences, and travel history when deciding on what location to visit, often using personal experiences that may be similar to a destination on which to base their opinion of the destination. A consumer may be considering a particular beach destination they have not been to. Gartner found that this consumer would compare the destination to other beach destinations they have visited and consider those experiences when deciding on a future potential destination. A 360-degree video ad for a destination may trigger similar sensations to being there, thus allowing an advertisement to feel more like an associated travel experience to compare to while considering a trip. Hyun, Lee, and Hu (2008) experimented with different forms of interactive and virtual experiences to convey information about a destination to potential consumers. Their experiment found that experiencing a destination in an interactive

virtual manner allowed potential consumers to experience a travel destination before travel, giving a better understanding of the destination. Tussyadiah et al. (2018) conclude that the feeling of being at the destination provides a positive sensation to potential tourists. Similarly, a study found that participants showed a higher likelihood of visiting a destination after virtually viewing the destination, a try-before-you-buy type experience (Gibson & O'Rawe, 2018).

Many tourism products currently use similar technologies in advertisements. Some hotel properties also use 360-degree photos to allow potential customers to view the inside of a hotel before visiting (Najafipour, Heidari, & Foroozanfa 2014). These static panoramic photos have been used to allow virtual tours of properties that travelers may visit. Though they are different from video advertisements, they show the potential that the technology may provide.

Research has been done in the travel advertisement world involving VR and 360-degree videos. Guttentag (2009) asserts that 360-degree video may not be an actual virtual reality experience in that it doesn't allow the same degree of physical interaction with objects that appear in the experience. Rather, 360-degree video represents a more interactive experience than traditional 2d video playing on a static screen. Wiltshier and Clarke (2015) proposed a more flexible interpretation of VR to include specific 360-degree video experiences, something Gibson and O'Rawe (2018) adopted in their study when comparing 360-degree video on a head-mounted display to traditional video on a stationary screen. They found that participants had a higher desire to visit destinations after seeing a 360-degree video on a head-mounted display (Gibson & O'Rawe, 2018).

Many studies have compared 360-degree videos to traditional 2d videos while using several different methods of viewing 360-degree videos (Griffin et al., 2017; Kerrebroek et al., 2017). Other studies have compared 360-degree video on a physically interactive viewing

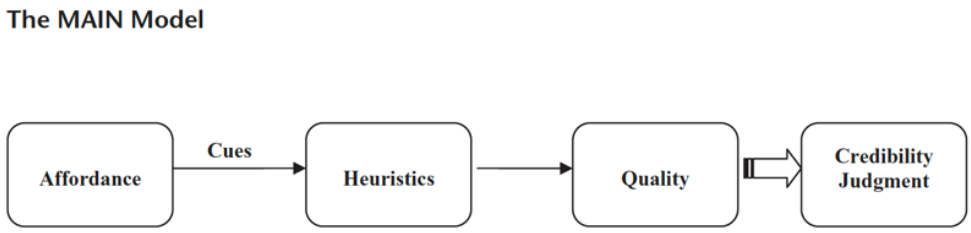
system to a viewing 360-degree on a standard computer screen with diffident motion input systems (Sundar et al., 2017). However, this study plans to look at a more specific question by having two groups use one form of media "360-degree video" with two different viewing technologies, instead of having two groups using two different forms of media "360-degree video and traditional video" and having two different forms of viewing technology. This study's participants will be viewing the same 360-degree video advertisement with matching audio experiences to determine the viewing technology's role in the viewer experience. One group will view the videos through a head-mounted display and wearing headphones. The other group will be viewing the videos on a tablet that allows motion control of the video experience while wearing the same headphones. Using the same media type and audio system, this study should be able to compare the viewing technologies.

Main Model

Understanding the effectiveness of 360° travel videos when presented on two different viewing methods requires an analysis of the affordances offered by the media to measure the difference between these two viewing methods: the tablet versus head-mounted display. Elements of Sundar's MAIN model (Sundar, 2008) provide a rubric to guide predictions about how these viewing methods differentially impact users' judgments and perceptions. Sundar's MAIN model examines technological affordances or action possibilities (Gibson, 1977). These affordances can activate specific heuristics or cognitive rules of thumb. The activated heuristics each affordance offers can affect a consumer's credibility judgment when viewing different travel media. Sundar found through research four broad affordances that show significant effects: modality, agency, interactivity, and navigability. These affordances exist in most digital media and can cue cognitive heuristics related to credibility assessments. The model's basic structure

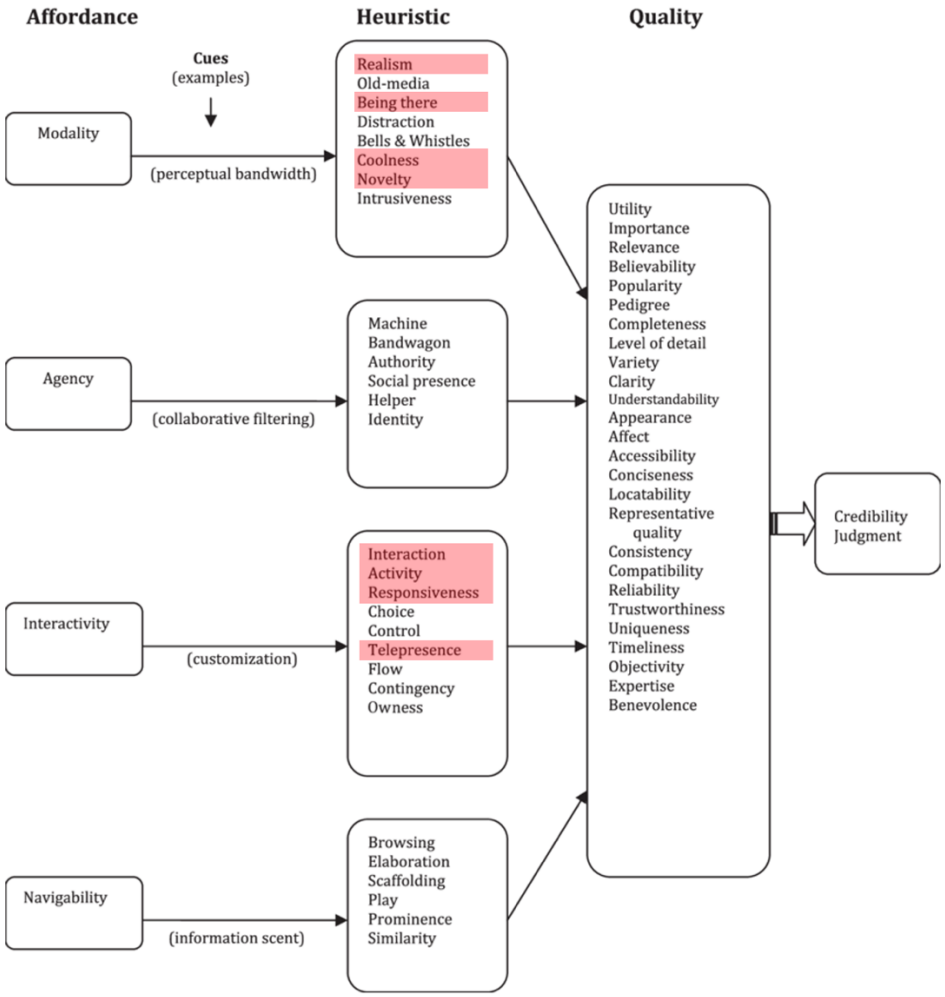
deals with affordance cues. Each affordance can trigger a heuristic that determines quality perceptions and affects a user's credibility judgment.

Figure 1. Overview of the MAIN Model (Sundar, 2008)



Sundar's model covers these four affordances and identifies many heuristics or qualities that may be present in digital media. This study, however, will not examine all aspects of the main model; instead, we will focus on the modality and interactivity affordances due to the potential impact the technology being used for the study will have on a user. The heuristics being used in this study have been highlighted in red.

Figure 2. The MAIN Model (Sundar, 2008)



The head-mounted displays and 360-degree video should play more heavily in the modality and interactivity affordances. Within the modality affordance, the study will look at realism, being/there, and coolness/novelty heuristics. The study will look at the heuristics of interaction, activity, responsiveness, and telepresence in the interactivity affordance.

Modality Affordance

Within the modality affordance, four heuristics are relevant to this study; these naturally pair themselves into two groups. The first group consists of realism and being there. The second group consists of coolness and novelty. The first two, realism and being there, address a media's

ability to connect the experience with the viewer. Sundar (2015) refers to realism as the transparency between human-human and human-computer interaction and finds that information presented visually may be perceived as more realistic because it represents reality (Sundar, 2008). The more realistic an experience is, the easier for a viewer to connect with the subject matter and feel drawn into the experience. Sundar (2008) also noted that variations of perceived reality can trigger the "being there" heuristic, a perception where sensory immersion in the mediated environment is an authentic experience. Realism and being there both represent users' interactions with media in a similar that can be described as presence and immersion.

Presence

Presence is often described as the sensation of being pulled into a media experience and relates to a media's ability to move beyond being a fake environment into something the viewer feels is reality (Barfield et al., 1995; Ijsselsteijn et al., 2000). Terkildsen and Makransky (2019) discuss the conceptualization of presence in 3 areas: Social-presence, Self-presence, and Spatial-presence. Social presence is a media experience's ability to connect the user to the media strongly enough to create social bonds with the subjects presented by that medium, such as having a more human connection to artificial entities or perceiving artificial surroundings as more real (Lee, 2004). Self-presence describes the user's ability to perceive the experience as happening to them, as opposed to the experience being a presentation (Kilteni et al., 2012; Terkildsen & Makransky, 2019). Spatial presence describes the sensation of being in the actual environment being presented instead of the environment the user is currently in (Slater, 2002). Looking at the variations of presence, we can begin to understand how the different viewing systems for 360° video travel advertisements might impact viewers.

While (Sundar, 2008) has social presence listed as a heuristic in agency affordance, this section will examine self-presence and its conceptual similarity to the heuristics realism and being there in modality affordance. Regarding self-presence, (Araiza-Alba et al., 2021) found that viewers who underwent training using 360-degree videos often perceived the training as more realistic when compared to traditional videos on a monitor. These viewers had higher chances of the skills being transferred to the real world, and they also found that memory retention was higher when viewing 360° videos. Lessiter et al. (2001) found several factors contributing to a higher sense of physical presence. While historically, higher fields of view and higher-quality imaging have had an advantage in connecting a viewer to a medium, (Lessiter et al., 2001) found that lower-quality imagery combined with higher senses of physical control of the experience led to higher senses of physical presence compared to higher quality imaging with no perceived control. This suggests that the control aspect of the media experience can have an effect on how the medium is perceived, so when comparing two viewing methods for 360-degree video, both allowing for control, one technology may lead to a higher sense of control and offer a higher sense of physical presence.

H1: Viewers will feel a greater sense of presence while using the HMD compared to viewing media on a tablet, leading to higher sensations of being there and realism.

Immersion

Another aspect of presence that may be relevant to self-presence is immersion. McMahan (2003) defines immersion as being surrounded by a completely other reality, an experience that takes over our attention and perceptions. Comparing immersion and presence, immersion describes how the physical traits of a viewing method can affect the viewer, including the field

of view, how much of a viewer's vision is occupied by the media, resolution, the number of pixels on the screen, and screen size, the actual physical size of the screen. Moreover, while Immersion deals with physical traits, presence is how the viewer feels (Slater & Wilber, 1997). Immersion is a significant aspect of presence; specifically, the greater immersion of a VR system increases presence (Diemer et al. l. 2015). (Visch, Tan, and Molenaar, 2010) found that immersion impacted viewer emotions, and viewer emotions factored into a sense of increased presence. Studies also suggest that a higher immersion can lead to an increase in the intensity of all viewer emotions, and the more intense emotional response leads to a higher sense of feeling of being in the fictional world or having a greater sense of presence in the fictional world (Lee, 2004; Schubert, 2009). This suggests that technological affordances such as different 360 video viewing methods and differing immersion levels could have various levels of presence for the participant. Immersion and self-presence should be closely connected when testing the viewing methods and their effect on participants.

H2: Viewers will feel a higher sense of immersion when using HMD compared to viewing 360-degree videos on a tablet, leading to higher feelings of being there and realism.

Coolness and Novelty

The following areas in the modality affordance are the coolness and novelty heuristics. The coolness and novelty heuristics look at participants' views of the technology presenting the media or the type of media more than the content of the media. In this study, the media content will be the same: a 360° video. However, the viewing methods will vary technologically and may trigger participants' coolness or novelty heuristic based on their viewing method. Sundar (2015) referred to the novelty heuristic as the association between the uniqueness of the technology and the content presented. Perceived novelty can be elicited by several factors:

unique physical interaction with an ad, unique physical placement of an ad, or unique presentation of a stimulus (Hopp & Gangadharbatla, 2016). Reeves & Nass (1996) discuss that novel media presentations get attention and are perceived well, though caution may be needed. They found that changing visuals can increase interest when viewing presentations, but too rapid changes could make a sequence too complex, and users would tune out.

H3: Viewing 360-media on an HMD may seem more novel to viewers than using a tablet.

Sundar (2015) discussed that content credibility may increase if received in a modality perceived as hip or stylish. This coolness perception can extend beyond the perception of the item itself; unique performance can also elicit feelings of coolness. Apple products are perceived as excellent due to their utility, with features and user interface ideas that were original and highly functional. This unique function was one of the factors that set them apart from other brands (Sundar et al., 2014). While Head Mounted Display usage has increased considerably over the last few years, with an estimated 13% of households in the US possessing one, their use is still much rarer than smartphones or tablets (D'Souza, 2025). So, there may be a difference in the user's perception of the content based on the coolness or Novelty of the HMD vs. the tablet in this study.

H4: Viewers will perceive HMDs as cooler than tablets.

Interactivity Affordance

The other affordance from the Main model that will be looked at is interactivity. Interactivity can encompass several heuristics that can be cued by the interface used to experience digital media (Sundar, 2015). The heuristics in the interactivity affordance this study

will be looking at are interaction, activity, responsiveness, and telepresence. Since this study uses the same 360-degree videos, comparing the different viewing systems' levels of interactivity should create different experiences.

Interaction

The interaction heuristic has been described as the extent to which users can modify the form and content of an experience in real-time (Steuer, 1992). This definition focuses on the subject's real-time participation. Others have focused on the user control aspect, interactive systems allowing a user control of the content information given, or different control styles allowing more significant interaction (Bezjian-Avery et al., 1998; Guedj et al., 1980). The main idea is that different affordances allow users varying levels of control over their experience.

H5: Viewers will have a higher sense of interaction when using the HMD vs tablets.

Activity

When looking at the activity heuristic, i.e., more activity is better than less, some affordances with higher levels of perceived interaction may lead to more activity (Sundar, 2015). HMDs that allow a user to navigate 360-degree videos with their head may have a more natural feeling to a user than moving a tablet around as a viewport. Studies have found that when presented with 360-degree video, different viewing technologies elicited different levels of exploration of the video environment (Van den Broenk, Kawsar, & Schoning, 2017). This study measured how much a user physically adjusted their viewing angle during watching. Head-mounted display users explored their video at a rate of 28 degrees per 30 seconds vs 9 degrees per 30 seconds with a tablet. This perceived more natural usage, leading to higher activity, may

represent higher levels of connection to the media, therefore taking greater advantage of the 360-degree video medium.

H6: Viewers will be more active in their viewing of 360-degree media when using HMDs vs tablets.

Responsiveness

The responsive heuristic is the psychological effect on a user and their perception of a technological device's ability to connect them to the media. System responsiveness can help achieve synchronicity with the media, allowing viewers to relate better to the media experience, feel more connected to their choices, and control their interactive experience (Liu & Shrum, 2002). The feeling of responsiveness a viewer feels affects their usage of media navigation systems and their media experience (Sundar, 2008). Response speed is one of the factors that can increase the responsive sensation of media content—how quickly devices respond to input can make the interactivity feel more natural to the viewer (Song & Zinkhan, 2008). With 360-degree video media requiring input from the viewer to control the experience, different viewing systems may elicit varied feelings of responsiveness based on the speed of the system's response to viewer inputs. The different viewing systems may also vary in how easily their control systems translate to users; an easier-to-use control system may feel more responsive to a viewer.

H7: HMDs will feel more responsive to viewers than tablets when viewing 360-degree videos.

Telepresence

The last interaction affordance heuristic this study will be looking at is telepresence. Telepresence is the perception by the user that they have been transported to the

place in the media (Sundar, 2015). Telepresence describes sensations similar to Spatial Presence, where there is a moment when the user feels as though they are no longer in their real environment and instead a virtual environment (Slater, 2002; Terkildsen & Makransky, 2019). Evoking a strong sense of telepresence between a user and a piece of media is usually a combination of vivid, sensory-rich presentations combined with higher levels of interactivity. This combination gives users the sense of being projected into a distant environment (Kaber & Usher, 1998). Previous research has found that using different devices for control input has increased the sensation of being in the media, such as using a steering wheel vs. a controller or a gun-shaped controller (Kim & Sundar, 2013; Schmierbach et al., 2012). For this study, while there are no control devices separate from the viewing system, the systems become the control device. Head-mounted display users' perception of the turning of the head vs. tablet users moving their hands may lead to higher levels of telepresence for one device over the other. Other Studies have found that viewing videos with HMD can deliver a higher sense of being there and interaction when compared to other viewing systems for 360-degree video, and both were higher than text-based media. The telepresence sensation could be seen as a joint effort of the modality and interactivity affordances (Sundar et al., 2017).

H8: HMDs will elicit higher sensations of telepresence for viewers than tablets when viewing 360-degree videos.

Credibility Judgment

Credibility judgment, as presented in the MAIN Model (Sundar, 2008), could be seen as the ability to alter a viewer's destination image when it comes to travel advertisement, where the more credible the advertisement is deemed, the greater the shift in the viewer's opinion of the

destination and their desire to visit. Destination image is defined as a collection of beliefs and thoughts about a specific environment (Jebbouri et al., 2022). studies have shown that the image of a location that a person has significantly impacts their future travel decision-making and destination selection (Soliman, 2019; Carvalho, 2022). A tourist's image of a destination can also influences their evaluation of a trip and affect their future intentions (Chi & Qu, 2008).

H9: HMDs will elicit better credibility judgments, leading to more favorable images of the destinations compared to tablets.

Discomfort

Discomfort does not appear as a part of the MAIN Model; however, many studies have found negative side effects from using HMDs (Regan, 1995). Motion sickness experienced by some users led to lower levels of presence. Poor experiences can affect the sense of balance and inertia, creating nausea (Barnes, 2016). Low latency can also cause motion sickness when using HMD's as the lack of perceived connection between physical movement and visual reaction (Guttentag, 2010).

H10: Watching videos on HMD's may lead to higher levels of discomfort than tablets.

CHAPTER III

METHODOLOGY

Design

This study is a 2 (viewing systems: 360-degree video shown on a head-mounted display /motion-controlled tablet) × 2 (destination: Tulsa/Dallas) repeated measures experiment, where the viewing systems is a between-subjects factor and destination is a within-subjects factor. Participants will be randomly assigned to the viewing system, and the order of the two destination videos they will see will be randomized. Participants will be presented with two advertisement videos with 360-degree video components and audio components. The commercials will be one minute and have been filmed in the Oklahoma area. This study compares how viewing methods affect a viewer's destination image when presented with travel advertisements.

Independent Variables

The study has two independent variables.

Viewing systems: The first independent variable will be the viewing technology the participant uses. The two viewing systems will be a head-mounted display system; this experiment will use the Oculus Quest 3 headset. The other viewing method will be a tablet that allows motion control of 360-degree video; this experiment will use Apple iPads. Both viewing systems allow for navigation of 360-degree videos.

Destination: The second independent variable will be the destination shown. Each participant will view two destinations, one at a time, with a 360-degree video advertisement for that destination. Accompanying audio for the destinations will be played over matching headphones for both viewing technologies. These videos will be viewed on the YouTube app under the 360 video settings, and the videos will be from travel destinations within the state of Oklahoma. The videos will showcase two or three areas at the travel destination, allowing the viewers to look around the scene while the audio is going on.

Dependent Variables

The dependent variables for this experiment will be eight heuristics, representing the modality and interactivity affordance presented by Sundar's Main model. The eight heuristics will be presence, immersion, coolness, novelty, interaction, activity, responsiveness, and telepresence. These variables will help determine the perceived quality of the advertisement, the credibility judgment of the destination, and how they change between the two viewing systems (head-mounted display versus tablet) when viewing the travel advertisements. Most variables will be measured using a 1 through 7 intensity scale, and some questions will be reverse-coded to ensure the results match measures for internal validity (Wimmer & Dominick, 2014). A composite index will be created for each variable, and the same variables will be measured after each exposure.

Presence

The first dependent variable measured will be presence (α=.88). When compared to tablets, questions were asked about physical presence and sensations of being there to determine what technological qualities of the head-mounted display will contribute to sensations of presence. The questions for presence are drawn from past research questionnaires such as the

Multimodal Presence Scale by Makranksy et al. (2017), the Presence Questionnaire by Witmer and Singer (1998), and the Slater-Usoh-Steed Questionnaire by Usoh et al. (2000). The questions measured the physical presence and being there.

Physical presence was a composite index of five items. The questions were measured on a 1-7 scale.

- The environment seemed real. Disagree Strongly – Agree Strongly
- I had a sense of acting in the environment rather than operating something from outside. Disagree Strongly – Agree Strongly
- My experience in the environment seemed consistent with my experiences in the real world. Disagree Strongly – Agree Strongly
- While in the environment, I had a sense of being there. Disagree Strongly – Agree Strongly
- I was utterly captivated by the experience. Disagree Strongly – Agree Strongly

Being there was a composite index of five items. The questions were measured on a 1-7 scale.

- Please rate your sense of being in the presented environment.
- To what extent were there times during the experience when the presented environment was the reality for you? Not a real experience – very real experience
- When you think back to the experience, do you think of the presented environment more as images you saw or as somewhere you visited? Images on a screen – Somewhere you have visited

- During the experience, did you feel as though you were in the presented environment or somewhere else? Presented environment – somewhere else
- During the experience, did you think to yourself that you were actually in the presented environment? Disagree Strongly – Agree Strongly

Immersion

The immersion dependent variable (α=.79) was measured on a 7-point scale to judge viewers' sense of immersion. The Multimodal Presence Scale by Makranksy et al. (2017) and the Temple Presence Inventory by Lombard et al. (2009) will help measure our participant's immersion.

Immersion was a composite index of four items. The questions were measured on a 1-7 scale.

- How completely were your senses engaged? Not engaged – fully engaged
- To what extent did you experience a sensation of reality? Not realistic – very realistic
- To what extent did you feel mentally immersed in the experience? Not immersed – very immersed
- Were you able to forget the device you used while watching the media? Aware of the room – not aware of the room

Novelty

The novelty dependent variable (α=.75) was measured on a 7-point scale to judge participants' views on the novelty of the technologies they used. Questions were used from the semantic differential method by Osgood et al. (1957) and the dimensions of product semantics by Hsiao and Chen (2006).

Novelty was a composite index of five items. The questions were measured on a 1-7 scale.

- Where would you rate your aesthetic view of the item: ugly - beautiful.
- Where would you rate the novelty of the item: typical - unique.
- Where would you rate the complexity of the item: simple – complex.
- Where would you rate your emotional response to the item: rational - emotional.
- Where would you rate the trendiness of the item: traditional – modern.

Coolness

The coolness dependent variable (α=.90) was measured on a 7-point scale to judge how cool a participant felt either of the viewing technologies was. This study used questions from the study Capturing Cool by Sundar et al. (2013).

Coolness was measured using a composite of six items. The questions were measured on a 1-7 scale.

- This device is original. Disagree strongly – agree strongly
- This device is distinct. Disagree strongly – agree strongly
- This device looks great. Disagree strongly – agree strongly
- This device makes people who use it different from other people. Disagree strongly – agree strongly
- If I use this device, it would make me stand apart from others. Disagree strongly – agree strongly
- The purpose of this device is to be helpful. Disagree strongly – agree strongly

Interaction

The interaction dependent variable (α=.31) was measured on a 7-point scale to judge how much a participant felt they were interacting directly with the presented media. The study used questions from The Virtual Environment Evaluation Questionnaire by Chertoff et all, (2010).

When running the reliability test, the value for the second question was flipped. This still left a low α level, so interaction was excluded from further analysis.

Interaction was a composite index of three items. The questions were measured on a 1-7 scale.

- The interaction with the environment felt natural. Disagree strongly – agree strongly
- The device was difficult to use. Disagree strongly – agree strongly
- You were able to navigate the device easily. Disagree strongly – agree strongly

Activity

The activity dependent variable (α=.72) was measured with a 7-point scale to determine how active users were while viewing the advertisement. Questions were derived from the Van den Broeck (2017) study on exploring 360-degree video viewing experiences.

Activity was a composite index of three items. The questions were measured on a 1-7 scale.

- Did you see everything that was shown in the advertisement? Missed most of it – saw everything
- Did you position the viewer to observe what you wanted to see in the advertisement? Unable to position viewer well – able to position viewer well
- Navigating the experience using the provided technology was easy. Disagree strongly – agree strongly

Responsiveness

The responsiveness dependent variable (α=.81) was measured on a 7-point scale to judge how well the technology responded to the user's input. The study used questions from the Interactivity perceptions questionnaire by Song et al. (2008).

Responsiveness was a composite index of three questions. The questions were measured on a 1-7 scale.

- The device processed my input very quickly. Disagree strongly – agree strongly
- I was able to navigate the experience without any delay. Disagree strongly – agree strongly
- I was getting instantaneous feedback when I changed my viewing angle. Disagree strongly – agree strongly

Telepresence

The telepresence dependent variable (α=.86) was measured on a 7-point scale to determine how strongly participants felt they were at the locations depicted in the experience. Questions for telepresence were used from the Multimodal Presence Scale by Makranksy et al. (2017).

Telepresence was the composite index of four questions. The questions were measured on a 1-7 scale.

- The presented experience seemed real to me. Disagree strongly – agree strongly
- I had a sense of moving in the presented experience rather than operating a device. Disagree strongly – agree strongly
- My experience in the presentation seemed consistent with my experiences in the real world. Disagree strongly – agree strongly
- I was completely captivated by the presented experience. Disagree strongly – agree strongly

Credibility

The credibility variable (α=.68) was measured using the Belief-Desire-Intention model to determine if a participant's views on a destination, or destination image, had changed. Did the

participant have a more positive view of the destination, desire to see the destination in person, or desire to travel to the destination (Chi & Qu, 2008)?

Destination image was a composite index of three items. The questions were measured on a 1-7 scale.

- Did the advertisement change your perception of the advertised location? Perception remains unchanged – changed perception
- Do you want to see the advertised location in person? Not interested in seeing – very interested in seeing
- Do you plan to visit the advertised location? Not interested in visiting – very interested in visiting

Discomfort

The discomfort variable (α=.85) was a composite index of 3 items. The questions were measured on a 1-7 scale.

- I felt confused while wearing the headset/moving to view the video.
- I felt disoriented while wearing the headset/moving to view the video.
- I felt discomfort (nausea, headache, eye strain, etc.) while wearing the headset/moving to view the video.

Sampling

A convenience sample will be taken from the University of Oklahoma student population. G*power software analysis has determined a sample size for calculating Power (.8) with a medium effect size of (.25), alpha=.05, with 1 degree of freedom and two groups. This

study will need 128 participants. The study will use students from the University of Oklahoma as participants in the experiment. 360-degree video advertising is one of the newer technologies used to digitally advertise travel destinations (Rahimizhian et al., 2020). Studies have found that millennials and Generation Z are more receptive to digital marketing than previous generations (Orabi, 2022). Expedia Media Solutions (2017) report found that Generation Z is more likely to be influenced by shared pictures and videos of travel destinations than previous generations. Sales of head-mounted displays, "one of the viewing systems being tested by this study," have increased recently, with almost 50% owned by 18 to 34-year-olds. Moreover, 71% of owners describe themselves as early adopters of new technologies (Vacano, 2023). Credibility judgments of emerging technologies are easier to judge by the generations more actively engaged in digital media (Sundar, 2008). With many current college students fitting into the Millennial or Generation Z category, college students would be a relevant participant base for this study. There will be a minimum age of 18, but no maximum age. There will be no limit to level in college while recruiting.

To help recruit participants, University of Oklahoma professors are asked to inform their students about the study and ask them to participate. There will be mass emails distributed to OU Students inviting them to participate in the study. Flyers will be posted in several areas with heavy student traffic, encouraging participants to participate. Five gift certificates of $20 will be given away randomly within the participant pool as an additional encouragement to participate.

Population

Population demographics for this study included age, ethnicity, current enrollment level, and citizenship status. There were no limits in place for participation. There were 52 participants in this study. The average age of the participants was 24.14, and 2 chose not to

answer. Ethnicity was broken into White or Caucasian, Black or African American, American Indian/Native American or Alaska Native, Asian, Native Hawaiian or Pacific Islander, and Hispanic or Latino. Most participants were White, with 40 participants. There were 4 Black participants, 3 Hispanic participants, 2 American Indian participants, 2 Asian participants, and 1 Native Hawaiian participant. Regarding level of education, juniors and seniors in college comprised the majority of responses. There were 22 Senior participants, 11 Junior participants, 7 Sophomore participants, 3 Freshman Participants, 1 Graduate Student participant, and 8 not currently enrolled in school. For citizenship, US Citizen was the majority of participants, with 49, 3 participants reporting Other/Non-US Citizens.

Stimuli

Both viewing systems will be using the same 360° video advertisements. The researcher will create and film the videos at two travel destinations with a 360° camera. Each video will be one minute long and include one of two locations at each destination. This will allow each video to showcase different areas at a destination while allowing the participant 30 seconds in each location. Both advertisements will have audio tracks with information about the destination and the locations the participants are viewing. This time will allow the participants to look around their environment using the different viewing methods. This length should also reduce the time required for participants to complete the experiment; participants' time requirement should be no longer than 20 minutes each.

Condition/Apparatus

The participants in the study will be shown travel advertisements in one of two ways. The first system will be an iPad tablet; the tablet will be pre-set up to allow easy access to the two travel advertisements. Tablet participants will hold the tablet in their hands, allowing them

to move around their fixed position to adjust the viewfinder of the 360° video to look around the destination. The other condition will be a Meta Quest 3 head-mounted display that will also be set up to allow easy access to the two travel advertisements. The participants in the head-mounted display category will also be allowed to move around in their fixed position to view more areas of their destination. Before the head-mounted users begin, the researcher will help them adjust the interpupillary distance; this adjusts the headset to match the distance between the screens to the distance between the participant's eyes. The IPD will be adjusted so participants will have an in-focus screen while using the headset. The head-mounted display will be synced with a television in the room so the researcher can help participants navigate the menus if they require assistance. Audio for the two devices will be synced through Bluetooth to a set of Bluetooth headphones, allowing participants in both viewing systems to have the same audio experience. Participants will be randomly assigned to which viewing system, and the viewing order of the videos will be randomized. A paper questionnaire will be used for pretesting and post-testing data collection.

Procedures

Participants start their experiment by signing a consent form that describes the experiment and how the results of their participation will be used. They will then be randomly assigned to either the head-mounted display or the tablet, and they will have the order they view the travel destinations randomized. Participants will then be given a pretest; the pretest questionnaire will determine the participant's familiarity with the different viewing systems or travel destinations. The pretest will determine if they have experience with head-mounted displays, and understanding their familiarity with those displays may factor into the effectiveness of the advertising. Participants will also be asked about their familiarity with the travel

destinations; if they have been to or seen a destination on television before, this may alter their experience.

Each participant will then begin their testing based on their assigned independent variable. Users of the tablet condition will be given the tablet and shown the basics of playing the selected video when they are ready and explained that they could move the tablet around to alter their 360° video viewing experience. Once participants have been given their headphones, they will have an opportunity to set a volume level that is comfortable for them with a test piece of media. Participants assigned to the head-mounted display will have the researcher help them put the headset on and adjust it for physical comfort. Then, the researcher will show the user how to adjust the IPD to get the clearest picture while participating in the experiment.

Participants will also have to be instructed on how to select the video to watch and to make sure they understand; they will be able to move their heads to look at different parts of the video. They will also be reminded that they cannot walk around to see different things. They will also be given their headphones and allowed to check the volume of the headphones with a test piece of media. After the participants view the first piece of media, they will remove the viewing system? and be given a questionnaire about the first travel destination they viewed. Once they are done with that questionnaire, they will put the equipment back on and repeat the experiment with the second destination. When they finish the second destination, they will remove the equipment and answer a final questionnaire. They will then be debriefed and asked if they have any questions.

Data analyses

Hypotheses will be tested with a 2 (viewing systems: 360-degree video shown on a head-mounted display /motion-controlled tablet) × 2 (destination: Tulsa/Dallas) ANOVA. Main

effects for the viewing systems on the dependent variables will be examined, as well as main effects for destination and systems × destination interactions.

Chapter IV

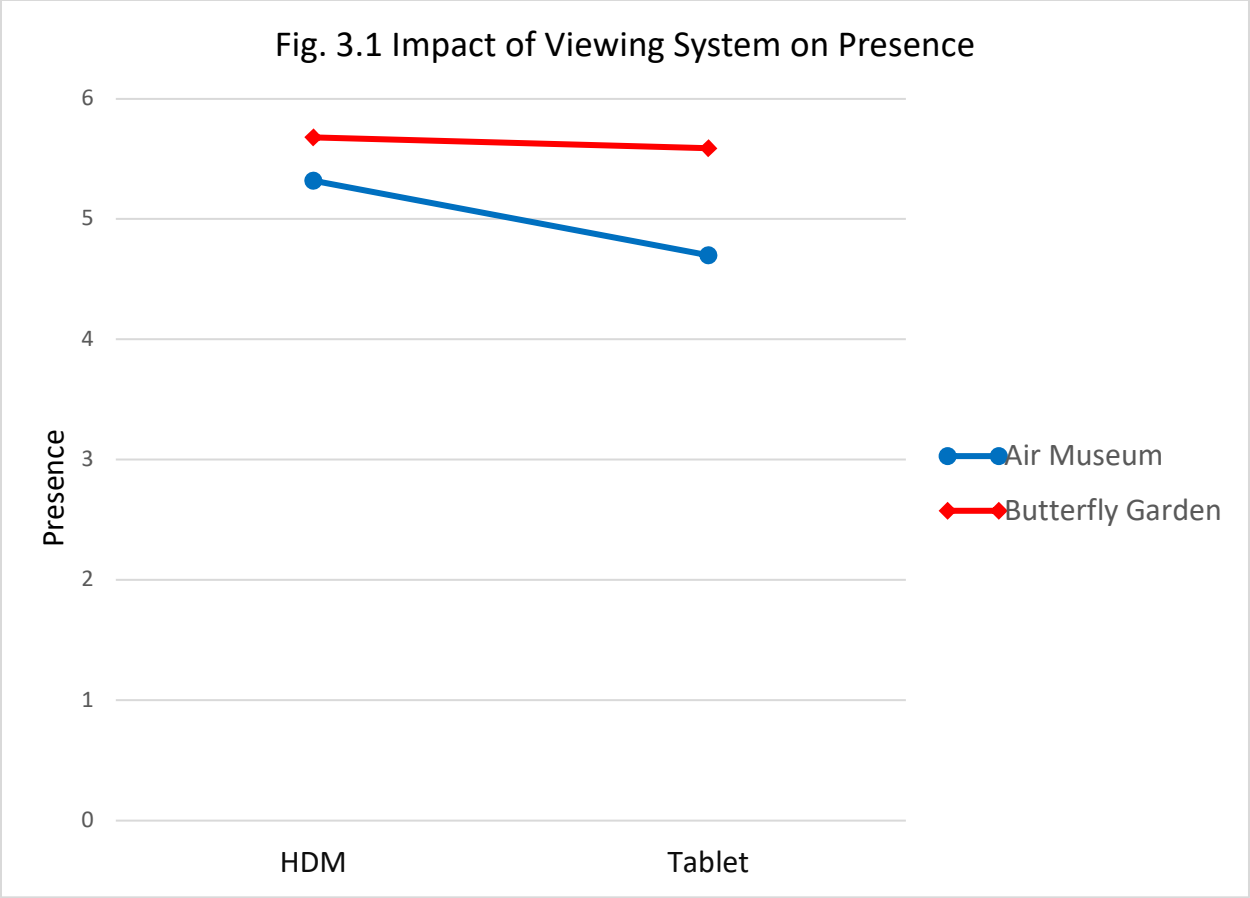
Results

The study examined how viewing systems affected a person's reaction to 360-degree travel videos. There were nine hypotheses to test: presence, immersion, novelty, coolness, interaction, activity, responsiveness, telepresence, and credibility. Because this was an exploratory study, the alpha level was set at .10.

H1 predicted that viewers will feel a greater sense of presence while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 repeated measures ANOVA (location: air museum/butterfly garden) was conducted on presence, where viewing system was between-subjects and location was within-subjects. There was a significant main effect of viewing system on presence ($F(1, 50) = 3.69$, $p=.06$, $\eta_p^2 = .07$), such that participants who viewed the messages via the HMD reported greater presence ($M_{HMD} =5.16$, $SD = 0.75$) than participants who viewed messages via the tablet ($M_{tablet} = 4.74$, $SD = 0.83$). H1 was supported.

Further analyses show that there was no significant main effect of location on presence ($F(1, 50) = 0.145$, $p=.705$, $\eta_p^2 = .003$). Also, there was no significant interaction on presence ($F(1, 50) = 0.018$, $p=.894$, $\eta_p^2 < .001$).

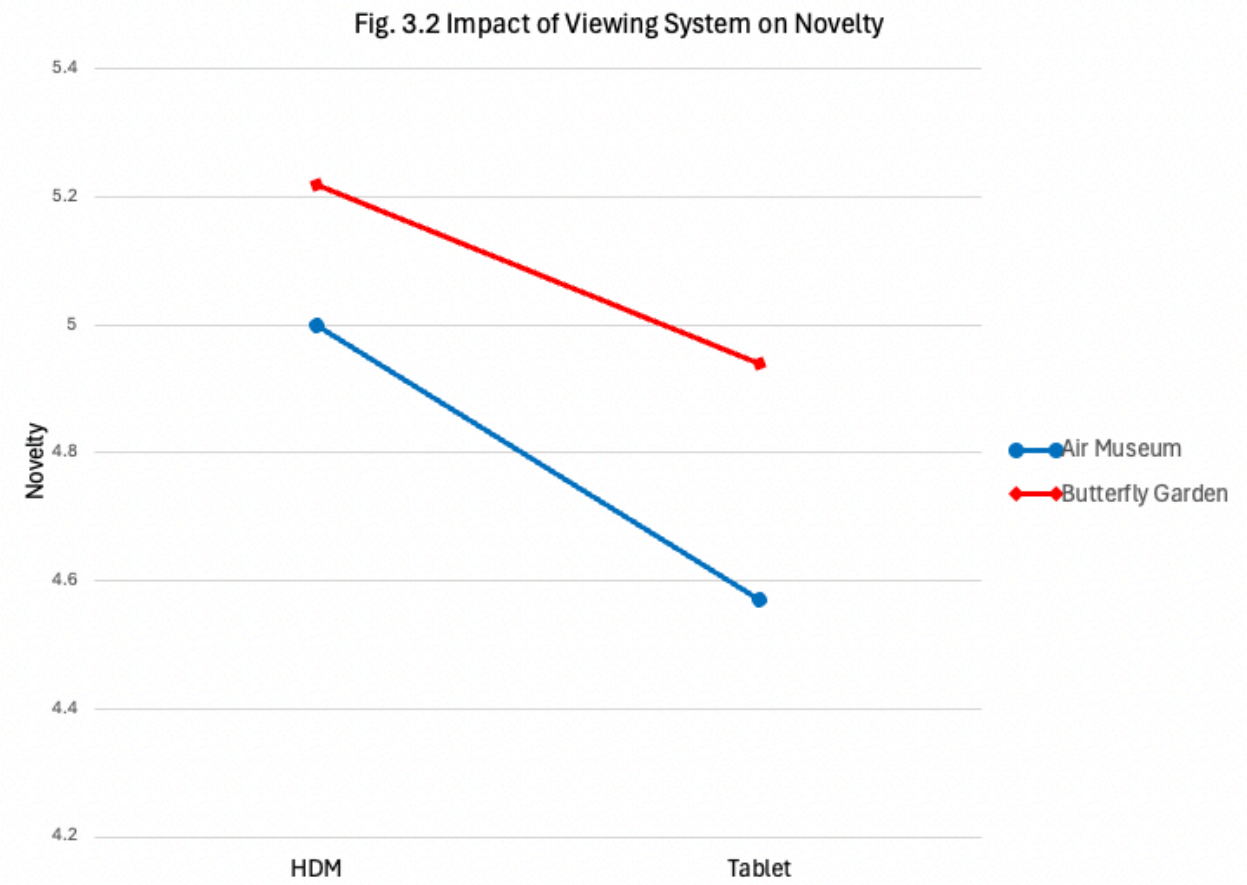
Figure 3.1 Impact of viewing system on presence



H2 predicted that viewers will feel a greater sense of immersion while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on immersion. There was no significant main effect on immersion by viewing system ($F(1, 50) = .43$, $p=.52$, $\eta_p^2 = .009$). There was also no significant main effect of location on immersion ($F(1, 50) = .001$, $p=.975$, $\eta_p^2 <.00$), nor was there a significant interaction on Immersion $F(1, 50) = 1.32$, $p=.26$, $\eta_p^2 = .03$). H2 was not supported.

H3 predicted that viewers will feel a greater sense of novelty while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on novelty. There was a close to significant main effect of viewing system on novelty ($F(1, 50) = 2.63$, $p=.111$, $\eta_p^2 = .05$), such that the HDM resulted in greater reported novelty ($M_{HMD} = 4.99$, $SD = 0.76$) than the tablet ($M_{tablet} = 4.57$, $SD = 1.01$).

Subsequent analysis also showed a significant main effect of location on novelty ($F(1, 50) = 2.28$, $p=.014$, $\eta_p^2 = .115$), such that the butterfly garden showed greater novelty ($M = 5.08$, $SD = 0.86$) than the air museum ($M = 4.57$, $SD = 0.91$). There interaction on novelty was not significant ($F(1, 50) = .395$, $p=.532$, $\eta_p^2 = .008$). With the significant effect of location present, and a Hypothesis that was looking at device only, a t-test was run just involving device and found that the effect of device on novelty was significant with ($t(50) = -1.703$, $p = .047$, $d = -.472$). This suggests that the H3 was supported. The main effect of viewing system on novelty is shown in Fig. 3.2.



H4 predicted that viewers will feel the device is cooler while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on coolness. There was no significant main effect on coolness by viewing system ($F(1, 50) = .59$, $p=.45$, $\eta_p^2 = .012$). There was also no significant main effect of location on coolness ($F(1, 50) = .932$, $p=.339$, η_p^2 .018), nor was there a significant interaction on Immersion $F(1, 50) = 1.50$, $p=.23$, $\eta_p^2 = .29$). H4 was not supported.

H5 predicted that viewers will feel the device has increased interaction while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on interaction. There was no significant

main effect on interaction by viewing system ($F(1, 50) = .570$, $p=.45$, $\eta_p^2 = .011$). There was also no significant main effect of location on interaction ($F(1, 50) = .044$, $p=.834$, $\eta_p^2 = .001$), nor was there a significant interaction on interaction ($F(1, 50) = 1.77$, $p=.189$, $\eta_p^2 = .034$). H5 was not supported.

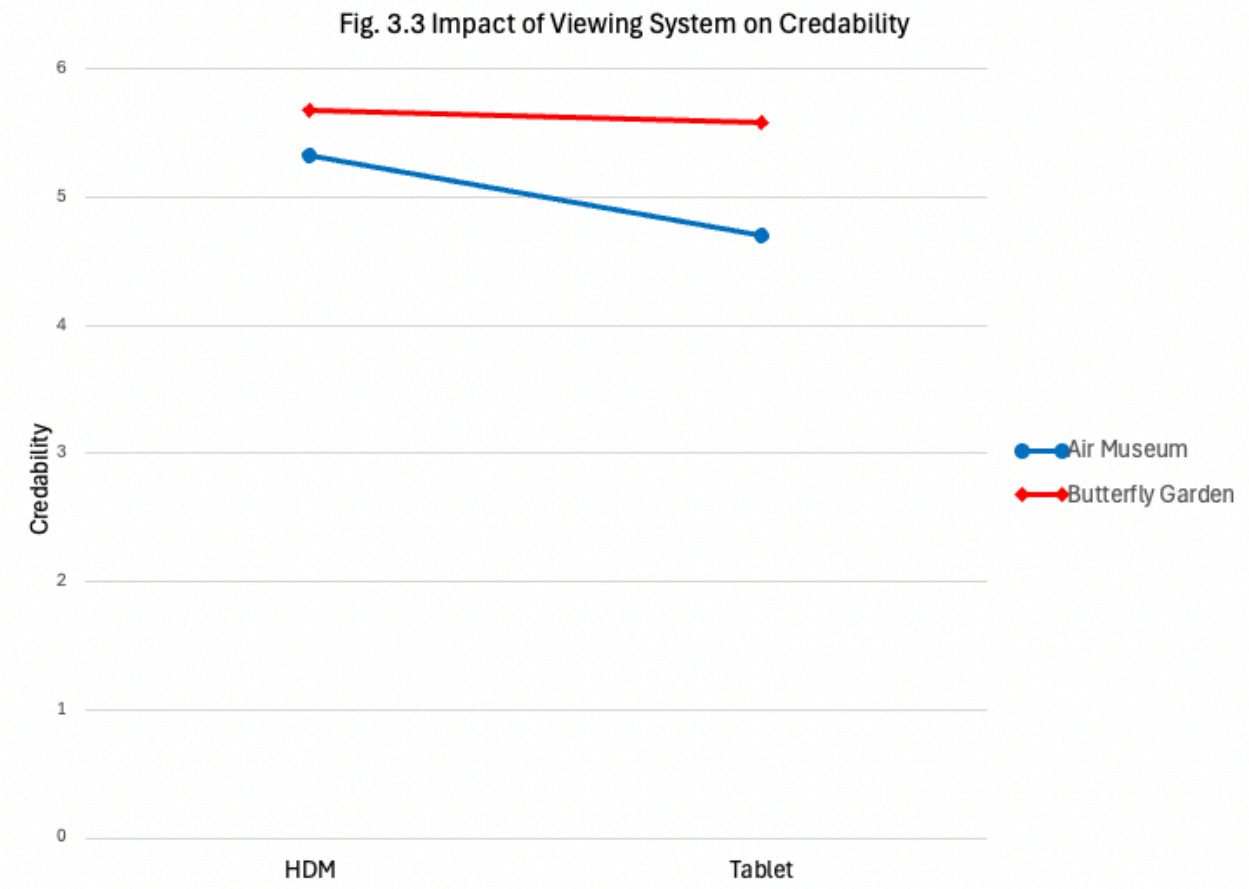
H6 predicted that viewers will feel a greater sense of activity while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on activity. There was no significant main effect on activity by viewing system ($F(1, 50) = .217$, $p=.644$, $\eta_p^2 = .004$). There was also no significant main effect of location on activity ($F(1, 50) = .75$, $p=.390$, $\eta_p^2 = .015$), nor was there a significant interaction on activity $F(1, 50) = .03$, $p=.86$, $\eta_p^2 = .001$). H6 was not supported.

H7 predicted that viewers will feel a greater sense of responsiveness while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on responsiveness. There was no significant main effect on responsiveness by viewing system ($F(1, 50) = .146$, $p=.704$, $\eta_p^2 = .003$). There was also no significant main effect of location on responsiveness ($F(1, 50) = .012$, $p=.912$, $\eta_p^2 < .001$), nor was there a significant interaction on responsiveness $F(1, 50) = .306$, $p=.582$, $\eta_p^2 = .006$). H7 was not supported.

H8 predicted that viewers will feel a greater sense of telepresence while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on telepresence. There was no significant main effect on telepresence by viewing system ($F(1, 50) = .144$, $p=.706$, $\eta_p^2 = .003$). There was also no significant main effect of location on telepresence ($F(1, 50) = .369$, $p=.546$, $\eta_p^2 = .007$),

nor was there a significant interaction on telepresence $F(1, 50) = .149$, $p=.701$, $\eta_p^2 = .003$). H6 was not supported.

H9 predicted that viewers will find the advertisement more credible based on device while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on credibility. There was close to a significant main effect on credibility by viewing system ($F(1, 50) = 1.936$, $p=.170$, $\eta_p^2 = .037$). There was a significant main effect of location on credibility ($F(1, 50) = 9.203$, $p=.004$, $\eta_p^2 = .155$), there was not a significant interaction on Immersion $F(1, 50) = 1.69$, $p=.200$, $\eta_p^2 = .033$). With the significant effect of location present, and a Hypothesis that was looking at device only, a t-test was run just involving device and found that the effect of device on credibility was significant with ($t(50) = -1.391$, $p = .085$, $d = -.386$). H9 was supported. The main effect of viewing system on credibility is shown in Fig. 3.3.



H10 predicted that viewers will feel a greater sense of discomfort while using the HMD compared to viewing media on a tablet. A 2 (viewing system: HMD/tablet) x 2 ANOVA (location: air museum/butterfly garden) was conducted on discomfort. There was no significant main effect on discomfort by viewing system ($F(1, 50) = .263$, $p=.611$, $\eta_p^2 = .005$). There was also no significant main effect of location on discomfort ($F(1, 50) = .000$, $p=1.00$, $\eta_p^2 = .000$), nor was there a significant interaction on discomfort $F(1, 50) = 2.296$, $p=.136$, $\eta_p^2 = .044$). H10 was not supported.

Chapter V

Discussion

This study determines how viewing systems alter consumer perceptions of travel advertising video and how that perception can carry over to the desire to visit a destination or destination image. This study predicted that participants using a head-mounted display would have a higher intention to visit the presented travel destination than those who viewed the travel advertisements on a tablet.

This study used the Main model to test the effectiveness of the advertising and determine how the technological affordances of the different viewing systems would lead to destination image intention to visit. This study looked at the modality and interactivity affordances, as well as the heuristics within them that may have impacted participants.

Of the heuristics that were observed, presence and novelty were found to be significant in their effect on viewers when comparing viewing systems. Credibility was found to have a close to significant effect based on viewing devices, with a p-value of .170. Had the study included more participants, there may have been a significant finding. The remaining heuristics—immersion, coolness, interaction, activity, responsiveness, telepresence, and discomfort—did not significantly vary as a function of the viewing devices.

The results for H1 indicate that the participants perceived a greater sense of presence when using the HMD than when using the tablet. In this study, presence was made up of physical presence and being there. Both of these categories returned significant results when

comparing the two viewing systems. For presence, there was no significant impact on the viewers based on location nor on the interaction between the viewing system and location. Previous research has suggested that travel consumers use memories of places they have been and experiences with similar places as a large part of the decision-making process. The higher sense of presence afforded by the HMD that triggers sensations of being at a destination could help consumers connect an advertisement to a higher sense of understanding the destination.

The results for H2 indicate that the participants did not feel a higher level of immersion when using HMDs over tablets. There was also no significance in the reported immersion between locations or the combination of location/viewing systems. One of the factors that may have contributed to this lack of distinction would be using the same methods of audio playback between both conditions. The larger tablet allowing a similar field of view to the headset, while using the same headphones that remove outside sound, may have led to the similar immersion sensation.

The results for H3 indicate that the participants felt a higher level of novelty when viewing the travel advertisements on the HMD than on the tablet. This result approached significance when comparing experiences of novelty based on the viewing device. Participants found the HMD to be more novel than the tablet; this could be due to the number of HMDs sold being much lower than a tablet and using a motion-controlled tablet may feel similar to people who use cell phones to watch videos. Participants with more experience and exposure to tablet or tablet-like experiences would find the HMD more novel.

Additionally, the effect of location on novelty was significant as well. Participants found the butterfly garden to be more novel than the airplane museum. The two locations may have

presented differently due to the way they were shot; the airplane museum had the camera placed in wide open spaces, with objects to look at further away, while the butterfly garden had the camera placed into small clearings with plants and flowers much closer to the viewer. The butterfly garden also had moving butterflies and water features, whereas the airplane museum was more static. These differences may have impacted the viewer's feelings of novelty.

The results for H4 indicate no difference in how participants viewed the coolness of the HMD compared to the tablet. There was also no main effect on coolness based on location. Both of the devices presented are now several generations old, and while consumers may not have the same less of experience with the viewing systems, they are aware of their existence. With part of coolness being usefulness and originality, it may explain how awareness of both systems' existence, coupled with their ability to perform the required functions well, leads to lower differences in feelings of coolness.

The results of H5 indicate no significant difference in the sensation of interaction when comparing HMDs to tablets. There was also no significant difference in interaction based on the location presented. As mentioned in H4, both viewing systems are several generations into production and, as such, should function well and be able to perform required tasks to high levels of satisfaction. As part of the interaction score was based on ease of use and ease of device navigation, two well-polished viewing systems may fail to differentiate based on these criteria.

The results of H6 indicate no significant difference in the sensation of activity between the HMD and Tablet viewing experience. There was also no significant difference between locations when measuring levels of activity. Activity measurements were based on the ability to navigate the viewing experience easily and to be able to observe the part of the video the viewer chose. Since both of these viewing systems use physical movement from the participant, as

opposed to a joystick or mouse, to control the area being viewed, the physical systems may share in their ability to facilitate natural navigation by a user.

The results of H7 found no significant difference in responsiveness when viewing 360-degree travel advertisements on the HMD vs the tablet. There was also no significant difference in responsiveness based on the location being viewed. Responsiveness was based on users' reaction to the ability of the viewing systems to match physical movement to changing camera angles in real time. The more significant the lag between motion and POV change would make it easier for a user to be mentally pulled out of the experience. Both viewing systems report strong responsiveness, with the tablet having a mean of 6.62 out of 7 and the HMD reporting a mean of 6.68 out of 7. These results made the viewing experience for most users almost seamless. With both systems operating well, a significant difference was not reported.

The results of H8 found no significant difference in the sense of telepresence reported by users when comparing HMD and tablet. There was also no significant difference in telepresence based on the location shown. Telepresence questions were geared to determine how much participants felt like they were really in the environment presented. As a 360-degree video viewing experience only accounts for one movement, the changing of the viewpoint, with no movement within the space and no ability to manipulate things with hands, the feeling of telepresence may have been limited in both experiences.

The results for H9 found a significant effect on credibility when viewing travel advertisements on an HMD instead of a tablet. There was also a significant effect on credibility when looking at location. There was no significant effect on credibility when looking at the intersection of location and viewing system. Credibility in this study was a combination of whether a viewer's opinion of the location changed and whether a person's interest in visiting the

location changed based on the viewing system used. The credibility judgement in the Main Model would present in this study as a devices ability to alter the destination image, or how a participant feels about a destination. This supports the idea of the study in determining the relationship between viewing systems and advertisement effectiveness. There was also a significant impact of location with the butterfly gardens in Dallas receiving higher scores for intention to visit than the airplane museum. The two locations used could be described as very different in that one is based on mechanical creations while the other is focused on nature. That experience and the difference in how each location was shot could help explain what locations may benefit the most from this type of advertising.

The results for H10 found that discomfort did not play a significant role for participants when comparing HMD to tablet. There was also no significant role in location determining a user's discomfort level. With some of the causes for discomfort being reaction time and lag, the better systems being used by this study seemed to have led to very little discomfort being reported. The means for discomfort on the tablet were 1.67 out of 7, and the HMD users reported 1.81 out of 7. Both of these devices seemed to offer very little discomfort.

The study found that presence made up of a physical presence and being there, as well as novelty, significantly impacted a participant's experience based on what viewing system they were using. These both reside in the mortality. The interactivity heuristics did not seem to have as significant an impact based on the device compared to the heuristics in the modality affordance. The modality heuristics focused on the user's perceptions of the experience, the realism afforded by the viewing system, the perceptions of the device itself, or the novelty of the viewing system. This comparison played on the physical differences between the systems and their ability to present an experience to the viewer as a measurement of presence. The novelty

results could be because the use of HMD is far less widespread than the use of tablets, so many users were less familiar with the HMD than the tablet. Participants reported a higher level of familiarity with tablets, with a mean of 3.35 out of 7, vs HMD, with a mean of 1.77 out of 7. While the interactivity heuristics seemed more focused on the user's experience with viewing systems, their functionality, and effectiveness, which may be better for comparing emerging technologies as opposed to existing technologies and their effectiveness. This study compared two well-developed systems, which may have made it more challenging for participants to differentiate the viewing experiences based on the system. Moving across the Main Model to credibility judgment, or as tested in this study, intention to visit and destination image, there was a significant result indicating that the HMD was more effective than the tablet as a viewing system for advertisements.

The Main Model is a very broad model with several affordances and heuristics that could benefit practitioners when evaluating technology's effect on media. If a practitioner is trying to determine technology effectiveness, they could easily decide what elements of their system are most important and then find the heuristics to match. If they were looking to check users' reactions to a user interface, the heuristics in the interactivity and navigability affordances would be a good starting point. If they were trying to determine the ability of a device to connect users to larger groups, looking at the agency's affordance could be helpful. The Main model is a good starting point for tailoring research to the questions a practitioner wants to answer.

Limitations and future research

One of the limitations of this study was the sample size; the original goal was 128 participants, and the study ended up running only 52. While a few of the dependent variables

were found to be significant, a larger body may have given better results for the others. Age and other demographics may have had an effect as well. Most respondents were undergraduate students between 18 and 22, with the mean being 24.14. This represents a younger generation with different levels of familiarity with technological systems than other generations. Another factor may be that many participants were enrolled at Gaylord College, studying one of several degrees that involved visual storytelling. Participants' familiarity with video and photography may give them a different view of the presented ads than the average person. There were several verbal comments about the shooting style and quality of the video that would come from someone learning filmmaking that the average person would not notice. Some commented about the higher levels of grain in the airplane museum being distracting, others commented on being able to spot the camera stand in the shots.

Another limitation may have been the videos themselves. The two destinations were very different, one being a historical museum of machinery, while the other was a nature space with vibrant plants and animals. Results showed higher novelty and credibility with the butterfly garden than the airplane museum. In addition to the different natures of the destinations, the two destination videos were also visually different. The airplane museum had large open spaces with planes and display pieces in a spread out area around the cameras position, but the butterfly garden had the camera placed in smaller areas with plants very close to the camera. There were also moving butterflies present in the butterfly garden, and several participants were observed following flying butterflies visually through the space and talking about being able to do that. The tighter, closer, higher movements from the butterfly garden may have contributed to the higher interest levels. In a future study, more similar destinations and shooting styles may help narrow that difference.

The first idea for future research might be to add more viewing systems. This experiment specifically looked at devices that may be set up at a trade show, but in reality, if a destination creates and releases 360-degree video ads to the public, a majority of viewers will be looking at the video using a cellphone. Previous research has included cell phone-based VR goggles, but few have used cell phones like the motion-controlled tablet, affording the viewer to move the device around with their hands to change the field of view. With a similar control system to the tablet, it may be interesting to see how the field of view and image quality affect users when comparing phones and tablets with both systems being operated in the same way, as opposed to using the phones with cardboard goggles.

Another idea for future research would be determining the best way to create 360-degree ads. Many advertisements found while doing research were similar to the ones recorded. A stationary 360-degree camera on a tripod allows a viewer to look in any direction at a static display. Several participants commented verbally that they did not know where to look and wondered if they missed something. Since traditional flat-screen ads employ multiple strategies to control sight lines for viewers and help direct them where the advertiser wants them to look, exploring the idea of directing attention in a 360-degree video might prove beneficial. I envision an experiment with three 360-degree advertisements for the same product with matching audio tracks, employing different methods of guiding a viewer's attention through the presented space and tracking the viewer's engagement.

Conclusion

This study aimed to determine if the technological affordances provided by a head-mounted display would give them an advantage over motion-controlled tablets when watching 360-degree travel videos. Would the HMDs trigger heuristics and lead to better credibility

judgments of intentions to visit the presented destinations? While many heuristics did not return a significant difference, presence and novelty did. Users found the HMD offered a higher level of presence and increased sensations of being there, and users also found the HMDs themselves to be more novel than tablets. Depending on the viewing system used, there was also a significant difference in destination image and intention to visit the destinations. If a travel destination was planning its booth for the travel conference circuit, they could see that the HMDs offer advantages over tablets for showcasing their destination. That difference may be even more significant in a loud, crowded show floor than in the small, quiet room where the testing occurred. As the prices of HMDs decrease and they become more mainstream and straightforward to use, they may be the correct choice.

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Appendixes

Appendix A

Questionnaires

Pre-test

Please read the following questions carefully and rate your answer by filling in the bubble.

Do you enjoy traveling?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very much

Have you ever been to the Tulsa Air and Space Museum

◯ Yes ◯ No

How Familiar are you with the Tulsa Air and Space Museum?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very familiar

Have you ever been to Discovery Butterfly Gardens in Dallas?

◯ Yes ◯ No

How familiar are you with the Discovery Butterfly Gardens?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very familiar

Do you want to visit the Tulsa Air and Space Museum?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very much

Do you want to visit the Discovery Butterfly Gardens?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very much

Have you watched 360-degree videos on a tablet, where you can move the tablet to see different parts of the video?

◯ Yes ◯ No

If so, did you enjoy watching 360-degree videos on a tablet?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very much

How regularly would you say you use a tablet to watch 360-degree videos?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Often

Have you watched 360-degree videos on head-mounted display, like a Quest, or Apple Vision Pro?

◯ Yes ◯ No

If so, did you enjoy using the head-mounted display to watch the 360-degree videos?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Very much

How regularly would you say you use a head-mounted display, like a Quest, or Apple Vision Pro?

Not at all ◯ ◯ ◯ ◯ ◯ ◯ ◯ Often

What is your Age?

_____

What is your ethnicity?

◯ White

◯ Hispanic or Latino

◯ Black or African American

◯ Native American or American Indian

◯ Asian

◯ Native Hawaiian or Other Pacific Islander

◯ Other

What is your classification in college?

◯ Freshman

◯ Sophomore

◯ Junior

◯ Senior

◯ Graduate Student

◯ Doctoral Student

◯ Not Currently enrolled in college courses.

What is your status?

◯ US Citizen

◯ Permanent Resident

◯ Other, non-US Citizen

◯ Do not wish to provide

Post-Test

Select the best response on the following questions.

The environment seemed real

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I had a sense of being in the environment rather than watching a video.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

My experience in the environment seemed consistent with my experiences in the real world.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

While in the environment, I had a sense of being there.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I was utterly captivated by the experience.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

Please rate your sense of being in the presented environment.

At the destination ○ ○ ○ ○ ○ ○ ○ Watching a video

To what extent were there times during the experience when the presented environment was the reality for you?

Not a real experience ○ ○ ○ ○ ○ ○ ○ Very real experience

Select the best response that addresses the question.

When you think back to the experience, do you think of the presented environment more as images you saw or somewhere you visited?

Images you saw ○ ○ ○ ○ ○ ○ ○ Somewhere you've been

During the experience, did you feel as though you were in the presented environment or somewhere else?

Presented Environment ○ ○ ○ ○ ○ ○ ○ Somewhere else

During the experience, did you think to yourself that you were actually in the presented environment?

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

How completely were your senses engaged?

Not Engaged ○ ○ ○ ○ ○ ○ ○ Fully Engaged

To what extent did you experience a sensation of reality?

Not realistic ○ ○ ○ ○ ○ ○ ○ Very realistic

To what extent did you feel mentally immersed in the experience?

Not Immersed ○ ○ ○ ○ ○ ○ ○ Fully immersed

Were you able to forget the device you used while watching the media?

Aware of the room ○ ○ ○ ○ ○ ○ ○ Not aware of the room

Where would you rate your aesthetic view of the item?

Ugly ○ ○ ○ ○ ○ ○ ○ Beautiful

Where would you rate the novelty of the item?

Typical ○ ○ ○ ○ ○ ○ ○ Unique

Where would you rate the complexity of the item?

Simple ○ ○ ○ ○ ○ ○ ○ Complex

Where would you rate your emotional response to the item?

Rational ○ ○ ○ ○ ○ ○ ○ Emotional

Where would you rate the trendiness of the item?

Traditional ○ ○ ○ ○ ○ ○ ○ Modern

Select the best answer to the following question.

This device is original.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

This device is distinct.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

This device looks great.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

This device makes people who use it different from other people.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

If I use this device, it would make me stand apart from others.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

The purpose of this device is to be helpful.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

The interaction with the environment felt natural.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

The device was difficult to use.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

You were able to navigate the device easily.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

You were able to see everything that was shown in the advertisement?

Missed most of it ○ ○ ○ ○ ○ ○ ○ Saw everything

You were able to position the viewer to observe what you wanted to see in the advertisement.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

Navigating the experience using the provided technology was easy.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

The device processed my input very quickly.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I was able to navigate the experience without any delay.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I was getting instantaneous feedback when I changed my viewing angle.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

The presented experience seemed real to me.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I had a sense of moving in the presented experience rather than operating a device.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

My experience in the presentation seemed consistent with my experiences in the real world.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I was completely captivated by the presented experience.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

The video changed your perception of the location.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I want to see the location in person.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I plan to visit the location in person.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I felt confused while wearing the headset/moving to view the video.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I felt disoriented while wearing the headset/moving to view the video.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

I felt discomfort (nausea, headache, eye strain, etc.) while wearing the headset/moving to view the video.

Disagree Strongly ○ ○ ○ ○ ○ ○ ○ Agree Strongly

Appendix B

IRB Approval Letter

The UNIVERSITY of OKLAHOMA

Institutional Review Board for the Protection of Human Subjects

Approval of Initial Submission – Exempt from IRB Review – AP01

Date: February 20, 2025 **IRB#:** 18239

Principal Investigator: Kevin Hahn

Approval Date: 02/19/2025

Exempt Category: 1, 2, & 3

Study Title: TECHNOLOGICAL AFFORDENCES IN 360-DEGREE VIDEO VIEWING APARATUS: A STUDY OF TECHNOLIGICALY TRIGGERED HEURISTICS AND THEIR EFFECT ON USER ATTITUDES ABOUT 360-DEGREE VIDEO TRAVEL ADVERTISMENTS

On behalf of the Institutional Review Board (IRB), I have reviewed the above-referenced research study and determined that it meets the criteria for exemption from IRB review. To view the documents approved for this submission, open this study from the *My Studies* option, go to *Submission History*, go to *Completed Submissions* tab and then click the *Details* icon.

As principal investigator of this research study, you are responsible to:

- Conduct the research study in a manner consistent with the requirements of the IRB and federal regulations 45 CFR 46.
- Request approval from the IRB prior to implementing any/all modifications as changes could affect the exempt status determination.
- Maintain accurate and complete study records for evaluation by the HRPP Quality Improvement Program and, if applicable, inspection by regulatory agencies and/or the study sponsor.
- Notify the IRB at the completion of the project.

If you have questions about this notification or using iRIS, contact the IRB @ 405-325-8110 or irb@ou.edu.

Cordially,

Aimee Franklin, Ph.D.
Chair, Institutional Review Board

Appendix C

Scripts for Videos

Title: Tulsa Air and Space Museum - Where STEM Takes Flight

Airplane Noise

Graphic of logo on screen for 5 seconds.

NARRATOR (V.O.):

At the Tulsa Air and Space Museum, our mission is to honor the past and inspire the future.

But we don't just tell stories… we let you experience them firsthand.

STEM learning takes flight with cutting-edge flight simulators…

Hands-on engineering challenges in real-world aerospace technology.

Ever dreamed of piloting a fighter jet?

Or docking a spacecraft?

At the Tulsa Air and Space Museum… you can.

Our programs bring science and engineering to life—

Inspiring the next generation of pilots, astronauts, and innovators.

Discover. Explore. Inspire.

The Tulsa Air and Space Museum—Where STEM takes flight.

Title: Texas Discovery Gardens – A Butterfly Paradise

Opens with Texas Discovery Garden Logo on screen for 5 seconds

NARRATOR (V.O.):

Step into a breathtaking paradise at the Texas Discovery Gardens Butterfly House and Insectarium.

Immerse yourself in a world of color, where hundreds of exotic butterflies dance around you…

Feel the magic as these delicate creatures float through the air creating an experience that's peaceful, fascinating, and unforgettable.

Towering tropical plants transport you to a lush jungle…

Where nature's beauty surrounds you at every turn.

Whether you're here to explore, capture the perfect photo, or simply relax in nature…

Every visit is an enchanting adventure.

Discover. Wonder. Escape.

Visit the Texas Discovery Gardens Butterfly House and Insectarium today.