

Exploring Enjoyment of Cinematic Narratives in Virtual Reality: A Comparison Study



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Abstract - This study compares watching a film in a traditional theater setting to watching the same film in a virtual theater using a virtual reality (VR) head-mounted display (HMD). The study seeks to determine whether watching a film in a virtual theater is a comfortable experience that viewers can tolerate; and whether watching in VR produces similar feelings of identification, transportation, and enjoyment for the films as watching in a traditional theater. Using the Oculus Rift DK2 HMD and the Riftmax virtual theater software, participants watched either *Signs* or *Ferris Bueller's Day Off* in a virtual theater. Other participants watched the same films in a traditional theater setting, and independent comparisons were made. Results indicate that over 90% of the VR participants were able to watch the entire movie in the virtual theater, and feelings of identification, transportation, and enjoyment were quite similar between conditions. Differences found were attributable to the films' content, with an interaction between VR and theater conditions. Implications and future research are discussed.

Index Terms - Virtual Reality; Movies; Film; Identification; Transportation; Enjoyment.

I. INTRODUCTION

Film companies are becoming increasingly interested in applying virtual reality (VR) technology to the experience of movies. This is shown by recent uses of VR to promote films such as *Interstellar* (Alexander, 2014) and the second installment in the *Divergent* series, *Insurgent* (McNary, 2015). At the time of this writing, IMAX theaters have announced their intention to provide venues for virtual reality content (Vincent, 2016). However, such uses of VR in the film industry have been tentative and limited so far.

What has been implemented as a more accessible first step is the creating of virtual reality theater software (see Harding, 2016; "RiftMax Theater - WEARVR," n.d.). This software employs VR to place the viewer in a 3D virtual theater environment, where 2D audiovisual content is then presented on a virtual screen. Visually, the appearance is similar to the perspective one would experience in a real-world movie theater. Netflix and Hulu (Harding, 2016; Road to VR, 2015) present viewers with a living room style environment, as if they were seated on a couch in front of a big screen TV.

The question that we investigate is whether audiences experience shows and movies screened in a VR theater in a similar way as to how they experience them in a real-world viewing situation. The biggest question is whether a person can comfortably wear a VR HMD throughout an entire feature film presentation of 90 minutes or more.

II. THEORETICAL CONSIDERATIONS

2.1 Selective Exposure

Our first grounding principle is that of selective exposure (Bryant and Davies, 2006). Individual viewers/users of media self-select (for the most part) the media they consume. They do this through an unconscious cognitive process known as excitatory homeostasis (Bryant and Davies, 2006). In this process, individuals select media that is likely to change their affective state such that they will be able to achieve an optimal level of physiological and affective arousal. An under stimulated or bored person may choose exciting, arousing fare, and an overstimulated person may choose relaxing, calming media.

A related concept is that of intervention potential, which describes the potential of a mediated stimulus to engage a viewer/user and have an impact on their affective state (Bryant and Davies, 2006). When applied to the present study, however, intervention potential may be related to technical aspects of the medium in question. Would a film viewed in a virtual reality environment have more intervention potential than a film viewed in a traditional theater setting? According to past research, the answer may be yes; virtual reality experiences have been shown to be significantly more arousing than traditional viewing experiences (Calvert and Tan, 1994).

Additionally, VR experiences are more immersive than traditional viewing

experiences, because VR head-mounted displays (HMDs) "envelop the senses with computer generated stimuli" (Biocca and DeLaney, 1995 p. 57) to a degree that traditional viewing, even in a large-screen theater, simply cannot. VR HMDs are successful at immersing viewers in the sensory experience because they block real-world stimuli and submerge "the perceptual system of the user" (Biocca and DeLaney, 1995 p. 57).

Modern VR HMDs can provide captivating visuals that seem to exist in a 360 degree sphere within which the user is situated; and they can do this more effectively than any VR technology that has come before, at least according to some journalistic reports (e.g., Heffernan, 2014; Strong, 2015). This immersion results in the virtual world taking the primary place in the user's consciousness; it becomes the primary egocentric reference frame (PERF; Wirth et al., 2007). For this reason, a movie presented in a virtual theater should provide a viewing experience similar to a movie presented in a real theater. As such, it will be useful to make comparisons on variables that are typically linked with enjoyment of watching a movie in a traditional setting. These variables fall under the general concepts of flow and involvement with media.

2.2 Flow

Flow is a term that refers to, as Csikszentmihalyi puts it, "the result of pure involvement..." (1975, p. 42). It is also conceptualized as a state of concentration so focused that it amounts to absolute absorption in an activity (Csikszentmihalyi, 1990, 2014). People enter a state of flow when they lose awareness of themselves, and focus only on the activity at hand. However, simply characterizing flow as concentration or attention is misleading. Again, we point to the characterization of flow as involvement. Being involved in a narrative can lead to flow experiences. It is important to acknowledge that flow experiences are more easily achieved in activities in which the user has a direct, participatory influence. However,

television and movie watching provide enjoyable flow experiences as well (Csikszentmihalyi, 2014).

In his book, *Flicker: Your Brain on Movies*, Jeffrey Zacks (2015) states that movies evolved to take advantage of the brains we have and our tendency to want to respond even physically to images and sounds we experience in a film. This concept is linked to what cognitive psychologists (Chandrasekharan, Mazalek, Nitsche, Chen, and Ranjan, 2010) describe as a common coding of the brain that exists between an action and a cognitive representation of an action. The concept of common coding is linked to the “ideomotor principle” (Chandrasekharan et al., 2010; James, 1890; Zacks, 2015).

The ideomotor principle holds that when actions, whether they be actions of a live or mediated actor, are observed in an arousing situation, our minds and bodies prepare to imitate that action. The processes that occur in the brain are the same neurological and chemical processes that would occur if we were about to perform the action ourselves – a common coding pattern in the brain (Chandrasekharan et al., 2010). Therefore, even imagining movements (muscle actions) activates a person’s motor movements implicitly. This process guides how we perceive and imagine other movements and actions—even those of an actor in a movie.

Therefore, the ideomotor effect can be explained by a common coding in the brain that connects a person’s movement, observation of movements as perceptual thoughts, and imagining movements themselves as an implicit function of both motor and perceptual representations (Chandrasekharan et al., 2010). Upon observing an action, the human brain behaves as if the action were being replicated in the body, readying the viewer physiologically to perform the action. Zacks (2015) points out that this happens when we physically want to react to what we see in movies. This is the reason why people flinch when viewing a

film, and in some cases even subtly mimic actions one might see on the screen. Essentially, the mind simulates the observed action (Chandrasekharan et al., 2010).

This evidence indicates that the experience of viewing a film (whether it be in an actual theater or in a virtual theater) and observing characters’ actions on screen fires mirror neurons which are associated with the muscles responsible for carrying out that action (Chandrasekharan et al., 2010; Fadiga, Fogassi, Pavesi, and Rizzolatti, 1995; Oztop, Kawato, and Arbib, 2006). When observation is done by those that have much experience in the observed action (such as a professional athlete observing their sport on film or TV) there is strong activity in the premotor, parietal and posterior cortical regions of the brain (Chandrasekharan et al., 2010).

Zacks (2015) points out that when we watch characters take an action like picking up objects onscreen, both somatosensory cortex and motor cortex mapping occurs in the brain (p.37). Our minds and bodies react in such a way that we are drawn deeply into the events taking place on screen, thereby contributing to the experience of flow. When experiencing a movie, one enters a state where one can lose self-consciousness and become immersed in the actions of characters. Csikszentmihalyi (2014) suggests that feelings of an intrinsic motivation and enjoyment accompany a flow state. Thus, it is enjoyable to watch a movie whether it be in a real or virtual theater environment and the act of experiencing a movie has in it the motivation to want to enter into the story depicted on the screen.

Additional studies have confirmed the benefits of flow in other activities similar to movie going that are also not physically active. Such studies include research in a videogame player’s ability to enter flow state as well as the importance of flow in the enjoyment factor of playing on new gaming systems (Bowers, 2016; Seger and Potts, 2012; Shafer, Carbonara, and Popova, 2011). One of the most rewarding experiences of a flow state is the autotelic experience

(Csikszentmihalyi, 2014). This type of experience is where the activity is done for pure enjoyment rather than possible benefits from the outcome (Bowers, 2016; Csikszentmihalyi, 1990). This experience can also be linked to the act of viewing a film. As a result of this activity, the flow state itself is beneficial because it increases enjoyment, intrinsic reward, optimal performance, and enhances neurofeedback (Bowers, 2016).

2.3 Involvement

Involvement is an important concept to consider in relation to flow and the experience of passive narrative viewership. In terms of involvement, two dimensions seem most salient: identification, and transportation (Greenwood, 2008).

The concept of involvement as it relates to viewing a narrative carries the idea of being swept up in the story; and forming positive affective feelings toward the main characters (Moyer-Gusé, 2008). Involvement, which contributes to flow (Csikszentmihalyi, 2014), can be understood as "the interest with which viewers follow the events as they unfold in the story" (Moyer-Gusé, 2008 p. 409). Involvement is said to be composed of several dimensions: parasocial interaction (PSI), identification, wishful identification, liking, similarity, and transportation (Greenwood, 2008; Moyer-Gusé, 2008). Of these dimensions, two seem most salient for the present study, because they have been found to be important to the experience of viewing film narratives (Cohen, 2001; Hall and Bracken, 2011).

2.3.1 Identification

First, identification with characters is an important process in any media narrative experience. In the identification process, the viewer imagines himself or herself as the character and assumes their role. The viewer who is closely identifying with a character shares the character's feelings, shares their perspective, shares their goals, and even may lose awareness of themselves and become absorbed in the narrative (Cohen, 2001;

Moyer-Gusé, 2008), leading to flow (Csikszentmihalyi, 1975).

2.3.2 Transportation

Second, transportation seems to have particular relevance to discussions about entertainment in virtual reality. The idea of transportation is conceptually similar to the notion of absorption, also a component of flow (Csikszentmihalyi, 1990). The term transportation applies to the viewer's experience with the narrative as a whole (Moyer-Gusé, 2008). Transportation, on the other hand, is less about spatial awareness and has much more to do with emotional engagement with the media text. A viewer who is experiencing transportation will feel drawn in to a story; their attention is fully engaged and they "feel strong emotions about the story's characters and events, and they become less aware of physical surroundings" (Hall and Bracken, 2011, p. 92).

Identification and transportation have both been found to contribute to enjoyment of media experiences. Transportation theory (Green and Brock, 2000, 2002) makes a definitive link between transportation and enjoyment of entertaining fare. Identification with media characters is also an important contributor to enjoyment according to several studies (Klimmt, Hefner, and Vorderer, 2009; Klimmt, Hefner, Vorderer, Roth, and Blake, 2010).

2.4 Cybersickness

In addition to the psychological aspects of watching filmic and televised narratives, practical concerns are also of interest when considering watching show-length or feature-length content in VR. Comparing real-world theater and VR theater experiences presumes that audience members are viewing the same stimulus material and specifically, that they are viewing the complete feature film or TV program. Whereas it is reasonable to assume that most audience members are capable of watching an entire feature film in a theater without discomfort or distress; there is reason to suspect that this may not be the case for the VR viewing experience. Specifically, the

form factor (size, weight, straps, optics, and so on) of the VR head-mounted display (HMD), along with the likelihood of cybersickness for many viewers, introduces the potential of a fatigue factor sufficient to curtail the viewing experience. On the other hand, the virtual theater experience is decidedly sedate as compared to typical VR gaming experience, so it may be that far fewer virtual theater viewers will experience cybersickness.

2.5 Research Question and Hypotheses

Based on the referenced research on identification and transportation, we propose the following research question:

RQ1: How will participants react to watching a full-length feature film in a virtual theater as compared to watching in a real theater in terms of dropout rate?

We also predict that viewer's affective reactions to the film will be similar, and that the two conditions will not differ in a significant way. This hypothesis is informed by the research already cited by Biocca and Delaney (1995), as well as Wirth and colleagues (2007).

H1: Differences (if any) found between VR and non-VR viewers on the variables of transportation, identification and enjoyment will be negligible.

We will also investigate the following general hypotheses across conditions, in keeping with previous research on identification and transportation:

H2: Identification with the film characters will positively impact enjoyment of the films.

H3: Transportation will positively impact enjoyment of the films.

III. METHOD

3.1 Participants

Participants (n = 141) were recruited from Film and Digital Media and Communication

courses at a medium-sized research university in the southwestern United States. All subjects were required to read and sign an IRB-approved consent form, which detailed the content they would encounter in each film. They were allowed to opt out of the study at any time during their participation. Four participants in the VR viewing condition had technical difficulties with the virtual theater software, and have been dropped from the analysis, resulting in a final sample of n = 137.

Because of the availability of viewing space and other factors, the study was designed as a pseudo-experiment. Random assignment to condition was not possible for both conditions of this study. Participants were relegated to one of two conditions based on how they signed up for the study. The Theater condition (n = 75; 28 females, 47 males) was populated by students in two large introductory film courses. These film courses have a required screening session each week as a component of the class. This screening was an ideal place to show the study films in a theater setting. As stated, participants were not required to participate in the research; they could opt out of doing the questionnaire and still earn credit for their course by attending the screening. Participants answered an online questionnaire by opening a browser on their own electronic device and navigating to a link provided to them by the research assistant administering the study.

The VR condition (n = 62; 32 females, 30 males) was populated by students from other similar film or communication courses who signed up via email recruitment and an online scheduling tool. Participants in the VR condition were randomly assigned to watch one of the two stimulus films. They then filled out the online questionnaire on the browser of the computer they used to view the stimulus material. Each participant only watched one film, either *Signs* or *Ferris Bueller's Day Off*, in either the VR or theater condition.

3.2 Hardware and Software

Stimulus material in the VR condition was displayed using Riftmax VR movie viewing software on the Oculus Rift Development Kit 2. Specifications for the DK2 are provided in Table 1.

Riftmax provides a virtual movie theater in which participants can view whatever movie the server operator (in this case, the PI) chooses. Each participant chose an avatar from several predefined templates, and then, using that avatar, entered the theater environment. The virtual environment looks just like a movie theater one might find in the real world. The theater environment appears to surround the participant, who views it from a first-person perspective. If the participant looked down, they could see the virtual body of the avatar they chose. The films were converted to .avi files from Blu-Ray disc with MacX Video Converter Pro. The DivX 4 codec was used for compression. The bitrate after compression was variable between 3 and 6 Mbps. *Signs* was shown in Riftmax at its original 1.85:1 aspect ratio, while *Ferris Bueller's Day Off* was shown in its original 2.35:1 aspect ratio.

In the real theater condition, the auditorium held approximately 150 seats. Viewing was handled by a Panasonic PT-EZ770Z video projector with 6,500 lumens, 5,000:1 contrast ratio, video raster resolution (played back at 1920 x 1080p/24 movie mode from a Blu-Ray DVD player), a 19:10 Aspect Ratio (cropped to 16:9 for movie playback) and a Panasonic ET-ELW20 Zoom Lens (1:30: 1-1.70:1) projected at a 16' x 9' display on the screen. The distance from the screen to the front of the lens was 21 feet, the distance from the screen to the first row of chairs was 21 feet and the screen distance to the rear row of chairs was 48 feet.

3.3 Stimulus Material

Two films were selected from the aforementioned film courses' scheduled viewing list: *Signs* and *Ferris Bueller's Day Off*. *Signs* (PG-13) is a 2002 science fiction drama. The runtime for the movie was 1 hour and 46 minutes (106 minutes). The original

aspect ratio (AR) was 1.85:1, but was released as an anamorphic widescreen movie in a 2.35:1 AR. The movie was shot on film and transferred to Blu-ray DVD where it was processed using a MPEG-4 AVC codec at 24.48 Mbps and played back at a 1080/24p resolution using a Blu-ray DVD player to the projector (Blu-ray.com., 2017).

The following synopsis is from imdb.com (Shyamalan, 2002):

Preacher Graham Hess, played by Mel Gibson, has lost his faith in God after his wife dies in a brutal car accident. He along with his son and daughter and his brother Merrill moves into a farmhouse. Crop circles begin to appear in their cornfields, which Graham dismisses as mischief by miscreants. After hearing strange noises and watching news coverage on crop circles appearing all over the world, the family begins to suspect of extraterrestrial activities. Now they must stick together and believe, as a family to survive the ordeal and find a way to escape from the clutches of the alien invaders.

Ferris Bueller's Day Off (PG-13) is a 1986 comedy. The runtime for the movie was 1 hour and 43 minutes (103 minutes). The original aspect ratio (AR) was 2.39:1. The movie was shot on film and transferred to Blu-ray DVD where it was released cropped to a 2.35:1 aspect ratio, processed using a MPEG-4 AVC codec at 31.95 Mbps and played back at a 1080/24p resolution using a Blu-ray DVD player to the projector (Blu-ray.com., 2017a).

The following synopsis is from imdb.com (Hughes, 1986):

High school student Ferris Bueller wants a day off from school and he has developed an incredibly sophisticated plan to pull it off. He talks his friend Cameron into taking his father's prized Ferrari and with his girlfriend Sloane head into Chicago for the day. While they are taking in what the city has to offer, school Principal Ed Rooney is convinced that Ferris is, not for the first time, playing hooky

for the day and is hell bent to catch him out. Ferris has anticipated that, much to Rooney's chagrin.

3.4 Measures

Identification was measured using the identification scale developed by Cohen (2001). The scale is composed of ten items, which are designed to be adapted to the form of media necessary for the pertinent study. For example, the item "During viewing, I felt I could really get inside character X's head" can be easily adapted to refer to any character in any media presentation. Similarly, the item "While viewing program X, I felt as if I was part of the action" can be adapted to read: "While viewing the film, I felt as if I was part of the action". Identification was measured for each character independently. For the character of Graham from *Signs*, reliability was good (Cronbach's $\alpha = .80$). Reliability was similarly good for Ferris from *Ferris Bueller's Day Off* (Cronbach's $\alpha = .80$).

Transportation was measured using a modified version of the transportation questionnaire used by Green and Brock (2000). The original questionnaire was designed to measure transportation in narratives communicated via text. As such, it was modified to reflect an audio-visually mediated narrative experience. For example, the item "While I was reading the narrative, activity going on in the room around me was on my mind" was modified to read "While I was viewing the narrative, activity going on in the room around me was on my mind". By doing this, the integrity of the original scale was preserved while changing the target narrative from a written form to an audiovisual form. Reliability for the transportation scale was acceptable (Cronbach's $\alpha = .71$).

Enjoyment was measured using the scale employed by Shafer and Raney (2012). The 8-item scale has been verified in numerous studies on media enjoyment (e.g., Raney, 2002, 2005; Raney and Bryant, 2002). Reliability analysis indicated good internal

consistency in the present study as well (Cronbach's $\alpha = .90$).

IV. RESULTS

Linear regression and analysis of variance (ANOVA) procedures were used to analyze the research questions and hypotheses.

Research question 1 investigated the dropout rate in the study based on VR theater or traditional theater viewing condition. Out of 62 participants in the VR condition, only 6 (9.7%) reported needing to end their viewing session early for non-technical reasons. Note that those few who terminated their participation early because of technical difficulties were removed from the analysis. Fifty-six participants (90.3%) were able to watch the entire film in VR. Of the six who ended their viewing session early, two reported that they felt too sick to continue, and four reported that they could not wear the headset for the full length of the film. All six participants who dropped out early were women.

Hypothesis 1 predicted that any differences found between VR and non-VR viewers with regard to transportation, identification and enjoyment would be negligible. A two-way multivariate analysis of variance procedure indicated that, as predicted, there was no main effect of viewing condition on the variables. However, there was a significant main effect of film watched (Wilks' $\lambda = .750$, $F_{(3, 135)} = 15.03$, $p < .001$, $\eta^2_{\text{part}} = .25$). Table 2 details the differences between the films on each variable tested.

In terms of main effects for each variable, *Ferris Bueller's Day Off* scored significantly higher than *Signs* for identification, transportation, and enjoyment (See Table 2).

More importantly, however, there was a significant interaction of condition with film watched (Wilks' $\lambda = .885$, $F_{(3, 135)} = 5.83$, $p = .001$, $\eta^2_{\text{part}} = .12$), meaning that at least for some variables, viewer responses to each different film depended somewhat upon viewing condition (see Table 3).

In looking more closely at the results, there was no significant interaction of film and viewing condition on enjoyment. Enjoyment of the film did not depend on viewing condition; viewers simply enjoyed *Ferris Bueller's Day Off* more than *Signs*. A significant interaction was found for identification, however, such that levels of identification for each film were different depending upon viewing condition (see Figure 1).

In the VR condition, the two films did not significantly differ on identification. However, in the theater condition, viewers reported significantly higher levels of identification with *Ferris Bueller* (see Table 4).

A similar finding emerged for transportation. Transportation levels were not significantly different based on the film viewed in the VR condition. In the theater condition, viewers of *Ferris Bueller's Day Off* felt significantly more transported than viewers of *Signs* (see Figure 2). In light of these results, H1 is partially supported.

Hypotheses 2 and 3 predicted that, consistent with past findings, identification and transportation would positively impact enjoyment of the films regardless of condition. Both hypotheses were supported; a hierarchical regression analysis showed that both variables were significant, positive predictors of enjoyment of the films (see Table 5). Identification was a strong determinant of enjoyment $\beta = .55$, $t(139) = 7.71$, $p < .001$. Alone, the variable explained nearly 30% of the variance in enjoyment, $R^2_{\text{adj}} = .29$, $F(1, 139) = 59.42$, $p < .001$. Upon adding transportation in the second block of the analysis, the model improved. The model including both identification and transportation was able to explain nearly 36% of the variance in enjoyment: $R^2_{\text{adj}} = .36$, $F(1, 139) = 39.73$, $p < .001$.

V. DISCUSSION

The results of the present study show that, generally speaking, watching a movie in a virtual theater produces similar responses to watching in a real movie theater. Audiences responded to both *Ferris Bueller's Day Off* and *Signs* in emotionally similar ways, as shown by the results of H1 and H2. Consistent with predictions and findings from previous research (Green and Brock, 2000, 2002; Green, Brock, and Kaufman, 2004; Klimmt et al., 2009, 2010), enjoyment was positively and significantly impacted by identification and transportation (indicators of flow) across conditions.

Evidence showed initially that feeling present in a virtual theater has a small impact on overall enjoyment of the films when analyzed in isolation, but became insignificant when transportation and identification were considered. This means that within the virtual environment, being transported to the world of the narrative and being able to identify with the characters was far more important to enjoyment than the virtual setting.

The results produced upon investigation of our research questions suggest that, for most participants, watching a full-length film in a virtual theater is a relatively comfortable experience. The evidence also shows that watching films in a virtual theater is quite similar to watching in a real-life theater. First, the main effects of the analysis indicated that the conditions produced no significant differences in terms of identification, transportation, or enjoyment. This means that viewers experienced similar levels of identification with the characters, similar feelings of transportation, and similar levels of enjoyment no matter what condition they were in.

There were significant differences between the films, however. Across conditions, *Ferris Bueller's Day Off* scored higher on identification, transportation, and enjoyment. This is likely because of the nature of the films. *Signs* is a thriller; a scary, uneasy affective excursion featuring characters

haunted by their past emotional losses. It is not a happy or joyful film. *Ferris Bueller's Day Off*, on the other hand, is full of mischief, rebellion against despicable authority figures, playful banter, and hijinks. It is fun. Therefore, viewers, especially our college student viewers who are quite close to Ferris' own age, probably felt more transported and identified more deeply with Ferris than for Graham of *Signs* for these reasons. They simply enjoyed the comedy more than the thriller. This is quite understandable, but our results also produced evidence of an interaction effect.

There was something about watching at least one of the films in VR that was distinctly different from watching it in the traditional theater. The analysis showed that for VR viewers, transportation and identification levels were quite similar across the films. However, *Ferris Bueller's Day Off* was significantly higher than *Signs* in both identification and transportation when viewed in the traditional theater. In the VR condition, again, viewers scored similarly on all variables.

We would assert that there is an element of the film *Ferris Bueller's Day Off* that allows for the high levels of identification we see in the theater condition. That element is the breaking of the fourth wall. Breaking the fourth wall refers to a situation in which an actor in a film or television show looks directly at the camera with full acknowledgement of the audience sitting beyond its lens. This is referred to by Brown (2012) as direct address in cinema. Breaking the fourth wall is Ferris Bueller directly addresses the audience at many points throughout his film, essentially letting us in on his plans for the day. It has been suggested that protagonist narration and direct address of the audience increases identification and strengthens parasocial relationships with those characters (Auter, 1992; Nodelman, 1991). This certainly seems to be the relationship we have found here.

However, audience members did not find *Ferris Bueller's Day Off* higher in identification and transportation in the VR viewing condition. There may be two explanations for this finding. First, film watching is, in many, cases, a social activity (Maltby, Stokes, and Allen, 2007). Even if going to the cinema is not undertaken with a group of friends, there is nevertheless a group of other moviegoers there, making watching the film a communal experience. This is especially true of Indian cinema (Srinivas, 2002). In our theater viewing condition, this communal environment existed. In the VR environment, it did not. The absence of the community of viewers may have served to even out responses to both films in the VR condition, whereas the presence of the community of viewers may have heightened comedic responses to *Ferris Bueller's Day Off*. The phenomenon that occurs when watching comedy in a group is the reason many sitcoms use pre-recorded laugh tracks.

Second, it is possible that viewers in the VR condition felt separated from what was taking place in the film by the extra layer of technology between them and the filmed events. As lifelike, realistic, immersive and transporting the virtual theater may seem viewers were still aware that they were not physically located in the theater where the film was being exhibited. This may have produced a certain psychological disconnect that may have inhibited some of the responses that came through in the real theater. However, both of these possibilities are conjecture, and require further study to confirm.

An additional limitation of the study may be previous exposure to the films, which was not tested. Some participants may have been predisposed to like the film they watched, which may have influenced the results slightly.

Regardless of these possibilities, the final implication of our findings is that many people can watch a full-length feature film in a virtual theater with little to no negative

effects. This opens up possibilities for co-present viewing from distant locations, simulating a theater environment when a real theater may not be available, and the possibility of more interactive interactions around and through the medium of film. Future research should test this feature—social presence with others—and its impact on virtual theater experiences.

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Table 1: Technical Specifications for Oculus Rift DK2

Oculus DK-2	
Release Date	July 2014
Diagonal Field of View	100° (90° H) 3D
Display Technology	AMOLED (Samsung Note 3)
Display Panel Size	5.7"
Display Screen Resolution	1920 x 1080
Display Screen Resolution per eye	960 x 1080 (1.13:1)
Pixel Display (per inch & layout)	441 (Pentile)
Total Pixels per eye	1,036,800
Display Refresh Rate	60Hz, 72Hz, 75Hz
Tracking Sampling Rate	1000Hz (Adjacent Reality Tracker)
Tracking Technologies	3-axis gyroscope for sensing angular velocity, 3-axis magnetometer for sensing magnetic fields, 3-axis accelerometer for sensing all accelerations including gravitational
Head Tracking	6DOF Positional Tracking (based on combination of 3-axis rotational plus 3-axis positional) USB connection using Near Infrared CMOS sensor
Positional Tracking Refresh Rate	60Hz Near IR CMOS) (Yaw Range @ <360°)
Low Persistence	2 ms, 3ms, full
Latency	20-40ms (Real-time ms of motion-to-photon latency testing)
Wireless	No (tethered)
Inputs	HDMI 1.4b, DVI-D single link, USB 2.0+, Infrared (IR) LED camera synchronization

Table 2

Two - Way MANOVA Results

Variable	<i>Ferris Bueller's Day Off</i> M(SE)	<i>Signs</i> M(SE)	$F_{(1, 137)}$	Sig.	η^2_{part}
Identification	4.01 (.05)	3.74 (.06)	12.16	$p = .001$.08
Transportation	3.46 (.05)	3.19 (.06)	13.32	$p < .001$.09
Enjoyment	8.33 (.16)	6.74 (.18)	45.23	$p < .001$.25

Table 3

Interaction Effects of Film with Condition for Identification

Condition & Title	Identification Mean (SD)	$F_{(1,64)}$	Sig.
VR <i>Ferris Bueller's Day Off</i>	3.79 (.37)	.063	.802
VR <i>Signs</i>	3.82 (.37)		
		$F_{(1,73)}$	
Theater <i>Ferris Bueller's Day Off</i>	4.22 (.44)	32.66	<.001
Theater <i>Signs</i>	3.66 (.31)		

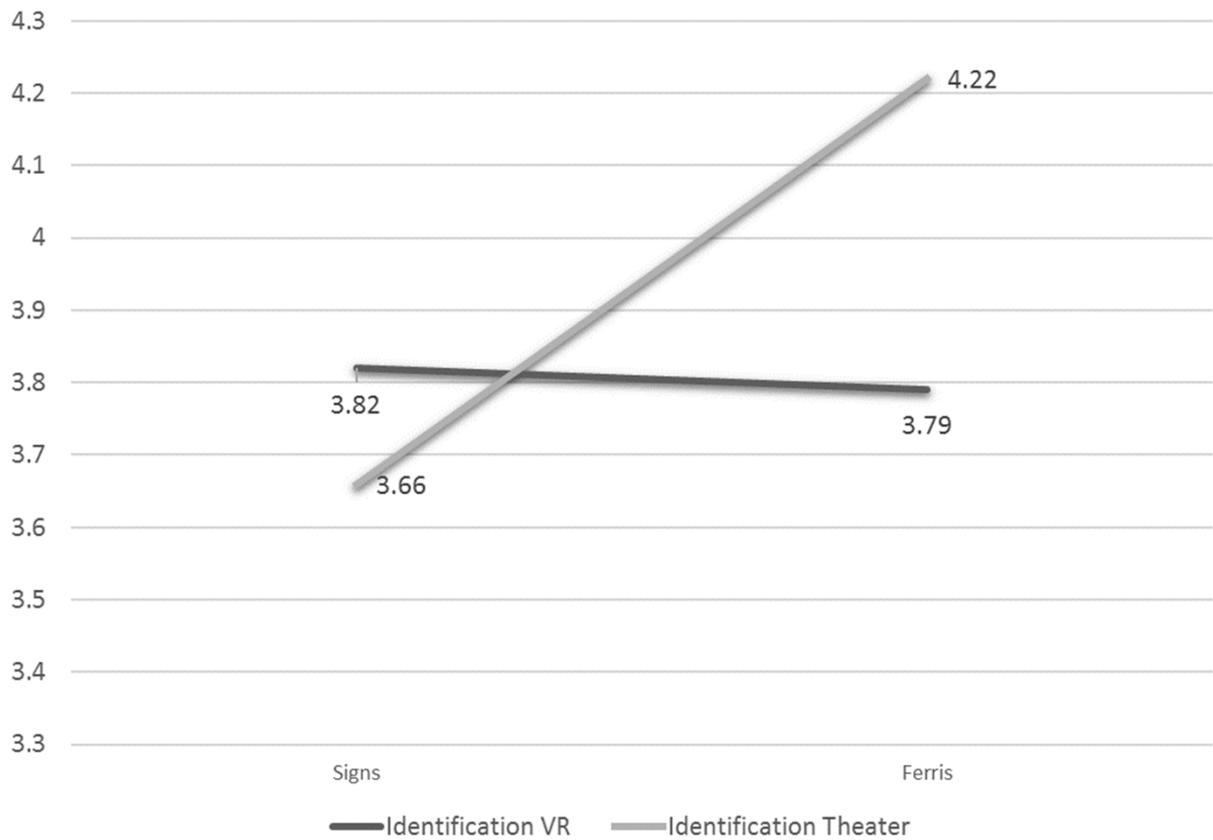


Figure 1. Interaction Effects of Film with Condition for Identification

Table 4

Interaction Effects of Film with Condition for Transportation

Condition & Title	Transportation Mean (SD)	$F_{(1,64)}$	Sig.
VR <i>Ferris Bueller's Day Off</i>	3.30 (.48)	.634	.429
VR <i>Signs</i>	3.20 (.49)		
$F_{(1,73)}$			
Theater <i>Ferris Bueller's Day Off</i>	3.62 (.36)	25.54	<.001
Theater <i>Signs</i>	3.18 (.36)		

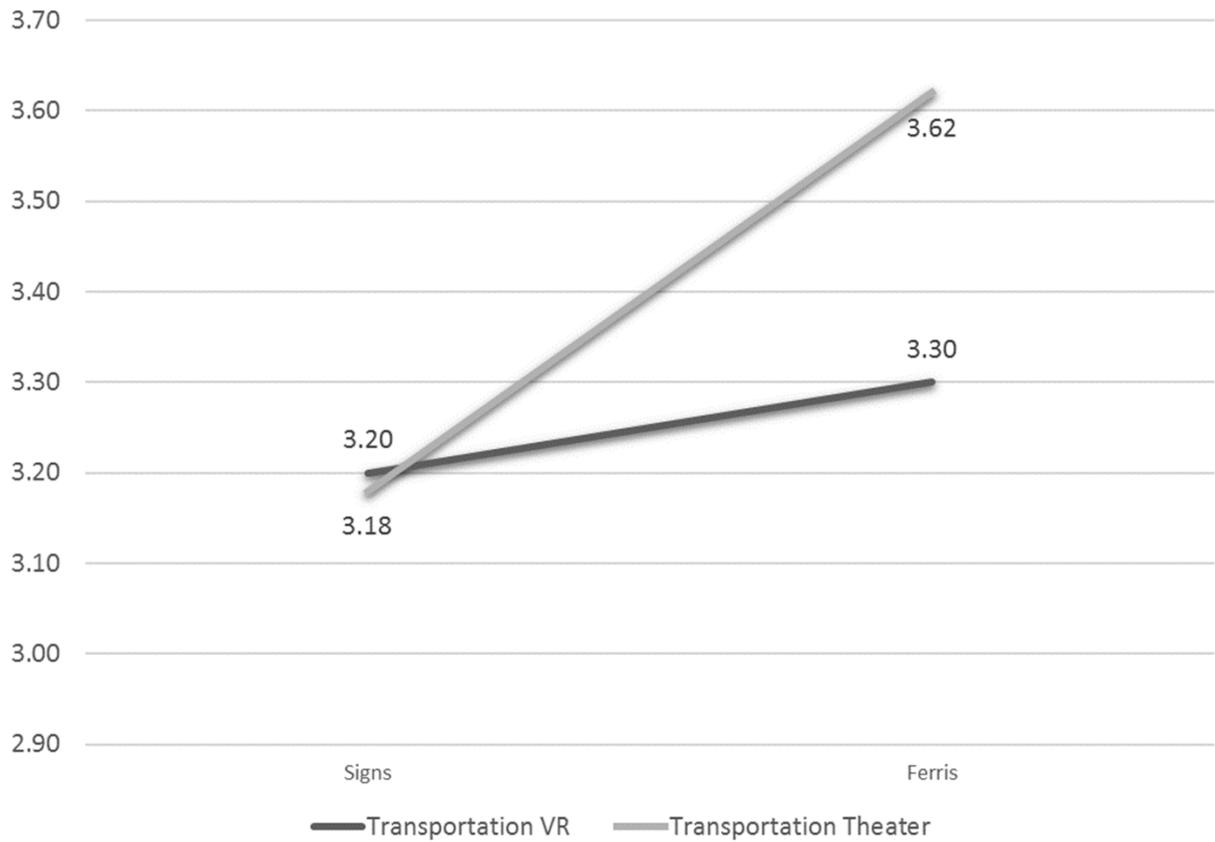


Figure 2. Interaction Effects of Film with Condition for Transportation

Table 5

Regression Results: Effect of Identification and Transportation on Enjoyment across Conditions

Variable	B	SE B	95% CI for B (LB, UB)	β	<i>t</i>	Sig.
Identification	1.18	.263	0.66, 1.70	.369	4.47	$p < .001$
Transportation	1.06	.280	0.51, 1.62	.313	3.79	$p < .001$



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