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ORIGINAL ARTICLE

Bringing People into the Story: How Virtual Reality Journalism Affects the Feeling of Presence

Sangwook Lee[a], Taenyun Kim[b], Sungho Kim[c], Kwan Min Lee[d], Namkee Park[e] and Hayeon Song[c,f]

[a]Department of Advertising, Public Relations and Design, College of Communication, Media, Design and Information, University of Colorado Boulder, Boulder, CO, USA; [b]Department of Media and Information, Michigan State University, East Lansing, MI, USA; [c]Department of Interaction Science, Sungkyunkwan University, Seoul, South Korea; [d]Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore, Singapore; [e]Department of Communication, Yonsei University, Seoul, South Korea; [f]Department of Human-Artificial Intelligence Interaction, Sungkyunkwan University, Seoul, South Korea

ABSTRACT

Virtual reality (VR) journalism can offer immersive experiences, enhancing the audience's empathy and issue involvement. In the literature, however, the term VR refers to different types of technology, which may obscure the clear effects of VR journalism. Guided by the framework for immersive virtual environment (FIVE), this paper investigated the effects of VR journalism focusing on two different features of VR: device-focused (i.e., head-mounted display (HMD)) and content format-focused (i.e., 360° video) by conducting a 3 (device-focused: HMD, computer, smartphone) X 2 (content-focused: 360° video, fixed view video) between-subjects experiment ($N = 171$). Results showed that participants in the 360° video condition, compared to those in the fixed video condition, experienced a higher level of social presence, which, in turn, increased their empathic concern toward the characters and led them to be more involved in the videos' topic. The HMD condition, on the other hand, did not show significant differences in helping participants engage in the characters and the topic, compared to computer and smartphone conditions. Theoretical and practical implications of the different features of VR are discussed.

KEYWORDS

Virtual reality; journalism; 360° view; head-mounted display; social presence; empathic concern

Virtual reality (VR) journalism, a form of "immersive journalism," allows viewers to experience news stories as if they were participants in the virtually reconstructed scenarios (De la Peña et al. 2010). By employing computer technology such as a Head-Mounted Display (HMD) and other devices, VR journalism creates the sensation of being in another place and experiencing news events directly (Sirkkunen and Uskali 2019). This unique characteristic of VR journalism immerses audiences in the news, making them feel more connected to and involved with the story (Sundar, Kang, and Oprean 2017).

VR is often called an "empathy machine" for its ability to create experiential and emotional engagement (Bujić et al. 2020). This is largely driven by two key technologies: HMD and 360° video. An HMD, a head-worn device with a display, is essential

CONTACT Kwan Min Lee kwanminlee@ntu.edu.sg; Hayeon Song songhy@skku.edu

in VR as it mimics real-world experiences by responding to head movements (Psotka 1995). It also enhances spatial awareness by providing bodily sensations and balance feedback (Hale, Stanney, and Malone 2009).

While VR is often equated with HMDs, it can also refer to 360° video content. Although VR is best experienced with an HMD, it is not the only way to view VR content. Audiences can also engage with VR 360° content using other devices, such as computers or mobile phones. Indeed, major news outlets, such as the New York Times and the Washington Post, created 360° videos to increase audience engagement with certain topics (e.g., NYT's Displaced), which can be viewed *via* various devices. Furthermore, organizations such as the United Nations also create VR storytelling content to build empathy and encourage donations (e.g., *Clouds Over Sidra* – refugee) or to improve understanding of historical events (e.g., *The Last Goodbye* – Holocaust).

The 360° videos can be viewed through HMDs, smartphones, and computers (e.g., Sundar, Kang, and Oprean 2017). However, the effects of each aspect of VR are not well explored and it is unclear whether an HMD is essential or if 360° content functionality is necessary. For example, the vast majority of previous studies have examined the effects of combining HMD and 360° content by comparing it to either 360° video alone or text-based modalities (e.g., Sundar, Kang, and Oprean 2017; Bang & Yildirim, 2018; Cummings et al. 2022). For instance, Bang and Yildirim (2018) found no significant differences in empathy or sense of presence between HMD and 360° video when viewing *After Solitary*, a 360° documentary on solitary confinement.

While past studies effectively compare VR journalism to other formats, they often blur the distinction between device and content, making it hard to investigate their individual effects. This is crucial, especially given the low HMD ownership in the U.S. (6%; Statista 2020). Clearer insights into what makes VR journalism effective could boost audience interest and adoption. This study addresses the gap by examining whether HMDs, 360° content, or both are key to enhancing VR journalism.

Guided by Slater and Wilbur's (1997) framework for immersive virtual environment (FIVE), we investigated the effect of VR journalism focusing on two different features of VR—device (i.e., HMD) and content format (i.e., 360° content)—and tested their effects on VR journalism experience separately. Additionally, we investigated the role of social presence in explaining how VR journalism contributes to a greater sense of immersion and empathic concern than traditional media. Through this investigation, we aimed to clarify the extent to which VR with HMD versus without HMD promotes immersive experience and whether those who do not have access to HMD can also take the benefits out of VR journalism.

Thus, our research questions (RQs) were as follows:

RQ1: *How do HMDs and 360° content individually or jointly contribute to the effectiveness of VR journalism?*

RQ2: *What role does social presence play in enhancing immersion and empathic concern in VR journalism?*

Literature Review

VR Journalism

Journalism is a practice of producing and disseminating information about recent events that are of public interest and significance (Schudson 2003). Journalism

communicates important issues to be perceived as interesting and relevant to people (Kovach and Rosenstiel 2021). However, achieving this goal of journalism is often very challenging because readers frequently become distanced from the news amid the overwhelming flood of information in modern society (Holton and Chyi 2012).

This challenge has led researchers and journalists to explore new approaches to counteract audience disengagement. Among these efforts, the integration of new digital technologies such as VR has been more commonly adopted in journalism, shifting digital practices from novelty to routine (Perreault and Ferrucci 2020). One such example is *immersive journalism*, which leverages VR to create a more impactful news experience. De la Peña et al. (2010) suggested the concept of immersive journalism as a method of news production using VR designed to help audiences comprehend news more deeply. It seeks to replicate the feeling of being present at events, countering news disengagement caused by media overload. Outlets like The New York Times and The Guardian use VR and AR to enhance audience engagement and empathy (Rogers 2020), expanding journalism's reach and creating immersive experiences (Zayani 2021). For instance, compared to the text modality, immersive gear VR experience can give viewers a higher level of immersion to the story (Sundar et al. 2017).

The highly immersive and realistic portrayal of news narratives foster a first-hand connection between the audience and the reported events or circumstances. It allows audiences to become deeply immersed in the situation and feel as if it is their own (De la Peña et al. 2010). For example, Barreda-Ángeles et al. (2020) revealed that immersive storytelling can improve users' perspective taking by increasing the feeling of presence. Cummings et al. (2022), using the VR narratives *Sleeping on Denver's Bitter Cold Streets* and *The Road to Nowhere*, found that 360° content with HMD was more effective in fostering empathy compared to other formats, such as 360° video with desktop and text. Bujić, Salminen, and Hamari (2023) also found that greater immersiveness in sorrowful media content predicts higher levels of negative emotions through a between-subjects repeated-measures experiment.

Putting oneself in others' shoes to understand their feelings and perspectives is crucial in journalism, as it plays a key role in drawing attention to specific topics (McCombs, 2002). In other words, setting the societal agenda would be one of journalism's most important functions (McCombs & Shaw, 1972). In this context, VR journalism aims to enhance issue involvement in a certain topic and elicit empathy toward the protagonists of the narratives, thereby fostering deeper engagement with the covered issues (De la Peña et al. 2010).

The Effects of VR Journalism: The Issue Involvement and Empathic Concern

Key psychological effects of VR journalism include issue involvement and empathy. Beyond raising understanding and awareness, its main goal is to create lifelike experiences that foster empathy and deeper emotional engagement, potentially driving greater audience involvement and action (De la Peña et al., 2010). Indeed, VR journalism often addresses pressing societal issues—such as hunger, racial discrimination, and war—that demand not just knowledge, but deeper understanding and active engagement (e.g., NYT – The Displaced). It can enhance news consumers' issue involvement by offering

a first-person perspective and reducing the psychological distance to certain issues (Lee and Kang 2024), which is critical because issue involvement reflects how personally important the topic is to an individual (Petty and Cacioppo 1979). When individuals possess internal significance or personal meaning toward an issue, they are more likely to be engaged in understanding and evaluating the issue (Petty and Cacioppo 1986). VR's immersiveness can lead audiences to be more involved in the event, making viewers put more effort into understanding social issues and taking action to solve the problem than traditional media (Kandaurova and Lee 2019). Compared to traditional media, such as TV or newspaper, VR journalism also allows viewers to be more engaged in the issue (Herrera et al. 2018; Mado et al. 2021), as they are more likely to feel socially responsible and engaged when they develop an accurate empathetic understanding of others' conditions and needs (Segal 2011).

In addition to increasing the level of issue involvement, VR journalism can also enhance empathy. *Empathy* is the ability to understand and share another person's experience (Gladstein 1983). It can lead to *empathic concern*, an other-oriented emotion that aligns with the perceived well-being of someone in need, which includes feelings such as sympathy, compassion, pity, tenderness, sorrow, sadness, distress, concern, and grief (Batson 2011).

More vivid and immersive VR narratives can heighten empathic concern for the story's main character. For instance, people are more likely to support those affected by homelessness after experiencing related VR content than by simply reading about it, with effects lasting up to a week (Herrera et al. 2018; Mado et al. 2021). In relation to VR journalism, VR can increase empathy toward characters presented in a virtual environment by providing first-person experience of news narratives (De la Peña et al. 2010). Consequently, empathy can elicit empathic concern and motivate individuals to take action to address the challenges faced by individuals featured in the news (Decety et al., 2016).

Various Approaches to VR

Although VR journalism has received scholarly attention, most studies have not separated device and content features, instead focusing on the combined effects of HMDs and 360° video compared to 360° video alone or text (e.g., Sundar et al., 2017; Bujić et al. 2023). This lack of distinction created a research gap in identifying whether device (HMD), content (360° video), or their combination most effectively enhances audience empathy and issue involvement. Furthermore, as VR journalism should be accessible to all, it is important to understand how experiences differ with and without costly HMDs. Limited research on individual VR features makes it hard to explore their impacts. Since HMDs are just one way to access VR, this study separates device (HMD, smartphone, computer) and content format (360° vs. fixed view) to examine their distinct effects on immersive experiences.

VR comes in various forms, often categorized as fully immersive, semi-immersive, or non-immersive based on multisensory simulation and real-world interaction (García-López et al. 2021). Fully immersive VR excludes real-world sensations using HMDs, while semi-immersive VR allows interaction through body movement or screens. Non-immersive VR enables virtual interactions while maintaining full perception of the actual world.

Most research on VR journalism has focused on fully immersive VR with HMDs, often assuming HMDs are essential for VR experiences. HMDs create a sense of presence through dichoptic image movements and, when paired with 360° video, allow perspective shifts *via* head movements (Turnbull and Phillips 2017), enhancing interactivity (Steuer 1992). As a result, many studies equate VR with 360° video viewed through HMDs (De la Peña et al. 2010; Lee and Kang 2024), comparing HMDs to other devices like smartphones and computers in a device-focused approach to immersive VR.

While most studies take a device-focused approach, some adopt a content-focused perspective, defining 360° video as VR regardless of the viewing device (Kang et al. 2019). This approach emphasizes the 360° video format over hardware, as it can be accessed *via* HMDs, smartphones, or computers (Van Damme et al. 2019). For instance, users can navigate 360° videos using a mouse on a computer or by tilting a smartphone. Since 2015, platforms like YouTube and Facebook have embraced 360° video, with over one million such videos shared on Facebook alone (Ayrey and Wong 2017).

Slater and Wilbur's (1997) framework for immersive virtual environment (FIVE) distinguishes the concept of immersion from presence and defines immersion as a technological description of the degree to which a virtual environment can provide "an inclusive, extensive, surrounding and vivid illusion of reality" to the senses and perception of individuals. In this framework, *inclusive* refers to how much physical reality is blocked off when experiencing a virtual environment. When describing a virtual environment as *extensive,* it implies that it provides a wide range of sensory experiences, including visual, auditory, tactile, and potentially other sensory aspects. *Surrounding* refers to how panoramic virtual reality is rather than restricted to a small area. *Vivid* pertains to the excellence and richness of the content that can be reproduced within a particular mode, encompassing elements like resolution, fidelity, and the diversity of energy. *Matching* refers to the extent to which users' physical movements are accurately mirrored by corresponding changes in the virtual environment. *Matching* between users' sensorimotor feedback from the body and the information provided to the users is required for immersion.

In this sense, the content format feature of 360° video is mainly based on the characteristics of the surrounding. For example, watching a 360° video would make audiences feel that the virtual environment surrounds them because it provides a wider field of view than non-360° content. Thus, when viewing a 360° video, regardless of which device to use, users' VR experience can be enhanced with their surroundings.

However, some features seem to be available only when HMD is used to view the VR content. For example, the enclosed structure of the HMD headset blocks off views of the physical world, such as light, so that only VR content can be seen. Blocking out the views of the physical world makes users experience inclusiveness. Other devices, such as smartphones and computers, cannot block out real-world distractions. Thus, inclusiveness is a unique feature that is available only when VR content is viewed with HMD, not other devices.

When an audience watches 360° video content, HMD may provide a high level of *matching,* as they feel the match between their sensorimotor feedback and the content. HMD users can navigate the virtual environment by moving their heads in the same way they would control their view in the real world. Smartphones also would provide a moderate to high level of matching when viewing 360° content. Thanks to

the gyroscope sensor in the smartphone, users can navigate the virtual world in a way similar to the real-world movement by adjusting their smartphone in their palm along with their head movement. By contrast, computer users must move their mouse to change the view when consuming 360° video content—which differs from the natural way people look around in the real world.

In sum, HMDs and 360° video offer more immersive, first-person experiences than smartphones, computers, or fixed-view content. Guided by the FIVE model, they enhance surrounding, inclusiveness, and matching, fostering greater empathic concern for the protagonist and issue involvement in VR content. Thus, the following hypotheses are proposed:

H1. HMD will evoke higher levels of empathic concern and issue involvement compared to computers and smartphones, controlling for content format focused features (fixed view and 360° view).
H2. The feature of the 360° view will evoke higher levels of empathic concern and issue involvement compared to the fixed view, controlling for device focused features (HMD, computer, and smartphone).

VR Journalism and Social Presence

Social presence plays a critical role in the VR experience. Presence refers to "a psychological state in which virtual (para-authentic or artificial) objects are experienced as actual objects in either sensory or nonsensory ways." (Lee 2004, p. 37). The presence of the virtual experience can pertain to virtual physical objects and environments (i.e., physical presence), virtual social actors (i.e., social presence), as well as the virtual self (i.e., self presence). While physical and self-presence are often considered important factors in VR studies, our focus was primarily on social presence, as it is directly relevant to the relational and emotional aspects of interpersonal interactions (Biocca, Harms, and Gregg 2001), pro-social behaviors (Pimentel et al. 2021), and empathy (J. Lee, Kang, and Kim 2023).

VR users would perceive virtual social actors as real, as they often do not distinguish between para-authentic virtual actors and artificial objects (Lee 2004). This can enhance social presence, shaping perceptions, attitudes, and behaviors. For example, Yoo and Drumwright (2018) found that participants experienced greater social presence in VR fundraising than on a tablet. Similarly, VR journalism would also enhance audiences' feeling of social presence.

In VR journalism, audiences can experience news vividly and perceive that they are with others in the news content (Jones 2017). In terms of the device-focused features of VR, HMDs offer immersive experiences by eliminating external distractions (inclusiveness), thereby enhancing the presence of entities within the virtual environment. Moreover, HMDs can also improve the quality of interactions within this environment by aligning users' physical movements with their virtual counterparts (matching). Furthermore, the 360° view would also enhance the social presence of entities in journalistic narratives within the virtual environment, placing the audiences at the center of the virtual space that mirrors the comprehensive surroundings of the real-world interpersonal interactions (surrounding). Thus, based on the previous literature and rationale, we suggest:

H3: When testing both device- and content format-focused features at the same time, HMD will evoke a higher level of social presence compared to computer and smartphone.
H4. When testing both device- and content format-focused features at the same time, the 360° view will evoke a higher level of social presence compared to the fixed view.

Social Presence, Issue Involvement and Empathic Concern

Social presence may underlie how VR journalism enhances empathic concern and issue involvement by strengthening narrative perspective-taking (Batson, Early, and Salvarani 1997) and increasing the emotional salience of mediated others (Pimentel et al. 2021). Since perspective-taking relies on prior knowledge and imagination (Ahn et al. 2016), social presence may ease this demand and promote more consistent viewer engagement (Bailenson 2018). When characters display clear emotional cues—like facial expressions and eye contact—users could more easily infer their inner states, fostering empathy (Biocca and Harms 2002). Indeed, previous studies showed that social presence enhances concern for others, such as in VR simulations of refugee camps where higher social presence led to more favorable responses (Steed et al. 2018). Immersive VR journalism, by boosting social presence, deepens audience engagement and empathic concern (e.g., J. Lee, Kang, and Kim 2023). Thus, we also suggest:

H5. Social presence will mediate the relationship between HMD and (a) empathic concern and (b) issue involvement.
H6. Social presence will mediate the relationship between 360° view and (a) empathic concern and (b) issue involvement.

Method

A 2 (content format: 360° view vs. fixed view video) x 3 (device: computer vs. smartphone vs. HMD) between-subjects design experiment was conducted. In total, 176 students recruited voluntarily from a large class in a private university in South Korea participated in the study and were randomly assigned into six conditions. The responses of 5 students were excluded due to missing data, leaving a total of 171 in the final analysis[1]: 73 males (42.7%) and 98 females (57.3%), with ages ranging from 19 to 27 ($M = 22.56$, $SD = 1.84$). None of the participants had used an HMD more than twice before the experiment. To verify randomization, we examined the effects of independent variables on pre-measured factors (age, gender, and issue involvement). ANCOVAs showed no significant effects of media device or content type on age or issue involvement ($p > .05$), and a Chi-square test found no association with gender ($p > .05$), confirming successful random assignment.

Procedure

Participants were asked to come to a lab on a scheduled date and time. They were first asked to fill out a short survey about their issue involvement before experiencing the main stimuli (i.e., the problem of low-income seniors in South Korea). Then, they

were randomly assigned to one of the six conditions (for Computer & Fixed, $n = 32$; for Computer & 360°, $n = 28$; for Smartphone & Fixed, $n = 31$; for Smartphone & 360°, $n = 29$; for HMD & Fixed, $n = 25$; for HMD & 360°, $n = 26$). Participants in the *360° video on computer condition* were directed to sit in front of a computer and view the material in the form of a 360° video by moving the mouse. In the *fixed-view video on computer condition*, they watched a standard, non-interactive video. *Smartphone condition* participants viewed either a 360° or fixed-view video; those in the *360° video on smartphone condition* were instructed to move and interact with the phone to explore the full view, while those in *the fixed-view video on smartphone condition* watched passively. *HMD condition* participants used a Samsung Gear VR to view either 360° or fixed-view content. In the *360° video on HMD condition*, they were instructed to turn their heads to explore the scene, while no such instruction was given in *the fixed-view video on HMD condition* due to its static nature. Participants remained seated to maintain consistent viewing height and used their hands only to start the video. They then completed the main questionnaire.

Stimuli

A professional VR film producer created a VR video for this study. Both 360° and fixed-view videos were filmed simultaneously at the same location with « an identical narrative using a dual-lens 360 camera (GEAR 360, FHD) and a fixed-view DSLR camera (Canon EOS-100D, FHD). The two-minute video minimized potential effects of viewing duration on presence and motion sickness. In the 360° condition, participants could explore the environment (home, road, kitchen, etc.), while in the fixed-view condition, they saw a single, static perspective (See Figure 1). Participants navigated the 360° video using HMD (head rotation), computers (mouse), or smartphones (touchscreen dragging). All content was in 2D format.

The video used a reporter-led narrative covering the rise in low-income seniors, their welfare issues, and suicide rates, including an interview with an elderly woman doing physically demanding labor. A professional voice actor narrated the script. To remove any confounds, both followed a reporter-led, TV news-style format (Jones 2017), since character-led storytelling—common in 360° videos—is less feasible in fixed-view due to limited perspective.

Measurement

Empathic concern ($\alpha = 0.93$) was measured on a 10-point Likert-type scale (1 = very strongly disagree, 10 = very strongly agree) with six items from the revised version of Gross's (2008) empathy emotion scale measurement (e.g., "I felt pity," "I felt sympathy," etc.).

Issue involvement was measured before experiencing the stimuli (existing issue involvement; $\alpha = 0.84$) and after (issue involvement; $\alpha = 0.90$). Answers were given on a 10-point Likert-type scale (1 = very strongly disagree, 10 = very strongly agree) to four questions developed by the researchers to assess how much they *were* or *became* "interested in the issue of low-income seniors," "willing to learn about the issue of low-income seniors," "thinking that the issues of low-income seniors are important,"

and "thinking that the issues of low-income seniors should be prioritized to be solved." The existing issue involvement served as a covariate for the analysis.

Social Presence (α = 0.91) was measured by two items adapted from the ITC-SOPI for the virtual reality environment (Lessiter et al. 2001). Participants answered whether they agree or disagree with the following statements based on a 10-point Likert-type scale (1 = very strongly disagree, 10 = very strongly agree): "I felt like the person being interviewed was talking in front of me," and "I felt like I was actually having a conversation with the people on the screen." We choose these items to capture the para-authentic interpersonal connection to the characters in the narrative.

Results

To test H1 to H4, a two-way analysis of covariance (ANCOVA) was conducted to separately examine the unique effects of the media device and 360° view. Existing issue involvement was used as a covariate in the analysis. The results revealed a significant main effect of pre-measured issue involvement on both empathic concern, $F(1, 164) = 49.40$, $p < 0.001$, partial $\eta^2 = 0.23$, and issue involvement, $F(1, 164) = 66.34$, $p < 0.001$, partial $\eta^2 = 0.29$. This indicates that as the existing issue involvement increased, so did empathic concern and issue involvement after viewing the stimuli. However, there was no significant main effect of pre-measured issue involvement on social presence, $F(1, 164) = 2.59$, $p = 0.11$, partial $\eta^2 = 0.02$.

In terms of empathic concern, there was a significant interaction effect between media devices and 360° view, $F(2, 164) = 3.72$, $p = 0.026$, partial $\eta^2 = 0.04$. However, the post-hoc pairwise comparison with Bonferroni correction showed no significant difference between conditions (all $p > .05$). Both media devices, $F(2, 164) = 0.49$, $p = 0.62$, partial $\eta^2 = 0.01$, and 360° view, $F(1, 164) = 0.11$, $p = 0.74$, partial $\eta^2 = 0.00$, did not show statistically significant effect. Similarly, in terms of issue involvement, neither interaction effect, $F(2, 164) = 0.80$, $p = 0.45$, partial $\eta^2 = 0.01$, nor main effects of media device, $F(2, 164) = 0.38$, $p = 0.69$, partial $\eta^2 = 0.01$ and 360° view, $F(1, 164) = 0.27$, $p = 0.60$, partial $\eta^2 = 0.00$, was significant.

However, the analysis revealed a significant main effect of 360° view on social presence, $F(1, 164) = 17.16$, $p < 0.001$, partial $\eta^2 = 0.10$. That is, participants who watched the story through 360° video perceived a higher level of social presence ($M_{\text{estimated}} = 5.69$, $SE = 0.26$) than those who saw it *via* the fixed view ($M_{\text{estimated}} = 4.21$, $SE = 0.25$). However, there was no main effect of media device on social presence, $F(2,$

a. 360-degree view b. fixed-view

Figure 1. News stories. These images are screenshots of 360° view and fixed-view stimuli.

164) = 1.19, $p = 0.31$, partial $\eta^2 = 0.01$, nor interaction effect between features, $F(2, 164) = 0.22$, $p = 0.80$, partial $\eta^2 = 0.00$. Thus, H1, H2, and H3 were not supported but H4 was supported (see Table 1 and Figure 2).

To test H5 and H6, a bootstrapping procedure using PROCESS Macro Model 4 (Hayes 2017) was used with 5000 bootstrap samples and bias-corrected 95% bootstrapped confidence intervals (CIs). First, testing the H5, the effect of media devices on empathic concern and post-measured issue involvement *via* social presence was analyzed through PROCESS Macro Model 4, controlling for the existing (pre-measured) issue involvement and content format. The analysis found that HMD did not evoke a higher level of social presence compared to smartphone ($a = -0.55$, $SE = 0.44$, $p = 0.21$) and computer ($a = -0.63$, $SE = 0.44$, $p = 0.15$), while social presence was positively associated with empathic concern ($b = 0.14$, $SE = 0.04$, $p < 0.01$). The indirect effect (unstandardized: HMD - smartphone: $ab = -0.08$, $SE = 0.07$, 95% CI [−0.22, 0.04]; HMD - computer: $ab = -0.09$, $SE = 0.06$, 95% CI [−0.22, 0.04]; partially standardized: HMD - smartphone: $ab = -0.05$, $SE = 0.04$, 95% CI [−0.15, 0.03]; HMD - computer: $ab = -0.06$, $SE = 0.04$, 95% CI [−0.15, 0.03]) and direct effect (HMD - smartphone: $c' = 0.25$, $SE = 0.25$, 95% CI [−0.23, 0.74]; HMD - computer: $c' = 0.32$, $SE = 0.25$, 95% CI [−0.16, 0.81]) of HMD on empathic concern were not significant.

Table 1. Effects of media device and content format.

	Empathic concern		Issue involvement		Social presence	
	EMM (SE)	*F*	EMM (SE)	*F*	EMM (SE)	*F*
Pre-measured issue involvement		49.40***		66.34***		2.59
Device Type		0.49		0.38		1.19
Computer ($n = 60$)	7.54 (0.17)		6.96 (0.17)		4.71 (0.30)	
Smartphone ($n = 60$)	7.47 (0.17)		6.91 (0.17)		4.80 (0.30)	
HMD ($n = 51$)	7.30 (0.18)		6.75 (0.19)		5.35 (0.33)	
Content Type		0.11		0.27		17.16***
Fixed View ($n = 88$)	7.47 (0.14)		6.82 (0.14)		4.21 (0.25)	
360° View ($n = 83$)	7.41 (0.14)		6.93 (0.15)		5.69 (0.26)	
Device Type X Content Type		3.72*[a]		0.80		0.22

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
Note: EMM = estimated marginal means; SE = standard error.
[a]Post-hoc pairwise comparison with Bonferroni correction was not statistically significant for all pairs.

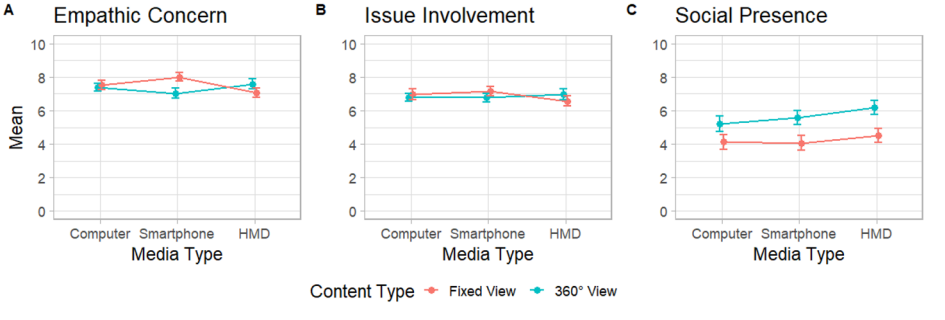

Figure 2. Effects of media device and content format on (A) empathic concern, (B) Issue involvement, and (C) Social presence.

In terms of model with the issue involvement, the level of social presence of participants in the HMD condition was not significantly different from the level of social presence of participants in the smartphone condition ($a = -0.55$, $SE = 0.44$, $p = 0.21$) and the computer condition ($a = -0.63$, $SE = 0.44$, $p = 0.15$), while social presence was positively associated with issue involvement ($b = 0.24$, $SE = 0.04$, $p < 0.001$). The indirect effect (unstandardized: HMD – smartphone: $ab = -0.13$, $SE = 0.10$, 95% CI [−0.33, 0.07] & HMD – computer: $ab = -0.15$, $SE = 0.11$, 95% CI [−0.37, 0.05]; partially standardized: HMD – smartphone: $ab = -0.09$, $SE = 0.07$, 95% CI [−0.21, 0.04] &; HMD – computer: $ab = -0.10$, $SE = 0.07$, 95% CI [−0.23, 0.03]) and direct effect (HMD – smartphone: c' = 0.30, $SE = 0.23$, 95% CI [−0.16, 0.76]; HMD – computer: c' = 0.37, $SE = 0.23$, 95% CI [−0.09, 0.83]) on issue involvement were not significant as well. Thus, H5 was not supported. In other words, media devices did not play a crucial role in eliciting empathic concern and engagement with the issue.

However, in terms of content format, PROCESS Macro Model 4 revealed significant indirect effects of 360° view feature on empathic concern and issue involvement through social presence, controlling for existing issue involvement and media devices, supporting H6. Specifically, the relationship between the 360° view and social presence was significant ($a = 1.47$, $SE = 0.35$, $p < 0.001$) and the association between social presence and empathic concern was also significant ($b = 0.14$, $SE = 0.04$, $p < 0.01$). The indirect effect (unstandardized: $ab = 0.21$, SE = 0.08, 95% CI [0.06, 0.39]; partially standardized: $ab = 0.14$, $SE = 0.06$, 95% CI [0.04, 0.26]) was significant but direct effects (c' = −0.31, $SE = 0.21$, 95% CI [−0.71, 0.10]) on empathic concern was not significant (see Figure 3). In addition, for issue involvement as a dependent variable, the path from 360° view to social presence was significant ($a = 1.47$, $SE = 0.35$, $p < 0.001$), and the relation between social presence and issue involvement was also significant ($b = 0.24$, $SE = 0.04$, $p < 0.001$). Despite the significant indirect effect (unstandardized: $ab = 0.35$, $SE = 0.11$, 95% CI [0.16, 0.58]; partially standardized: $ab = 0.23$, $SE = 0.07$, 95% CI [0.11, 0.36]), the direct effect (c' = −0.27, $SE = 0.20$, 95% CI [−0.65, 0.12]) on issue involvement was not significant (see Figure 4). Thus, H6 was supported.

Discussion

Journalism seeks to bring audiences closer to stories, and VR offers enhanced immersion through its technology. While past studies highlight the power of immersive VR—typically combining HMDs and 360° video—they often overlook the separate effects of each. This study addresses this gap by independently examining device-focused (HMD) and content format-focused (360° video) features. The results showed that 360° video significantly increased social presence compared to fixed video. While it did not directly affect empathic concern or issue involvement, these effects were mediated by social presence. HMDs did not significantly impact any of the key outcomes compared to other devices.

Theoretical Implications

The current study suggests three major theoretical implications. First, one of the most important contributions is to dismantle the effects of VR journalism. Previous studies

did not clarify the effects of VR's different parts, and this blurs the differences of content and device approach of VR. Rather than treating VR as a single technology, we conducted separate analyses to test the unique effect of two important features: media device and content format. Despite previous studies highlighting the effectiveness of HMDs (e.g., Greber et al., 2024), our findings showed that watching 360° video does make individuals feel a higher level of social presence regardless of the device featuring the 360° content (i.e., computer, smartphone, and HMD). However, using different types of devices did not significantly impact the feeling of social presence, empathic concern, and issue involvement. This finding suggests empirical evidence that watching a 360° view video could have substantial potential for enhancing empathic concern and issue involvement—elements crucial for effective news delivery—mediated by social presence.

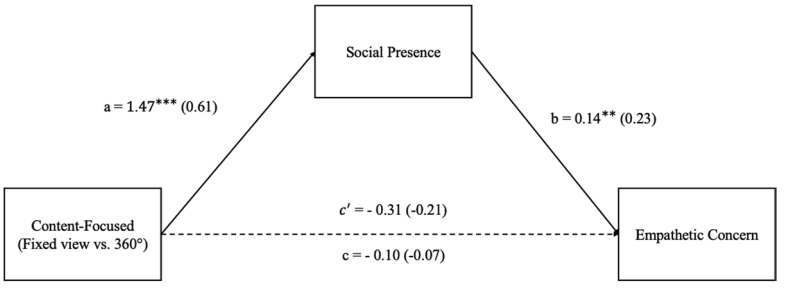

Figure 3. Mediating effect of social presence between the content format of VR and empathic concern. 'a' is the effect of content-focused VR on social presence; 'b' is the relation between social presence and empathic concern; 'ab' is the indirect effect of content format on empathic concern through social presence; 'c'' is the direct effect of content format on empathic concern; 'c' is the total effect of content format on empathic concern; (Partially) Standardized coefficients are reported in parentheses; *$p < 0.05$; **$p < 0.01$; *** $p < 0.001$

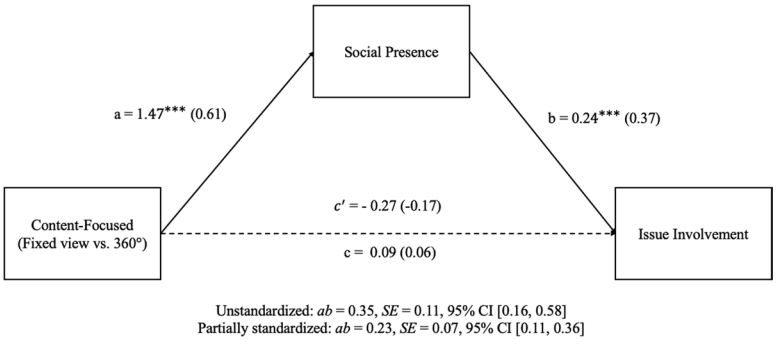

Figure 4. Mediating effect of social presence between the content format of VR on issue involvement. '*a*' is the effect of content-focused VR on social presence; '*b*' is the relationship between social presence and issue involvement; '*ab*' is the indirect effect of content format on empathic concern through social presence; '*c*'' is the direct effect of content format on issue involvement; '*c*' is the total effect of content format on issue involvement. (Partially) Standardized coefficients are reported in parentheses. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

This suggests two important theoretical implications for VR journalism as well as VR research in general. 1) VR researchers are recommended to clearly indicate which type of VR is being examined in order to provide more accurate implications. Explanations about the VR type can also provide guidance about the practical use of VR for various sectors, including journalism, marketing, education, and training, and help prevent confusion among the public, who may easily assume that VR has to be experienced by wearing HMD and watching 360° video. This assumption may limit the benefits that VR's diverse features can provide. 2) Our research and findings call for more studies that can fill the research gap on the effects of various types of VR journalism experiences. For example, the effect of VR journalism *via* smartphone has been understudied. More people can access VR *via* smartphones, and it can be a great way to expand the number of people who benefit from VR journalism. The global penetration rate of smartphones was approximately 68% as of 2022, meaning that around 6.3 billion people use smartphones around the world (Laricchia 2023). This means that the smartphone could be a channel to reach a larger population, including low-income populations. Especially, when the goal is to disseminate critical information pertinent to low-income populations—such as public health advisories on infant mortality—leveraging the smartphone's reach would be able to amplify the message's effectiveness and impact.

Second, the current study also expanded the theoretical framework of FIVE by applying it to the device and content approach of VR. Our findings showed that individuals who viewed the 360° video content *via* HMD reported a significantly higher level of social presence compared to those who used HMD with the 360° feature disabled. However, it is important to note that the effectiveness of 360° view would not be limited to the HMD but could be also effective in other media devices. Individuals who viewed the 360° video *via* computer, smartphone, and HMD reported a higher level of social presence compared to those who used the same device without 360° feature. This finding highlights the importance of surroundings, one of the features of VR from Slater and Wilbur's (1997) FIVE. Watching 360° video provides a wider field of view, allowing users to feel immersed in the virtual world and to experience the feelings of being surrounded by the virtual environment. Furthermore, HMD blocks out the view of the physical world around the users and makes their experience more inclusive to the virtual environment. HMD users can control their view by moving their heads just like in reality, which promotes matching between the virtual and real worlds. Our results showed that the content feature of surrounding in 360° video could be an important factor across all devices, while the media features of inclusiveness and matching in the HMD may not. Indeed, previous studies also have revealed the importance of a wider field of view in increasing the feeling of presence as well as enjoyment (Seay et al. 2001; Van Damme et al. 2019).

However, it is possible that other factors beyond those in the FIVE may also impact the effectiveness of immersive virtual environments. For instance, a 360° view may inherently allow the audience to experience a higher level of interactivity—the extent to which users are able to dynamically adjust the form and content of a virtual environment in real time (Steuer 1992)—than a fixed view, as its content dynamically reacts to user input—such as dragging with a finger or mouse or rotating their head—resulting in different information being presented. While this aspect overlaps to some extent with matching in FIVE, we believe it is worth distinguishing between

them. Therefore, the current study's finding calls for further studies to investigate the effects of the surrounding of FIVE in both the content focus and device focus format of VR journalism.

Third, this study highlights the importance of considering social presence in VR research. While empathic concern and issue involvement were not directly induced by 360° video, it indirectly increased empathic concern and issue involvement through the mediating effect of social presence. This association between social presence and both empathic concern and issue involvement in VR journalism suggests that social presence is a strong predictor of successful VR journalism outcomes. These results are in line with studies that showed social presence can enhance concern for others in the virtual environment (Pimentel et al. 2021; Steed et al. 2018). A higher level of social presence would prompt audiences to feel more involved with others in the narrative and empathize with the subject(s) of the story to a greater extent, which in turn could increase the credibility of the journalism (Sundar, Kang, and Oprean 2017). As the role of social presence is important, we believe that more studies should be conducted to investigate the predictors of social presence in VR journalism and explore ways to further enhance VR journalism experiences.

However, the non-significant total effect suggests that alternative mediators may also play a role in enhancing empathic concern and issue involvement. For example, physical presence—the feeling of being physically immersed in a virtual environment (Lee 2004)—could positively influence these outcomes (Xu, Huang, and Shang 2021). Additionally, the perception of interactivity, which arises from engaging with objects in a VR environment (Greber et al., 2024), may create a more vivid and immersive experience, further increasing empathic concern and issue involvement.

Practical Implications

Our study suggests that news content providers may not have to limit themselves to HMD-based VR journalism but should consider 360° format on smartphones or computers. They may expand their audience beyond HMD owners to include users of other devices, as the key factor could be an immersive experience of 360° video content, rather than the device itself. Indeed, the limited user base and suboptimal user experience of HMDs may hinder the widespread adoption of VR journalism. Globally, only 26 million consumers own VR HMD as of 2020, which is less than 1% of the global population (Osterland 2020). Furthermore, individuals who are sometimes susceptible to motion sickness may experience discomfort while using HMDs (Dziuda et al., 2014; Lo and So 2001). Similarly, people with loose or curly hair could find using the headset uncomfortable or difficult, especially if the device is too large (Brown 2019). We revealed that the contribution of the 360° view could be larger than the contribution of the HMD in experiencing social presence, empathic concern, and issue involvement in VR journalism. Thus, viewing 360° video without HMD would not compromise the effectiveness of the VR experience, and VR journalism should be made available in a 360° format on smartphones or computers to appeal to a wider audience.

Our study also suggests that VR journalism practitioners should prioritize improving social presence in VR journalism. Our findings showed that the 360° video enhanced

empathic concern and issue involvement by fostering a sense of social presence. Therefore, VR journalism practitioners are encouraged to explore technological features and content formats that can further enhance social presence. For instance, the protagonists (or interviewees) in VR journalism may need to be more realistic and interact more with the audience because such cues can enhance social presence (Oh, Bailenson, and Welch 2018), which may result in fostering audience empathic concern with them. Additionally, from a technological standpoint, VR journalism could enhance the sense of audience community by integrating features like live chat or comments, helping viewers feel connected and aware that others share their sentiments (Luo et al. 2020). Thus, VR journalism practitioners should focus on developing narrative and shooting techniques to maximize the feeling of their surroundings and increase social presence, even on smartphones or computers without high-end technologies, such as HMD.

Limitations and Future Study

This study has several limitations. First, we focused on a single journalism topic—low-income elderly in South Korea—to control external factors, which limits generalizability. The use of a reporter-led narrative, typical in traditional media, may have reduced empathic engagement and issue involvement. Character-led narratives, offering a personal perspective, may be more effective. The lack of significant main effects observed here might be different depending on the content type. Future studies should examine how different narrative approaches and content types interact with VR to optimize its impact.

Second, we examined only three components of the FIVE model—inclusiveness, surrounding, and matching—limiting a full analysis of all its elements (Slater and Wilbur 1997). Vividness and extensiveness were controlled, though factors like screen size may have influenced perception. The study focused on head rotation and view changes, excluding other sensorimotor interactions such as grabbing or walking. Thus, we argue that future researchers should also test VR in terms of the FIVE model.

Third, there are limitations related to the sample, including its relatively small size and limited diversity. Although our sample size per condition may be adequate for detecting main effects—as supported by prior studies and G*Power analysis—we would like to acknowledge the limitation of small sample size. As Blake and Gangestad (2020) noted, studies investigating interaction effects typically require larger sample sizes than those suggested by standard power analyses. Small sample sizes can increase the risk of both false positives and overestimated effect sizes (Wilson et al. 2022). Therefore, future research should examine the effects of device- and content-focused features in VR journalism using a larger sample. Moreover, the lab-based setting at a private university limited sample diversity. Given the topic—low-income seniors—this may have affected the impact of VR journalism on empathic concern and issue involvement. Although random assignment minimized third-variable effects, future research should use more diverse samples to enhance generalizability.

Finally, it should be acknowledged that the mediating role of social presence in the relationship between VR content and empathic concern or issue involvement, which we identified in this study, is based on path analysis and is inherently correlational rather than causal. This raises the possibility that unmeasured third variables contributed to

the observed relationship. For instance, individual differences may underlie both greater perceived social presence and heightened empathic concern or issue involvement, suggesting a shared factor rather than a direct causal effect of social presence. In addition, it is also possible that heightened empathic concern or issue involvement leads to a higher sense of social presence, not vice versa (Yang et al. 2022). Thus, future research should account for such variables to better isolate the specific role of social presence.

Conclusion

VR has attracted significant attention in both academia and industry. To build more precise insights and provide actionable guidelines, it is important to test the effects of VR, considering its various types and features. Our study explored the impacts of two distinct VR features: device-focused (HMD) and content format-focused (360° video). Findings indicate that 360° video fosters greater social presence compared to fixed video, indirectly enhancing empathic concern and issue involvement through this heightened social presence, while controlling for participants' pre-existing involvement. Although previous studies emphasized HMDs in VR journalism, our results show they did not significantly enhance social presence, empathy, or issue involvement in reporter-led content on low-income seniors. This highlights the need to explore how elements such as 360° video and social presence can better immerse users in VR journalism—an effort that could also benefit fields like gaming, therapy, and education.

Note

1. A power analysis using G*Power indicated that 158 participants are needed to detect a medium effect size ($f = 0.25$) with 0.8 power (numerator $df = 2$, number of groups = 6, number of covariates = 1).

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