

## **ABSTRACT**

WILSON, RAGAN LEE. Within-Headset Experiences and Individual Differences in Watching Sports Media with Virtual Reality (Under the direction of Dr. Christopher Mayhorn).

With the advent of different ways to watch sports media, it is important to explore and pinpoint differences not only between different modalities but also between video formats. This study explored possible differences in users' experiences of sports media content across 180-Degree and 2D media video formats within a virtual reality headset (HMD). Additionally, the effect of individual characteristics such as fanship and team disposition were also explored. Participants watched a piece of sports media footage either in a 180-Degree or 2D format before answering counterbalanced questions about their experiences of presence, suspense, enjoyment, team disposition, and fanship. When analyzed with a MANOVA, there was no difference between the two video format conditions. However, when analyzing fanship and team disposition using hierarchical regressions, results did show that the inclusion of fanship did help explain more variance in enjoyment scores when users watched sports media in virtual reality.

Within-Headset Experiences and Individual Differences in Watching Sports Media with Virtual Reality

by  
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## **BIOGRAPHY**

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## TABLE OF CONTENTS

LIST OF TABLES.....	iv
<b>Within-Headset Experiences and Individual Differences in Watching Sports Media.....</b>	<b>1</b>
Introduction.....	1
Literature Review.....	2
Problem Statement.....	2
Purpose of Research.....	3
Literature Review.....	4
Research Questions and Hypotheses .....	10
Method.....	12
Restatement of Major or General Hypothesis.....	12
Population, Participants, and Sampling .....	13
Setting.....	14
Research Design.....	14
Materials .....	14
Measurement.....	15
Procedure .....	17
Data Analysis .....	18
Results.....	19
Descriptive Statistics.....	19
Group Differences.....	21
Research Question 1 .....	21
Correlations between Components.....	22
Research Question 2 .....	23
Research Question 3 .....	24
Research Question 4 .....	25
Discussion.....	26
General Discussion.....	26
Limitations.....	27
Future Directions .....	29
References.....	31

**LIST OF TABLES**

Table 1	Descriptive Statistics of Participants Spread Across Both Experimental Conditions.....	19-20
Table 2	Correlations between Experiential and User Variables.....	22-23

## INTRODUCTION

When fans and non-fans decide to watch a sporting event, they now have a variety of viewing options available to them. These possible options have only increased as developments in entertainment and other technology have allowed for a variety of different video experiences (Wilson, Ferreri, & Mayhorn, in press). This now includes experiences beyond the constraints of 2D screens as companies have put some emphasis on displaying sports media on virtual reality and other types of newer technology as a way of enticing new viewership (Wilson et al., in press). Virtual reality has existed in some form for several decades now, most notably with the father of VR, Morton Heilig, and both of his inventions: the Telesphere Mask and the Sensorama (Bown, White, & Boopalan, 2017; Carlson, 2007). However, it was only with the introduction of the Oculus Rift and other commercial headsets including the HTC Vive and Samsung Gear that everyday people were able to access virtual reality experiences (Miah, Fenton, & Chadwick, 2020). This newer, commercial access has led to a variety of consumer-facing pleasurable experiences including games and media playing, above and beyond previous instructional applications (Bown et al., 2017). These include specifically sports experiences, which now have their own applications on virtual reality headsets (Wilson et al., in press). For example, before it was acquired by Apple and subsequently shut down in 2020 (Hall, 2020), the company NextVR was producing media watching experiences in collaboration with the National Basketball Association (NBA) and National Hockey League (NHL) along with a list of other entertainment venues. However, although sports media is present in virtual reality, its actual presentation within virtual reality can take a wide variety of forms. The differences between those forms regarding sports media remains little understood and little studied in comparison to other presentations of sports media (Wilson et al., in press). Therefore, the purpose of this research is

to support further understanding of these different display types by investigating differences in sports media viewing experiences.

## LITERATURE REVIEW

### Problem Statement

As of 2020, out of twenty-three applications labelled as video watching software within the Oculus Quest store, at least nine different applications have some form of sports media content on them. These applications include but are not limited to ESPN (ESPN, 2019), Red Bull TV (Red Bull, 2019), and MLB VR (MLB, 2020). So, at least on this one platform, what this means is that over one third of their media applications have some form of sports media content associated with it. This makes sports media a sizable chunk of content that could be viewed within virtual reality.

However, as mentioned previously, these apps are inconsistent when it comes to presentation of their sports media video. Although the apps mentioned above tend to be more consistent about using similar video presentations (ESPN, 2019; MLB, 2020; Red Bull, 2019), there are at least three different types of presentation of sports media that are possible across these media applications. These different types of media presentation include 2D video on a blank or computerized background (ESPN, 2019), 180-Degree video (Strange, 2017), and 360-Degree video (REWIND, 2018). Out of these types, currently 2D video seems to be the more popular option, being present in more programs such as ESPN (ESPN, 2019) and YouTube VR (Google LLC, 2019). However, all three of these media types have been found in at least one of the applications available in virtual reality up to 2021.

This variation can be a source of strength for sports media presentation within virtual reality, providing a possible way to entice users with new ways to watch the media that they

love. However, to utilize it effectively there needs to be more understanding as to what different presentation types can bring to users' experience watching sports media. Additionally, more understanding about what characterizes and differentiates each presentation type can help media companies decide which experiences to invest in and make available.

Currently, there is a lack of understanding of these media presentation differences specifically regarding the user experience of watching sports media in virtual reality (Kim & Ko, 2019; Wilson & Mayhorn, 2020). By labelling sports media viewing within virtual reality as virtual reality spectatorship (VRS) (Kim & Ko, 2019), research is exploring new ideas. From the limited previous body of research, there are differences in presence, suspense, enjoyment, and flow when users are watching sports media clips in virtual reality versus watching it on a 2D monitor (Kim & Ko, 2019; Wilson & Mayhorn, 2020). Although establishing differences like this is important, there also needs to be more emphasis on different presentation types within virtual reality for VRS. Without knowing what characterizes these displays and how different they are from each other, both developers and researchers still have a reduced ability to iterate and improve user experiences.

### **Purpose of Research**

Although different sports media viewing applications exist within virtual reality headsets as shown in the previous example with the Oculus Quest store, they are inconsistent with their presentation of sports media and that could lead to different experiences in presence, suspense, and enjoyment. Additionally, although team disposition and fanship have been previously considered to be important in 2D sports media literature (Cummins, 2009; Kim, Cheong, & Kim, 2016; Peterson & Raney, 2008), these variables have not been fully considered within virtual reality spectatorship (VRS). Therefore, the purpose of this research is to not only explore further



the differences between different ways of presenting sports media within virtual reality, but also to explore two important individual characteristics and what they could add to these experiences.

## **Literature Review**

### *Knowledge Base*

Some key terminology has been mentioned, but it would be beneficial to further define this terminology as well as some terms used within previous literature, including previous sports media research. Therefore, this section will be split into two categories: technical and experimental. Within technical terminology, it is important to understand not only what virtual reality (VR) is in the commercial product sense, but also how different media presentations are displayed, including 2D, 180-Degree, and 360-Degree. Following that, a few key experimental terms will be defined, including experiential variables like presence, suspense, and enjoyment as well as the user characteristics of fanship and team disposition.

### *Technical Terminology*

There are currently several ways to present different media content, including sports media, within a virtual reality's head mounted display (HMD). To describe the technology as well as the different ways to display media, there are very specific terms that need to be understood starting first with the hardware. For those unfamiliar with the technology, virtual reality headsets display media in a way that encapsulates the viewer, blocking out the outside world. These headsets vary wildly in their sophistication, as they can be as advanced as the Oculus Quest and be independent from a connection to a PC (Facebook Technologies, 2021) or as basic as a smart phone put into a Google Cardboard frame (Google LLC, n.d).

Beyond hardware, there are plenty of different ways to view video across many different applications, as previously stated. For example, within video apps such as YouTube VR, some

clips consist of fully 360-Degree recordings around the viewer (Google LLC, 2019). These 360-Degree videos allow the viewer to not only see what is happening in front of them, but also around them via specialized cameras that capture every angle around where it is placed (REWIND, 2018). Another variation on this that falls in between traditional 2D and 360-Degree presentation is the 180-Degree presentation. What this presentation type does is cut the visible field of the 360-Degree video in half, making a presentation type that is both not as all-encompassing as 360-Degree but also larger than traditional 2D displays within virtual reality (Strange, 2017). Lastly, the more traditional 2D display within virtual reality is very similar to how it appears in real life. The only difference is that it is projected onto a virtual 2D screen instead of a physical monitor in apps such as Red Bull TV (Red Bull, 2019), which plays video on a backdrop of the computerized Oculus ‘home’ environment.

As a basic overview of the different ways to present media within virtual reality, this apparent variation in presentation is the reason why research into only one way to present media is useful but does not provide the full picture when it comes to the experimental concepts introduced in the next section.

### *Experiential Terminology*

Experimental terminology includes concepts such as presence, suspense, and enjoyment. Presence is conceptualized according to the model that Lessiter et al. (2001), developed while creating the ITC Sense of Presence Inventory. This conceptualization of presence focused on four factors that go into an overall sense of presence while experiencing media, including spatial presence, engagement, ecological validity, and negative effects (Lessiter et al., 2001). While ‘being there’ includes the four subcategories of presence listed above, they all contribute to the concept of overall presence in different ways. Spatial presence covers being ‘there’ in a spatial

sense while looking at a piece of media (Lessiter et al., 2001). Next, Engagement involves how engaged a person feels while experiencing media (Lessiter et al., 2001). Additionally, ecological validity and negative effects are measures of how real the experience feels and physiological negative side effects, respectively (Lessiter et al., 2001). Suspense and Enjoyment are a bit more easily broken down and defined, as they are whole constructs by themselves. Suspense is defined as the fearful effect of wondering what will happen during the course of watching an experience, especially to a favored character or team (Knobloch-Westerwick et al., 2009; Kim et al., 2016). Likewise, enjoyment can be defined as the pleasure from watching an experience itself (Gan, Tuggle, Mitrook, Coussement, & Zillmann, 1997; Kim, Cheong, & Kim, 2016; Peterson & Raney, 2008).

In addition to these initial experiential variables, user characteristics should be considered. Beyond typical demographics such as age, sex, etc. there is also fanship and team disposition. Fanship describes how much someone is a fan of something, such as a sports team or a hobby (Reysen and Branscombe, 2010). A person's feeling towards a particular sports team, such as a collegiate or professional team, is team disposition (Peterson & Raney, 2008).

### *Empirical Research*

This section focuses on three parts that are involved in investigating screen size within virtual reality and user outcomes of presence, suspense, and enjoyment. The first section will give an overview of current research involving presence, suspense, and enjoyment within sports media viewing and relevant theories that connect these concepts together. Secondly, previous research is examined both within and outside of sports media viewing to explore how different presentations of media translate into different user experiences. The third section will tie in

relevant individual characteristics to this research, describing how fanship and team disposition relate to varying degrees of presence, suspense, and enjoyment.

### *The Relationship of Presence, Suspense, and Enjoyment*

Although not found in Wilson & Mayhorn (2020), other previous sports media research has found that there is a relationship between presence, suspense, and enjoyment while viewing sports media footage (Kim, Cheong, & Kim, 2016; Peterson & Raney, 2008). The idea, as described by Kim et al. (2016), is that these variables interact with one another and may include other variables (such as game attractiveness). The common model is that more presence leads to higher suspense, and that higher suspense leads to more enjoyment in a cascading effect (Kim et al., 2016; Peterson & Raney, 2008). The current research manipulates the presence variable with different technology and media presentation types to determine how that influences individual ratings of suspense and enjoyment.

### *Truly a Different Experience?*

By definition, virtual reality is a very presence-filled experience for users. In a literature review of technology and presence, Cummings and Bailenson (2016) found that certain characteristics inherent to virtual reality tended to evoke more presence. These included the features of headtracking and a larger field of view that can sometimes translate into more presence in users' experiences. This mirrors research looking at markedly different experiences of sports media such as Kim et al. (2016) and Wilson & Mayhorn (2020) that have found differences due to technology presentation factors. Thus, further research needs to be conducted on similar yet possibly different experiences within virtual reality headsets that might influence presence to influence suspense and enjoyment.

Potential differences between 180-Degree and 2D experiences could result in two particular patterns: they could be different experiences similarly to 360-Degree and 2D as found in Wilson & Mayhorn (2020), or they could follow previous research into different 2D sizes of screens. What Wilson & Mayhorn (2020) found was that, when a virtual reality experience was compared to a 2D screen outside of virtual reality, there were marked differences in presence, suspense, and enjoyment even if the model itself did not follow previous research from Kim et al. (2016). If this current research follows that path, then there should be differences between these two media presentation types within virtual reality headsets because they are different experiences with their own characteristics similar to what Kim et al. (2016) found when they compared home and theater presentations of a longer FIFA sports match on presence, suspense, game attractiveness, and enjoyment.

However, another possibility is that users do not consider these experiences within virtual reality headsets to be two different experiences. Given this pattern, results might conform to previous research with screen size in 2D screens where screen size has been shown to impact presence and suspense but only to a certain extent (Lombard, Ditton, Grabe, & Reich, 1997; Lombard, Reich, Grabe, Bracken & Ditton, 2000; Reeves, Lang, Kim & Tatar, 1999; Rigby, Brumby, Gould, & Cox, 2016).

Generally, larger screen sizes could potentially lead to more intense experiences of actions that align with engagement and presence (Lombard et al., 1997; Lombard et al., 2000) across at least some genres (Lombard et al., 1997). However, more recent research into immersion, instead of presence, has found an interesting possible boundary to this idea where screen size may not matter as much (Rigby et al., 2016). In Rigby et al. (2016)'s investigation of screen size and immersion, a diminishing return on screen size was identified where immersion

differences in experiences of screen size were less apparent as the overall size of compared screen increased. Although immersion is not presence, what is notable is that there is overlap with definitions between Rigby et al. (2016)'s definition of immersion as developed by Brown and Cairns (2004) and Lessiter et al. (2001)'s definition of presence through both of their uses of engagement.

Along with influencing engagement in immersion, larger screen sizes could also be related to higher levels of arousal during media exposure in reaction to the media content in the screen (Reeves et al., 1999). Although not necessarily the same as suspense, arousal has frequently been used as a proxy for suspense (e.g., Cummins, Keene, & Nutting, 2012) such that larger televisions could potentially lead to more suspenseful user experiences. However, beyond presence and arousal, what is interesting is that screen size does not seem to matter as much when it comes to enjoyment of the experience (Lombard et al., 1997; Lombard et al., 2000).

Previous research has not explored differences between presence, suspense, and enjoyment within headsets for sports media experiences across a range of different presentation types. If user experience varies by presentation type, the 180-Degree and 2D experiences within the headset should be markedly different with different levels of presence, suspense, and enjoyment. By contrast, if user experience follows 2D screen size research, there might be more complicated differences, if any, between the two experiences in presence, suspense, and enjoyment (Lombard et al., 1997; Lombard et al., 2000; Rigby et al., 2016, Reeves, et al., 1999).

#### *Fanship, Team Disposition, and User Experience*

Along with technological variables, user characteristics need to also be considered during sports media presentation research in VRS. Two characteristics that this study focuses on, fanship and team disposition, have been considered important in previous sports media research

(Cummins, 2009, Kim et al., 2016; Peterson & Raney, 2008) as they too, along with technological variables, can help shape users' experiences of sports media.

Fanship can enhance and change experiences of sports media as shown in studies from Cummins (2009) and Cummins, Gong, and Kim (2016). To summarize the findings of this type of research, which relied on comparisons between people who were non-sports fans and sports fans, people who watch media that they are fans of tend to have better experiences (Cummins, 2009) or pay attention to different items within sports broadcasts such as particular statistics (Cummins et al. 2016).

The other characteristic, team disposition, could also potentially enhance experiences with sports media according to theories such as affective disposition theory, which theorizes that experiences of media are enhanced for viewers if liked characters succeed (Raney, 2017). For this reason, team disposition, which has also been called affective disposition, has also been examined in previous studies about experiences of sports media (i.e., Peterson & Raney, 2008).

Although these two characteristics have been previously considered in sports media research, their presence is still new in sports media studies that utilize virtual reality. Thus, fanship and team disposition need to be considered in how they interact with the experience, namely presence, suspense, and enjoyment.

### **Research Questions and Hypotheses**

Given the previous literature reviewed earlier, the current study served to further the investigation of virtual reality spectatorship in sports media. While past VRS research has found that there are differences between watching sports media in virtual reality versus on a monitor (Kim & Ko, 2019; Wilson & Mayhorn, 2020), these differences have not been explored as much.

Also unclear is the perceived differences in experiences of VRS within the headset with variation in media formats.

Additionally, to tie it more closely with previous sports media research and give more insight as to how user variables interact with experiences, this study will be considering fanship and team disposition. These variables, which are almost a mainstay in previous sports media research (Cummins, 2009; Cummins et al. 2016; Kim et al. 2016; Peterson & Raney, 2008), have not been considered as much within the limited amount of VRS research.

The goal of the current research is to explore what variations in experiences with VRS can happen within a headset with varying video formats, but it also ties closely to previous sports media research by exploring individual characteristics within a virtual reality setting. The research questions below were generated to address those points.

**RQ1:** Are there differences in presence, suspense, and enjoyment between 180-Degree (HMD) and 2D (HMD) video?

**Hypothesis 1:**

**H0:** For presence, suspense, and enjoyment, the 180-Degree (HMD) video condition will be the same as 2D (HMD) video condition.

**H1:** The 180-Degree (HMD) video condition will rate higher in presence, suspense, and enjoyment than the 2D (HMD) condition.

**RQ2:** Does including fanship within a model of presence, suspense, and enjoyment explain more variance in scores?

**Hypothesis 2:**

**H0:** A model that includes fanship will not explain more of the variance in presence, suspense, and enjoyment scores than a model that does not include fanship.



**H1:** A model that includes fanship will explain more of the variance in presence, suspense, and enjoyment scores than a model that does not include fanship.

**RQ3:** Does including team disposition within a model of presence, suspense, and enjoyment explain more variance in scores?

**Hypothesis 3:**

**H0:** A model that includes team disposition will not explain more of the variance in presence, suspense, and enjoyment than a model that does not include team disposition.

**H1:** A model that includes team disposition will explain more of the variance in presence, suspense, and enjoyment than a model that does not include team disposition.

**RQ4:** Does including both fanship and team disposition within a model of presence, suspense, and enjoyment explain more variance in scores?

**Hypothesis 4:**

**H0:** A model that includes both fanship and team disposition will not explain more of the variance in presence, suspense, and enjoyment than a model that does not include both.

**H1:** A model that includes both fanship and team disposition will explain more of the variance in presence, suspense, and enjoyment than a model that does not include both.

## **METHOD**

### **Restatement of Major or General Hypothesis**

The purpose of this study is to examine if and what differences there could be between 2D and 180-Degree presentations of sports media within virtual reality HMDs. The previous studies in this line of research have found that there are differences between 2D video presented externally (via a monitor) and 360-Degree presentations of sports media even in small clips (e.g., around 5 minutes) (Wilson & Mayhorn, 2019; Wilson & Mayhorn, 2020). With this study, we

explore this further by comparing similar presentation types (180-Degree and 2D within an HMD) to determine if there are difference when all media conditions are presented in virtual reality.

Additionally, in this study we are examining the potential importance of fanship and team disposition, which have been previously considered in other research as important user characteristics when looking at sports media presentations (Cummins, 2009; Cummins et al. 2016; Kim et al. 2016; Peterson & Raney, 2008). This study does not only examine the presentation of sports media, but also the users who watch sports media and how their characteristics could influence their experience.

### **Population, Participants, and Sampling**

The objective of the study is to examine the differences between types of sports media presentation within virtual reality. In order to do this, short clips of both types of media (180-Degree and 2D) were presented via YouTubeVR.

YouTubeVR (Google LLC, 2019) is a program present on many different virtual reality platforms that allows the user to see a wide range of different presentations of media in a virtual reality headset. This allows the presentation of the same type of clip in two different modalities, 180-Degree and 2D. Similar to the description in the introduction, the 180-Degree videos within YouTube VR were displayed in front of the user with a black backdrop behind them. With the other type of media, 2D videos were projected onto a rectangle in front of the user in a gray-black void, similar to seeing a video on a television or other type of 2D screen (Google LLC, 2019). Participants did not know that there were two different versions of the same clip on the platform as they were randomly assigned to one condition.

Based on G\*Power calculations as well as consideration of how many people currently own a virtual reality headset that can run YouTube VR, a convenience online sample of 234

participants who were not minors were gathered from the online survey panel Prolific (Prolific, 2014). These individuals either were born or resided in the United States and owned some form of virtual reality headset that could play YouTubeVR. Headsets that could not support the YouTube VR app were not allowed for this study. Participants who completed the study earned a payment of \$5.

### **Setting**

This study was conducted remotely outside of the lab, so participants used their own virtual reality headset in a location of their choice such that they accessed all of the online study materials through their own devices. They accessed their assigned clip through YouTube VR (Google, 2019), and they completed survey materials via Qualtrics (Qualtrics, 2005) on their desktop or laptop computer.

### **Research Design**

This study design utilized a completely randomized design (CRD) that varied by video presentation type (i.e., 180-Degree vs 2D). The independent variable (video clip presentation) was manipulated in a between subjects fashion. Dependent measures collected included six variables including presence components: spatial presence, engagement, ecological validity, and negative effects. The two others were suspense, and enjoyment. Additionally, user characteristics such as team disposition and fanship were measured. Each participant was assigned to one condition, either watching the video in 180-Degree presentation or in 2D presentation, and their counterbalanced survey responses were compared.

### **Materials**

The materials for this study included two approximately five-minute video clips recorded during a North Carolina State University (NCSU) versus University of North Carolina at Chapel

Hill (UNC-CH) women's volleyball game. This video, taken from the far side of the court, shows a segment of the game where both sides scored and exchanged points, with NCSU winning at the end. The video, captured using an Insta360 Pro (Insta360, 2017), was originally part of a larger, 40-minute segment that was cut down to facilitate a better remote study experience for the participants. For the 180-Degree video, the 360-Degree video field of view was cut in half in front of the viewer similar to a typical 180-Degree video (Strange, 2017), and to create the 2D video a portion was cut out of a section of that 180-Degree video. For both video conditions, a computerized scoreboard was placed at the bottom of the video so viewers could keep track of the score during video viewing. Both videos had metadata that told YouTube VR how to play them, and they were tested through the YouTube VR (Google LLC, 2019) app on the Oculus Quest 2 headset (Facebook Technologies, 2020).

## **Measurement**

Measurements for this study focused on participants' reactions to the overall experience of watching the sports media footage (Experiential) as well as the characteristics of the users (User Characteristics).

### *Experiential*

The dependent variables included in this study were presence, suspense, and enjoyment, and they were all self-reported by participants. Additionally, the surveys included attentional check questions.

*Presence.* The construct of presence was based on Lessiter et al. (2001)'s work where measures of spatial presence, engagement, ecological validity, and negative effects were collected using the ITC Sense of Presence Inventory with 44 overall items. Four sub scores were generated for the presence factors. The survey was split into two parts where participants rated their experiences of watching the video using anchors 1 (Strongly Disagree) to 5 (Strongly

Agree). In addition, an optional qualitative open-ended response section asked users to add any additional thoughts they had about the experience. Reliability of the questions from each subscale were calculated using Cronbach's Alpha: spatial presence  $\alpha = .95$ , engagement  $\alpha = .93$ , negative effect  $\alpha = .86$ , and ecological validity  $\alpha = .77$ .

*Suspense.* Participants gave their own self-reported ratings of suspense due to the remote nature of this research using a questionnaire developed by Oliver & Bartsch (2010). Three items queried self-reported suspense by asking them to rate their agreement/disagreement with statements about the nature of the video clip using anchors 1 (Strongly Disagree) to 7 (Strongly Agree). The overall set of items had a Cronbach's Alpha of  $\alpha = .90$ .

*Enjoyment.* Enjoyment was measured using a questionnaire developed by Gan et al. (1997) and adapted by Peterson and Raney (2008) for use in sports media research. Participants rated their agreement on seven statements about their enjoyment of the clip using anchors 0 (Not at all) to 10 (Extremely). The Cronbach's alpha for this measure was  $\alpha = .93$ .

*Attentional Check Metrics.* For attentional checks, participants completed multiple choice items where they had to identify what sport was played on the clip and which team won. A further attentional check item included a fill-in-the-blank response where people had to identify the teams that played the game. To ensure that people watched their assigned video, an additional question had them identify the video they watched (VK1VK1 for the 180-Degrees video and VK2VK2 for the 2D video, respectively).

#### *User Characteristics*

As additional variables, user characteristics of fanship and team disposition were also measured through self-report.

*Demographics.* Standard demographics items included age, sex, and occupation. Additional questions asked users about their previous experience with watching media and virtual reality and had them rate their experience on items related to those topics from beginner to expert.

*Fanship.* Fanship was measured using an instrument developed by Reysen and Branscombe (2010). Eleven items assessed sports media fanship where participants agreed/disagreed with statements about money spent and time spent watching such activities using anchors 1 (Very strongly disagree) to 9 (Very strongly agree). The Cronbach's alpha for the measure in this study was  $\alpha = .96$ .

*Team Disposition.* Team disposition questions were adapted from Peterson and Raney (2008) to assess each participants' feelings towards the teams in the video. To rate each team, participants completed two items where they rated statements about hoping a particular team would win and their general like of that team from 1 (Extremely Dislike/Hope to Lose) to 11 (Extremely Like/Hope to Win). Consistent with Peterson & Raney (2008), we discovered a high correlation between the two items per team ( $r = .71, p < .001$  for NCSU and  $r = .75, p < .001$  for UNC-CH) such that we averaged the two item scores into one team disposition score per team to be used in data analysis.

## **Procedure**

Participants were recruited through the Prolific panel (Prolific, 2014) based on their profiles that recorded them as being from the United States and owning a virtual reality headset. The interested participants signed a consent form where they, again, certified that they owned a virtual reality headset that could play the application YouTube VR (Google LLC, 2019).

Following consent, participants were randomly assigned to one of two groups (180-Degree or 2D

video) and sent a link with instructions to view the video as well as the attentional, presence, suspense, enjoyment, fanship and team disposition surveys. The duration of the study was approximately 30 minutes.

After clicking on the link, participants entered their Prolific ID and were provided directions on how to reach either the 180-Degree video or the 2D video through the YouTube VR (Google LLC, 2019) application by searching for the exact title of the video (VK1VK1 for the 180-Degree condition, VK2VK2 for the 2D condition). Once the video began, participants were not able to move forward until the time to watch the video, about five minutes, passed in real time. This was to prevent “fast forwarding” and, along with responses to the attentional questions, ensure that the video was watched. After approximately five minutes had passed, participants were allowed access to answer the surveys, starting out with the attentional questionnaire and the counterbalanced surveys for presence, suspense, enjoyment, team disposition, and fanship. Finally, participants completed the demographics survey at the end of the study and were debriefed via a form at the end with a completion code they could report back to Prolific to get their \$5 credit.

### **Data Analysis**

To evaluate the research questions and test the hypotheses, data from each participant was prepared such that individual items from the dependent variables were averaged to create a holistic score for each concept. All reverse-coded items were re-coded, and those re-coded values were incorporated into the averaging. The only items that were treated differently were the team disposition characteristics as described previously. In total there were six dependent variables and two user characteristic variables calculated: spatial presence, engagement, ecological validity, negative effects, suspense, enjoyment, team disposition, and fanship.

The descriptive statistics of all variables were examined by condition to verify the data's distribution. Mean, median, standard deviation, range, kurtosis, and skewness were included in the descriptive statistics, and additional histograms were graphed for each variable holistically and by condition. If the data were non-normal, potential transformations were considered prior to additional data analysis. Post-examination of data, a MANOVA was conducted to determine differences between 2D and 180-Degree VR presentation of sports media within virtual reality headsets. Additional hierarchical regression was performed to examine the potential relationship between user characteristics and each of the dependent experiential variables.

## RESULTS

### Descriptive Statistics

Table 1 illustrates the descriptive statistics of the main dependent variables. Overall, there were a total of 234 participants in the study, with 125 in the 180-Degree video condition and 109 in the 2D video condition. The average age of participants across both conditions was 30.03 (SD = 8.37) years old, and most of the participants were men (76.07%). When asked about previous experience with virtual reality, the sample was bimodal with a basic (43.16%) or intermediate (39.74%) experience.

**Table 1.** Descriptive Statistics of Participants Spread Across Both Experimental Conditions.

Baseline Characteristics	180-Degree Video		2D Video		All	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
N	125		109		234	
Sex (M)	98		80		178	
Sex (F)	27		27		54	
Age	30.37	8.85	29.64	7.80	30.03	8.37



**Table 1** (continued).

Experiential Variables						
Presence						
Spatial Presence	2.93	0.85	2.93	0.95	2.93	0.90
Engagement	3.23	0.80	3.19	0.89	3.21	0.84
Ecological Validity	3.59	0.79	3.58	0.76	3.59	0.77
Negative Effects	1.95	0.82	2.03	0.83	1.99	0.82
Suspense	3.55	1.57	3.55	1.70	3.55	1.62
Enjoyment	5.93	2.29	5.97	2.36	5.95	2.32
User Variables						
Fanship	4.53	2.21	4.65	2.18	4.59	2.19
NCSU Team Disposition	7.01	1.90	7.13	2.00	7.07	1.94
UNC-CH Team Disposition	6.42	1.77	6.11	2.02	6.27	1.90

In accordance with previous research and official guidelines, the presence questionnaire generated subscales for spatial presence, engagement, ecological validity, and negative effects. Participants rated statements about their experiences during and after viewing the short sports media clip. Scores ranged from 1, indicating low levels of that factor such as spatial presence, engagement, ecological validity, and negative effects, to 5 indicating high levels of a specific factor.

Suspense scores were averaged across three items taken from Oliver & Bartsch (2010) where participants rated statements about the suspense of the video clip from 1 (Strongly Disagree) to 5 (Strongly Agree). Averaged scores ranged from 1 to 7, with lower scores indicating lower levels of suspense and higher scores indicating higher levels of suspense.

The Enjoyment questionnaire was scored based on guidelines provided by Gan et al. (1997) and later adapted by Peterson and Raney (2008). Similar to the other questionnaires, participants rated their agreement to several statements about their enjoyment of the clip on a scale from 0 (Not at all) to 10 (Extremely). Averaged scores were 0 to 10, with lower scores indicating lower levels of enjoyment and higher scores indicating higher levels of enjoyment.

The Fanship questionnaire scores were calculated according to the guidelines set by Reysen and Branscombe (2010) where users rated their agreement with several statements about their fanship of sports media watching from lowest at 1 to highest at 9. Team disposition was calculated via averaging two highly correlated items from Peterson & Raney (2008), as mentioned previously.

### **Group Differences**

An additional series of Pearson Chi-square tests was performed to assess categorical group distribution differences within the two conditions for the following variables: sex, education, computer experience, how often participants played computer games, average weekly TV viewing, most watched television size, television production knowledge, previous use of stereoscopic 3D glasses, previous use of experimental virtual reality, knowledge about how 3D images are produced, and general knowledge of virtual reality. Overall, there were no group differences between these categorical variables in the presentation conditions.

### **Research Question 1**

To examine differences in presence, suspense, and enjoyment between 2D and 180-Degree videos viewed within virtual reality headsets, a MANOVA was conducted. The between-subjects groups were 180-Degree and 2D media presentation, and the dependent variables were presence (as measured by spatial presence, engagement, ecological validity, and negative

effects), suspense, and enjoyment. Results indicated that there were no significant differences in presence, suspense, and enjoyment between the two groups,  $F(1, 232) = 0.387, p = .89$ ; Pillai's Trace = 0.01. Therefore, the first hypothesis was not supported.

### Correlations between Components

Prior to the rest of the research questions being addressed about the added value of fanship and team disposition to the relationship between presence, suspense, and enjoyment, a standard Pearson correlation was conducted between all of the experiential and user behavior variables mentioned previously. The correlation matrix in Table 2 below shows the relationships between them. Overall, the variables that make up the variable of presence per Lessiter et al. (2001), tend to correlate the highest with each other, which is to be expected of components that are associated with one broader concept like presence. In addition, from previous findings like Kim et al. (2016), it is not surprising that most of these presence components correlated significantly with suspense and enjoyment, as their relationship has been elaborated in previous research (Kim et al., 2016; Peterson & Raney, 2008). No variable reached the threshold for multicollinearity set for this study (.90), although Spatial Presence and Engagement's relationship came close ( $r = .85, p < .001$ ). Because this threshold was not reached, multiple hierarchical regressions were conducted to examine the value of fanship and team disposition as additional variables within the presence, suspense, and enjoyment series of relationships within virtual reality-presented sports media.

**Table 2.** Correlations between Experiential and User Variables.

Variable	n	1	2	3	4	5	6	7	8	9
1. Spatial Presence	234	-								
2. Engagement	234	.85***	-							
3. Ecological Validity	234	.74***	.74***	-						

**Table 2** (continued).

4. Negative Affect	234	.04	.00	-.21***	-					
5. Suspense	234	.70***	.74***	.54***	.01	-				
6. Enjoyment	234	.69***	.79***	.60***	-.15*	.78***	-			
7. Fanship	234	.46***	.46***	.32***	-.02	.49***	.51***	-		
8. NCSU Team Disposition	234	.54***	.53***	.45***	.00	.57***	.54***	.36***	-	
9. UNC-CH Team Disposition	234	.32***	.32***	.35***	.14*	.27***	.33***	.11	.25***	-

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\*  $p < .05$ , \*\*  $p < .01$  \*\*\*  $p < .001$

### Research Question 2

To examine possible additional variance from including fanship and team disposition within the presence, suspense, and enjoyment experiences of 180-Degree and 2D videos within virtual reality headsets, a hierarchical regression was conducted with a base and an additional model. A hierarchical regression was conducted to determine whether including fanship would explain additional variance within the existing model that includes presence, suspense, and enjoyment in the 180-Degree and 2D viewing experience. Given the previous results that indicated no differences in presence, suspense, and enjoyment between viewing conditions, scores were collapsed across conditions.

Two sets of models were evaluated for the hypothesis. The base model included just presence variables and suspense as predictor variables for participant enjoyment. For this base model, the included variables did explain a significant amount of variance in participant enjoyment scores ( $R^2 = 0.73$ ,  $F(5,228) = 121.41$ ,  $p < .001$ ). To determine if fanship would enhance the model further, a revised model including the fanship variable was generated. The inclusion of fanship was related to a significant increase in variance in reported participant enjoyment ( $\Delta R^2 = 0.01$ ,  $F(1,227) = 8.66$ ,  $p = 0.004$ ). The fanship-enhanced model included the

value of fanship along with the previous predictor variables in explaining enjoyment. Therefore, the hypothesis was supported, as including fanship did significantly enhance the model.

### **Research Question 3**

To examine possible additional variance from including team disposition to the model including presence, suspense, and enjoyment, a multiple hierarchical regression was conducted. As previously described, data from both viewing conditions was collapsed in this analysis. For the base model, presence, suspense, and enjoyment were included, and for the added variance model, team disposition for both NCSU and UNC-CH was added.

Similarly to the last research question's analysis, there were two sets of models that were compared for the hypothesis, the base and the modified models. The base model included just presence variables and suspense as predictors for participant enjoyment. For this base model, the included variables did explain a significant amount of variance in participant enjoyment scores ( $R^2 = 0.73$ ,  $F(5,228) = 121.41$ ,  $p < .001$ ). For the modified models, team dispositions towards both teams were added separately to the base model and together such that NC State and University of North Carolina team dispositions were examined separately and together in revised models.

Starting with the NC State team disposition, a revised model including the NC State team disposition variable was generated alongside the base model. The inclusion of the NC State team disposition variable did not significantly increase the amount of variance explained in participant enjoyment scores ( $\Delta R^2 = .003$ ,  $F(1,227) = 2.94$ ,  $p = 0.09$ ). The same result was found when the UNC-CH team disposition variable was added to the model instead where no significant further variance in participant enjoyment scores was explained ( $\Delta R^2 = .003$ ,  $F(1,227) = 2.35$ ,  $p = 0.13$ ).

Lastly, both teams' team disposition variables were added to the model to examine their joint impact on the relationships between presence, suspense, and enjoyment. When these variables were examined together, there was not a significant increase in variance explained for participant enjoyment ( $\Delta R^2 = .01$ ,  $F(2,226) = 2.50$ ,  $p = 0.08$ ). Therefore, due to the lack of significant added variance, the third hypothesis was not supported.

#### **Research Question 4**

Lastly, a hierarchical regression was conducted to determine whether including both fanship and team disposition would explain additional variance within the base viewing model that includes presence, suspense, and enjoyment. Given the lack of differences in the viewing conditions, the scores of presence, suspense, and enjoyment were not separated by condition for analysis. For the base model, presence, suspense, and enjoyment were included similarly to previous research questions. The revised model was different from previous research questions, combining both fanship and team disposition from both teams (NCSU and UNC-CH).

The base model included just presence variables and suspense as predictor variables for participant enjoyment. Just like the base model in the other research questions, the included variables did explain a significant amount of variance in participant enjoyment scores ( $R^2 = 0.73$ ,  $F(5,228) = 121.41$ ,  $p < .001$ ). To determine the contributions of fanship and team disposition (including NCSU team disposition and UNC-CH team disposition), a revised model including all variables was generated. The inclusion of both fanship and team disposition variables was related to a significant increase in variance in participant enjoyment scores ( $\Delta R^2 = 0.02$ ,  $F(3,225) = 4.60$ ,  $p = 0.004$ ). Because significant variance was accounted for by the addition of fanship and team disposition, the fourth research hypothesis was supported.

## DISCUSSION

### General Discussion

Possible differences in viewing experience measured by presence, suspense, and enjoyment between 180-Degree video and 2D video were explored in this study. Additionally, the impact of fanship and team disposition was examined. Overall, out of the four research questions, only the second and the fourth were supported by the results. There were no differences between the two conditions in presence, suspense, and enjoyment between 180-Degree and 2D video conditions. Additionally, team disposition did not seem to explain the added variance in the relationships between presence, suspense, and enjoyment. However, the user characteristic of fanship was found to significantly increase the variance explained in enjoyment scores above and beyond a base model of presence, suspense, and enjoyment.

For explaining the lack of difference between the 180-Degree and 2D presentations of short sports media clips, possible explanations tie back to differences in screen size research as done by researchers such as Rigby et al. (2016). Presentation of 180-Degree and 2D media purely within the headset may be too similar to distinguish since the screens in both cases are big enough that differences do not matter. This would be an interesting tie back into previous screen size research (i.e., Rigby et al., 2016) instead of other sports media research comparing different presentation types such as Wilson & Mayhorn (2020).

Considering the additional value of fanship to a base model of presence, suspense, and enjoyment, fanship has been assessed an important factor in other research involving presence, suspense, and enjoyment (Cummins, 2009; Cummins, Gong, & Kim, 2016). Therefore, it would make sense that it would be impactful here, even though the media presentation here is different from previous studies (Wilson et al., in press).

To explain the lack of additional value of team disposition, this result does not align with previous literature on user experiences of sports media (Peterson & Raney, 2008). However, one thing to keep in mind was that the teams (local collegiate teams) and the sport used (women's volleyball) could have had a confounding impact on team disposition. For example, users may have a higher disposition towards NC State athletic teams but may not have as much care towards women's volleyball as with other sports such as football.

Overall, results from this study seem to align more with previous research into different screen sizes (such as Rigby et al., 2016) versus studies in sports media both within Wilson & Mayhorn (2020) as well as in comparison of experiences focused around 2D media (Kim et al., 2016). However, there were several limitations to this study, as mentioned in the next section that need to be taken into consideration when looking at these results.

### **Limitations**

There are several technical and other limitations to the execution of this study that should be considered when interpreting the results. The limitations below are separated into more technical limitations and methodological limitations.

#### *Technological Limitations*

Due to the impact of coronavirus 19 within the United States, this study was conducted entirely remotely. Although this allowed the study to continue and provided for a much wider subject pool, there were several issues with remote data collection. First, the video was uploaded online to a video sharing platform (YouTubeVR) (Google, 2019), and relied on users' own internet connections and equipment to have a stable, higher quality experience. According to qualitative feedback from the presence questionnaire, this was a problem for a few participants who noted that the video was lower quality and there were audio issues. Second, although all



users were required to use the YouTube VR app, which restricted the number of virtual reality headsets that could be used, there was still a wide range of headsets and setups (connected to PC or not) that could have been used by the participants. Such variations could have impacted the experience of watching the clip even beyond quality of internet streaming. Finally, clip length could have been a factor, as the clips were, similarly to Wilson & Mayhorn (2020) around five minutes long. While aligning with previous research in this series (Wilson & Mayhorn, 2020), the current content was primarily meant to be easier for participants to watch all the way through at home. However, there might be benefits to exploring longer whole-game sections in future, in-person research.

#### *Methodological Limitations*

In addition to technological limitations due to this study being conducted remotely as a result of the pandemic, there are additional limitations. Due to the remote nature of the study, everything experiential was self-reported by the participants, including measures of suspense. Although this worked for the previous version of this study (Wilson & Mayhorn, 2020) for differentiating suspense between different types of media presentation, user perceptions of suspense may not be sensitive enough to differentiate suspense between two very similar conditions presented in the same modality (virtual reality).

Finally, due to the short nature of the video clip and remote methodology, every single measure was presented post-task. While efforts were made to keep participants engaged and the experience fresh in their minds, there still could have been some effect if suspense, presence, or another one the variables was one of the last questionnaires answered versus the first one.

## **Future Directions**

Future directions for this study are considered with the mindset of post-coronavirus pandemic testing, which should resolve some of the issues presented above. They are detailed below both methodologically and technically.

### *Technological*

Future research should assert more control over the internet speed and headset type that are used to keep consistency when the stimuli are shown. In addition, there should be longer lengths of clips used, which is more easily done in a lab versus a non-moderated setting in places like the participant's apartment or other locations. Although some have been using a variety of short clips (Peterson & Raney, 2008), others have used whole games to study sports media (Kim et al., 2016). Including longer game clips within lab settings would increase generalizability and help this study have the best of both worlds with controlled settings and also a whole game experience more aligned with what participants would actually see.

### *Methodological*

For methodology, the largest change that future research should investigate is incorporating the physical sensation of arousal alongside participants' self-reported ratings of suspense. Arousal has previously been used in studies focused on sports media and has been shown to differentiate based upon the characteristics of clips shown such as camera angle (Cummins et al., 2012). Incorporating physiological measures of arousal to supplement self-reported suspense measurements would allow for a more nuanced examination of different media presentations and their effects on participants in a way that has not been examined previously.

Beyond that, other possible methodological changes would be to include more during-viewing measures to compare against post-viewing measures. Quick measurements of presence,

suspense, and enjoyment during longer periods of lull (such as commercial breaks) within sports media viewing could help not only examine post-viewing ratings of presence, suspense, and enjoyment, but also during-viewing experiences. That could allow for some interesting comparisons between the two ratings and allow not only examination of post-viewing experiences but also during-viewing experiences.

### *Conclusions*

Sports media viewing is still an area of technological advancement that needs to be examined not only through 2D presentation such as television but also virtual reality. Although the current study did not find differences between the two conditions on presence, suspense, and enjoyment, there was a series of relationships found that shows that users' perceptions of sports media viewing are affected by user characteristics such as fanship. More research should be conducted to examine differences between virtual reality sports media viewing and other ways of watching sports media to find ways that sports media can evolve to better serve customers within virtual reality. To do this, examinations of physiological effects such as arousal and within-game data gathering of presence, suspense, and enjoyment would allow questions such as what the differences between different presentation types are to be answered more comprehensively. As virtual reality evolves, it is important that no piece of media is left behind in terms of examination and development as customers come to virtual reality for all sorts of experiences. To keep the virtual reality ecosystem flourishing with the best forms of any type of media possible, future examinations into specific types of specialized media such as sports are important and need to continue into the future.

## REFERENCES

- Bown, J., White, E., & Boopalan, A. (2017). Looking for the ultimate display: A brief history of virtual reality. In *Boundaries of self and reality online* (pp. 239-259). Academic Press.
- Brown, E., & Cairns, P. (2004, April). A grounded investigation of game immersion. In *CHI'04 extended abstracts on Human factors in computing systems* (pp. 1297-1300).  
<https://doi.org/10.1145/985921.986048>
- Carlson, W. (2007). *A critical history of computer graphics and animation [lecture notes]*. Ohio State University. <https://design.osu.edu/carlson/history/lesson17.html>.
- Cummings, J. J., & Bailenson, J. N. (2016). How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. *Media Psychology, 19*(2), 272-309.
- Cummins, R. G. (2009). The effects of subjective camera and fanship on viewers' experience of presence and perception of play in sports telecasts. *Journal of Applied Communication Research, 37*(4), 374-396. <https://doi.org/10.1080/00909880903233192>
- Cummins, R. G., Gong, Z., & Kim, H. S. (2016). Individual differences in selective attention to information graphics in televised sports. *Communication & Sport, 4*(1), 102-120.  
<https://doi.org/10.1177/2167479513517491>
- Cummins, R. G., Keene, J. R., & Nutting, B. H. (2012). The impact of subjective camera in sports on arousal and enjoyment. *Mass Communication and Society, 15*(1), 74-97.  
<https://doi.org/10.1080/15205436.2011.558805>
- ESPN. (2019). ESPN (Version 1.0.2). [Computer application]  
<https://www.oculus.com/experiences/quest/2295552207136342/>
- Facebook Technologies. (2021). Quest 2 Virtual Reality Headset. [Apparatus and Software].  
<https://www.oculus.com/quest-2/>

- Gan, S-L., Tuggle, C. A., Mitrook, M. A., Coussement, S. H., & Zillmann, D. (1997). The thrill of a close game: Who enjoys it and who doesn't? *Journal of Sport and Social Issues*, 21(1), 53-64. <https://doi.org/10.1177/019372397021001004>
- Google LLC. (n.d). Google Cardboard. <https://arvr.google.com/cardboard/>
- Google LLC. (2019). YouTubeVR. (Version 1.34.25). [Computer application].  
<https://www.oculus.com/experiences/quest/2002317119880945/>
- Hall, Z. (2020, May 14). Exclusive: NextVR Acquired by Apple (Updated). 9To5Mac.  
<https://9to5mac.com/2020/05/14/apple-nextr-ar-headset/>
- Insta360. (2017). Insta360 Pro [Camera Hardware]. Retrieved from  
<https://www.insta360.com/product/insta360-pro>
- Kim, D., & Ko, Y. J. (2019). The impact of virtual reality (VR) technology on sport spectators' flow experience and satisfaction. *Computers in human behavior*, 93, 346-356.  
<https://doi.org/10.1016/j.chb.2018.12.040>
- Kim, K., Cheong, Y., & Kim, H. (2016). The influences of sports viewing conditions on enjoyment from watching televised sports: An analysis of the FIFA World Cup audiences in theater vs. home. *Journal of Broadcasting & Electronic Media*, 60(3), 389-409.  
<https://doi.org/10.1080/08838151.2016.1203320>
- Knobloch-Westerwick, S., David, P., Eastin, M. S., Tamborini, R., & Greenwood, D. (2009). Sports spectators' suspense: Affect and uncertainty in sports entertainment. *Journal of Communication*, 59(4), 750-767. <https://doi.org/10.1111/j.1460-2466.2009.01456.x>
- Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoperators & Virtual Environments*, 10(3), 282-297. <https://doi.org/10.1162/105474601300343612>

- Lombard, M., Ditton, T. B., Grabe, M. E., & Reich, R. D. (1997). The role of screen size in viewer responses to television fare. *Communication Reports*, 10(1), 95-106.  
<https://doi.org/10.1080/08934219709367663>
- Lombard, M., Reich, R. D., Grabe, M. E., Bracken, C. C., & Ditton, T. B. (2000). Presence and television. The role of screen size. *Human Communication Research*, 26(1), 75-98.  
<https://doi.org/10.1111/j.1468-2958.2000.tb00750.x>
- Miah, A., Fenton, A., & Chadwick, S. (2020). Virtual reality and sports: The rise of mixed, augmented, immersive, and esports experiences. In *21st Century Sports* (pp. 249-262). Springer, Cham. [https://doi.org/10.1007/978-3-030-50801-2\\_15](https://doi.org/10.1007/978-3-030-50801-2_15)
- MLB. (2020). MLB VR (Version 4.5.10.1). [Computer application].  
<https://www.oculus.com/experiences/quest/2873640696088444/>
- Oliver, M. B., & Bartsch, A. (2010). Appreciation as audience response: Exploring entertainment gratifications beyond hedonism. *Human Communication Research*, 36(1), 53-81.  
<https://doi.org/10.1111/j.1468-2958.2009.01368.x>
- Peterson, E. M., & Raney, A. A. (2008). Reconceptualizing and reexamining suspense as a predictor of mediated sports enjoyment. *Journal of Broadcasting & Electronic Media*, 52(4), 544-562. <https://doi.org/10.1080/08838150802437263>
- Prolific. (2014). Prolific (Version August 2021). [Computer application] <https://www.prolific.co>
- Qualtrics. (2005). Qualtrics (Version August 2021). [Computer application].  
<https://www.qualtrics.com>
- Raney, A. A. (2017). Affective disposition theory. *The International Encyclopedia of media effects*, 1-11.

- Red Bull. (2019). Red Bull TV (Version 1.0.5). [Computer application].  
<https://www.oculus.com/experiences/quest/2225300714196671/>
- Reeves, B., Lang, A., Kim, E. Y., & Tatar, D. (1999). The effects of screen size and message content on attention and arousal. *Media Psychology, 1*(1), 49-67.  
[https://doi.org/10.1207/s1532785xmep0101\\_4](https://doi.org/10.1207/s1532785xmep0101_4)
- REWIND. (2018). 360 Video Production. REWIND. <https://rewind.co/services/360-video-production/>
- Reysen, S., & Branscombe, N. R. (2010). Fanship and fandom: Comparisons between sport and non-sport fans. *Journal of Sport Behavior, 33*(2), 176.
- Rigby, J. M., Brumby, D. P., Cox, A. L., & Gould, S. J. (2016, September). Watching movies on netflix: investigating the effect of screen size on viewer immersion. In *Proceedings of the 18th international conference on human-computer interaction with mobile devices and services adjunct* (pp. 714-721). <https://doi.org/10.1145/2957265.2961843>
- Strange, A. (2017). YouTube's VR 180 and daydream cameras bring immersive video to traditional creators. Mashable. <https://mashable.com/article/youtube-daydream-vr-180>
- Wilson, R., Ferreri, N. & Mayhorn, C. B. (in press). Game on: Using virtual reality to explore the user experience in sports media. In M. M. Soares, F. Rebelo, & T. Ahram (Ed.). *Handbook of usability and user-experience (UX): Volume 2*. CRC Press.
- Wilson, R., & Mayhorn, C. B. (2019, November). Examining the role of video in sports media viewing. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*(Vol. 63, No. 1, pp. 1978-1982). Sage CA: Los Angeles, CA: SAGE Publications.

Wilson, R., & Mayhorn, C. B. (2020, December). On the Field: Examining differences in video format in sports media viewing. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 64, No. 1, pp. 781-785). Sage CA: Los Angeles, CA: SAGE Publications. <https://doi.org/10.1177/1071181320641181>