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Original Research

Virtual Reality versus TV: Comparing Empathy, Engagement, Enjoyment, and Usage Intentions

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Abstract: Grounded in media richness theory, this study examined whether different types of technology (TV and VR) impact users' empathy, engagement, enjoyment, and usage intentions. The study was conducted in Nigeria (n = 50) and the US (n = 51) using an experimental design. Participants watched an animated documentary titled "*Is Anna OK*?" at two time points, each time using a different device (i.e., *Oculus Rift S* and TV). Participants completed an online survey to measure empathy (α = 0.92), engagement (α = 0.93), enjoyment (α = 0.92), and usage intentions (α = 0.92) immediately after watching the documentary. A one-way ANOVA was used to examine the effects of technology type on the level of participants' empathy, engagement, enjoyment, and intentions. The study revealed no significant difference in empathy between the TV and VR groups on Day 1 for both Nigerian and US participants. However, on Day 2, the VR group showed significantly higher empathy levels for both samples. Both the Nigerian and US participants who watched the documentary using a VR headset reported slightly higher levels of engagement and intentions than those who used a TV on Day 1, with more pronounced differences on Day 2. Nigerian participants who watched the documentary on TV reported higher levels of enjoyment on Day 1, while the VR group showed higher levels on Day 2. US participants showed a higher level of enjoyment for the VR group on both Day 1 and Day 2. The implications of these findings are discussed.

Keywords: *Empathy, Engagement, Enjoyment, Usage Intentions, Immersive Technology, VR*

Introduction

Empathy, a fundamental component of normal social functioning, serves as the basis for prosocial behavior, the maintenance of social relationships, and the enhancement of psychological well-being (De Corte et al. 2007). Technology has been criticized for its negative impact on social interactions, making people less empathetic (Misra et al. 2016). With growing concerns about the adverse effects of technology, the relationship between empathy and technology has gained recognition, particularly in light of advancements in information technologies (Manney 2008). Media technologies, such as TV and virtual reality (VR), are recognized for their ability to enhance viewer empathy for characters in media and storytelling (Chory-Assad and Cicchirillo 2005; Shin and Biocca 2018). While sensory and media stimuli activate mirror neurons, facilitating empathy, genuine empathy is cultivated through storytelling (Manney 2008; Shin 2018).

VR's immersive nature makes it a superior medium for storytelling compared to other empathy-building technologies like TV (Shin and Biocca 2018). In VR, users engage with computer-generated 360-degree, 3D environments through a head-mounted display (HMD) and hand controllers, enabling realistic interaction with virtual objects (Ahn et al. 2016). This technology blocks out real-world sensory input, replacing it with stimuli from the virtual environment, creating a strong sense of presence (Herrera et al. 2018). VR also provides a multi-sensory experience, incorporating audio-visual, olfactory, and tactile cues, enhancing interactivity and the sense of presence (Lindner 2020). This allows users to vividly immerse themselves in any scenario, effectively bridging the gap between VR and reality.

These immersive experiences foster empathy by compelling users to transcend their own perspectives and engage in perspective-taking, enabling them to immerse themselves mentally and emotionally in the experiences of others (Oh et al. 2016). When using a VR headset, users are immersed in the situations or experiences of characters, gaining the ability to comprehend, evaluate, and emotionally connect with these scenarios as if they were their own (van Loon et al. 2018). Given VR's unique position as an engaging and immersive technology (Hu-Au and Lee 2017), it is considered effective in enhancing empathy through storytelling.

While we speculate about the superior ability of VR to induce or enhance empathy compared to traditional digital media like TV, research in this field, particularly concerning the effects of technology type on users' cognitive, affective, and behavioral responses, remains unexplored. Consequently, it remains uncertain whether immersion significantly influences users' perceptions of empathy, engagement, enjoyment, and usage intentions. In order to address this uncertainty, the present study aims to provide further empirical support for the superior ability of VR to induce or increase empathy compared to traditional digital media such as TV. We also propose that users' level of engagement, enjoyment, and usage intentions differ depending on the medium (VR vs. TV). This study can offer guidance for VR interactions and interface design and provide insights for organizations looking to leverage the opportunities offered by media technology.

Literature Review

Media Richness Theory

Media richness theory (MRT) proposes that effective communication depends on aligning the richness of a medium with uncertainty and the equivocality of the task (Ishii, Lyons, and Carr 2019) and that richer communication mediums improve understanding of intricate messages and tasks (Robert and Dennis 2005). For example, face-to-face interaction is considered the highest level of communication medium because the physical presence in face-to-face interactions enables multi-sensory engagement with others and the surrounding environment, whereas email is considered a lower-level medium (Kandaurova and Lee 2019). Uncertainty is tied to insufficient information and can be lessened with more data, while

equivocality is linked to confusion or misunderstanding and can only be lessened with equally rich information (Trevino, Lengel, and Daft 1987). That is, uncertainty and equivocality reduction enhance information processing (Daft and Lengel 1986). Therefore, face-to-face interaction or an equivalent medium is superior to other media in facilitating message comprehension as they deliver the message while reducing uncertainty.

Tsai (2021) argued that five attributes of immersive affordance, including (1) a vivid, lucid, and lifelike virtual environment with high-quality sensory elements, (2) authentic content carrying personal significance, (3) comprehensibility with a logical and coherent flow of narration, (4) realistic physical and social interactions, and (5) volitional controllability to process information and make movements, are considered components of media richness. Steuer (1992) viewed media richness as consisting of depth and range. Depth pertains to the extent of information conveyed by media, while range relates to the involvement of various sensory organs in communication (Steuer 1992). For example, VR provides 3D realistic images as well as auditory and tactile information that allow users to experience more depth and perspective than 2D TVs do (Yoo and Drumwright 2018). Therefore, VR provides a deeper and broader range of information than 2D media (Ishii, Lyons, and Carr 2019; Yoo and Drumwright 2018).

The richness of media content not only prompts cognitive responses in users like heightened understanding and attention but also generates positive emotional reactions, including experiencing flow, enjoyment, and empathy when users engage with the media (Novak, Hoffman, and Yung 2000; Tsai 2021; Wu, Wong, and Lin 2021). In other words, technology-based mediums that immerse users in sensory-rich environments enhance communication, elevate emotional engagement, and improve the overall user experience (Wu, Wong, and Lin 2021). Consequently, media richness plays a role in shaping subsequent behavioral intentions (Kandaurova and Lee 2019; Tsai 2021). Accordingly, MRT provides a theoretical rationale for this study, assuming that VR, as a media-rich technology, enables users to perceive a higher level of empathy, become more engaged with the media content, enjoy their experiences more, and develop a greater intention to use the device compared to TVs, which represent a less media-rich platform.

Empathy

A key characteristic that sets humans apart as social beings is their capacity to constantly contemplate and respond to the thoughts, feelings, intentions, and actions of others (Rameson and Lieberman 2009). Empathy, vital for interpersonal relationships and societal cohesion, enables individuals to deeply connect with others, comprehending and sharing their thoughts and emotions. This involves cognitive recognition, understanding, perception, and emotional resonance with others' experiences. In essence, empathy involves the ability to adopt someone else's viewpoint (empathic perspective-taking) while also experiencing an emotional response (empathic concern), including feelings of compassion for others (Davis 1983).

Empathic perspective-taking refers to "the tendency to spontaneously adopt the psychological point of view of others" (Davis 1983, 169) and is synonymous with cognitive empathy (Young, O'Dwyer, and Smolic 2022). This phenomenon is one facet of the broader perspective known as 'the neuroscience of empathy.' According to this framework, empathy involves the automatic internalization of others' mental states through representation, understanding, and brain-based reactions (Rameson and Lieberman 2009). Consequently, empathic perspective-taking demands significant cognitive resources (Martingano, Hererra, and Konrath 2021).

The other dimension of empathy, empathic concern, refers to "an individual's tendency to experience feelings of warmth, compassion, and concern for others" (Davis 1983, 169). Empathic concern is considered a form of affective or emotional empathy. In contrast to empathic perspective-taking, a substantial body of evidence suggests that empathic concern is rapid, automatic, and occurs spontaneously (Neumann and Strack 2000). As a result, empathic concern demands fewer mental resources compared to empathic perspective-taking. Additionally, affective empathy is also known to foster the development of cognitive empathy (Raine, Chen, and Waller 2022).

Researchers have used various media forms to promote empathic perspective-taking and empathic concern, ultimately enhancing empathy. These mediums encompass text, audio, video (including 2D screens and 3D VR). Mediated tasks are favored because they supply information to participants lacking contact or having erroneous information about a social target (Gehlbach et al. 2015), rather than relying solely on imagination (Herrera et al. 2018).

Text-based stimuli reduce social distance and increase empathy by offering specific information about people or events (Eckel, Grossman, and Milano 2007). However, it has limitations, such as limited visual content, semantic cues, and reliance on the reader's interpretation (Lee, Kang, and Kim 2023). Audio narration and storytelling offer a contextually richer experience than text but rely on the speaker's ability to convey a perspective effectively and the listener's capacity to decode the intended meaning, which can lead to misinterpretations.

Video, like TV, combines auditory and visual elements, reducing subjectivity in encoding and decoding. TV shows create an avenue in which people encounter those who are different and separate from us by challenging the notions of "otherness" and exclusivity (Latini 2012). An empathetic relationship with personae and fictitious characters is created by a storyline that is well crafted with good cinematography (Latini 2012), as people anticipate the unfolding of their lives daily or weekly. One possible explanatory mechanism for why viewers can empathize with fictional TV screen characters is because the mirror neurons in the brain can recreate the distress seen on screen (Iacoboni 2013). Development of empathetic reactions to the lives and experiences of on-screen characters becomes transformative as it helps us to see past prejudices and acknowledge the common humanity of people we may have categorically judged and rejected (Latini 2012).

The most potent medium for inducing empathy might be one that combines audio, video, and stimulation of all senses, creating an immersive environment where participants are fully immersed in another world, potentially fostering greater empathy (Barreda-Ángeles, Aleix-Guillaume, and Pereda-Baños 2020; Levett-Jones, Cant, and Lapkin 2019). The immersive virtual environments that VR offers (1) block out the immediate environment of users, replacing it with perceptual input from the virtual world, (2) alleviate the cognitive task of imagining situations, and (3) present accurate digital scenes that demand fewer mental resources. Previous studies and MRT suggest that VR may induce greater and longer-lasting empathy compared to less immersive technology (Herrera et al. 2018; Yoo and Drumwright 2018). We, therefore, hypothesize as follows:

- Hypothesis 1: Experiencing a character's perspective through immersive VR will result in greater empathy compared to watching the same character on a TV screen.

Engagement

When an individual engages in technologically mediated communication, they simultaneously navigate two separate environments: the physical environment they physically inhabit, and the virtual environment presented through the medium (Steuer 1992). This perceptual illusion of non-mediation is referred to as presence (Lombard and Ditton 1997). This concept is closely linked to the sensations of immersion and engagement, creating the sensation of being truly present within the mediated environment, rather than the immediate physical surroundings (Steuer 1992). In research, various terms, including telepresence, immersion, and engagement, have often been used interchangeably to describe this concept of presence (Lupinek et al. 2021). Of these terms, engagement specifically denotes the degree of connection or involvement and stands as a pivotal element in comprehending user behavior concerning the overall outcomes of their actions within computer-based environments (Wiebe et al. 2014). In this study, we employ the term engagement to represent the notion of presence. Engagement can be considered an important factor that would influence how effective a medium is in eliciting an anticipated outcome, such as increased engagement via TV or VR experience (Schutte and Stilinović 2017).

The level of engagement a medium can generate depends on the number of cues it provides. Different media vary in their capacity to reproduce social cues (Oh et al. 2016), and the effectiveness of communication and outcomes hinges on media richness (Otondo et al. 2008). According to the social presence theory, different communication media offer varying degrees of social presence, representing the sense of involvement and 'realness' that an experience conveys (Oh et al. 2016; Schutte and Stilinović 2017). These variations in social cues across media significantly influence the perception of social presence. Therefore, media that offer more social cues are often more interactive and are more likely to evoke greater engagement.

TV engagement involves viewers regularly watching a program from start to finish and having a strong affinity for it (Askwith 2007). TV serves as a versatile medium for news,

entertainment, and education. TV shows foster a sense of community and provide conversation topics among friends, colleagues, and family members, leaving a lasting impact on viewers and boosting engagement. In the context of TV ads, engagement refers to a mental connection, immersion, and presence with the advertisement, and it is a crucial metric for advertisers to assess the success of their campaigns and determine pricing (Kim et al. 2017).

Compared to less immersive technologies like TV, VR generates more social cues and hence greater engagement. The immersive nature of VR and its affordances, such as 3D immersive virtual environments, images, spatial sound quality, feedback, movement tracking, synchronized body movement, and interactivity, leads to body transfer and ownership, a sense of embodiment and presence, giving it an edge over less immersive technologies at increasing engagement (Ahn, Bailenson, and Park 2014; Cummings and Bailenson 2016; Schutte and Stilinović 2017; van Loon et al. 2018). Based on MRT and engagement studies, therefore, we hypothesize that:

- Hypothesis 2: The level of engagement with the virtual character and experience will be higher in VR than through on-screen TV.

Enjoyment and Usage Intentions

Perceived enjoyment refers to the extent to which the activity of using a specific system is perceived to be enjoyable, aside from any performance consequences resulting from system use (Venkatesh 2000). The primary psychological and hedonistic advantage that comes from using media is the perceived enjoyment, and this significantly impacts user acceptance and their intention to continue using it (Lee, Kim, and Choi 2019).

As Rideout (2016) noted, watching TV is a prevalent pastime. For example, in the US, individuals above 15 years of age spend an average of three hours per day watching TV, which accounts for about 78 percent of the population annually in 2021 (U.S. Bureau of Labor Statistics 2023) In Nigeria, the TV and video market has demonstrated significant growth, increasing by 7.5 percent to reach $806 million in 2020, up from $732 million in 2018. Subscription revenue stands as the primary driver of this market in Nigeria, constituting 72.3 percent of total earnings in the TV and video sector in 2018 (International Trade Administration 2023).

Previous work on the use of VR to influence enjoyment during exercise found that an immersive experience enhances the level of enjoyment. Past iterations of VR, which provided a less immersive experience using 2D screens like computers, TVs, or projectors, did not yield significantly higher levels of enjoyment when compared to more immersive VR experiences involving an HMD that allows for 360-degree exploration (Mouatt et al. 2020). Similar results were obtained from a study conducted by Ijaz et al. (2017), where enjoyment of a moderate physical activity was compared in two VR experiences. One experience was static while the other was more interactive. Although participants in both groups found VR enjoyable, those in the more interactive environment reported higher levels of engagement and thus enjoyment.

Enjoyment is influenced by how much agency a participant has when interacting in a VR environment. Li and Chen (2019) examined the effectiveness of VR for tourism marketing and found that perceived enjoyment of a tourist destination in VR significantly culminated in positive behavioral intentions to travel among tourists (Lee, Kim, and Choi 2019; Li and Chen 2019). A meta-analysis on the effect of enjoyment on technological acceptance found that perceived enjoyment significantly influences users' intention to use conventional and unconventional technology, including VR devices (El Shamy and Hassanein 2017). In the video game context, intrinsic motivation to play a game in future in VR is increased when playing a VR game is pleasurable (Jang and Park 2019).

The findings of previous studies suggest that intention is influenced by the extent of immersion of the experience. To the best of our knowledge, studies have not been carried out to explore the intention to use VR after watching a documentary. Based on MRT and previous studies, we hypothesize as follows:

- Hypothesis 3: Enjoyment of the virtual experience will be significantly higher in VR than through on-screen TV.
- Hypothesis 4: The intention to use the medium will be significantly higher for VR than for TV following the virtual experience.

Cultural Differences

Culture plays a pivotal role in the utilization of media, as individuals draw upon their cultural background to derive meaning from the signals provided by the technology they are employing (Gibson 2015). Previous research has also demonstrated that culture can determine individuals' attitudes toward and adoption of information technologies (Hassanein, Head, and Ju 2009; Yen and Tu 2011). Therefore, we argue that a media user's cultural experiences will likewise shape their interpretation of the cues embedded within the media content. Since the interpretations can vary, they have the potential to determine the degree of empathy a user feels toward the characters in the media content, their level of engagement with the material, the extent of enjoyment derived from consuming the content, and their intentions regarding the future use of the device.

Method

Research Design and Participants

A between-subject experimental study was conducted where technology type (VR headset vs. 2D screen TV) was manipulated to test the effect of technology type on individuals' empathy, engagement, enjoyment, and usage intentions. Study participants watched an animated documentary titled *Is Anna OK*? at two time points using a different device each time (see Table 1). The documentary is about the story of twin sisters (*Anna* and *Lauren*) whose lives

are profoundly altered by a car accident, when *Anna* sustains a head injury from being struck by a car. The segment of the documentary that participants viewed provided them with an opportunity to experience the perspective of *Anna*.

Table 1: Experimental Conditions and Randomization Table

Run Order	*Experimental Condition*	
	Day 1	*Day 2*
1 (n = 51)	VR	TV
2 (n = 50)	TV	VR

Participants were selected based on availability from a business school in Southwest Nigeria and a private university in the Northeastern US. To be included in the study, participants had to be students and have no history of epilepsy or seizures. Researchers assessed their eligibility and health risk by asking about any history of epilepsy or seizures during the recruiting process and before the first session. Participants were told that they would be part of a two-day study and were required to come to the lab twice at both locations respectively. Consent forms were signed by participants before taking part in the study. Participants (N = 101) were from Southwest Nigeria (n = 50) and Northeast US (n = 51). Most study participants were male (61.39%), undergraduate students (61.39%), and Black (60.40%). Participants' age ranged from 18 to 57 and their average age was 26.83 (SD = 8.00) (see Table 2).

We conducted a power analysis using G*Power 3.1.9.7 software (Faul et al. 2009) to determine the sample size required to identify the effects of the manipulations on technology type (effect size = 0.5, α level = 0.05, power = 0.80). The result of the power analysis revealed that this study required a total sample size of 102 to secure an actual power of 0.80. A total of 101 participants completed the study.

Table 2: Demographic Characteristics of Participants

Demographic Characteristic		*Total (N = 101)*		*Nigeria (N = 50)*		*US (N = 51)*	
		F	*%*	*F*	*%*	*F*	*%*
Gender	Male	62	61.39	27	54.00	35	68.63
	Female	39	38.61	23	46.00	16	31.37
Age	18–19	7	6.93	0	0	7	13.73
	20–24	45	44.55	6	12.00	39	76.47
	25–29	17	16.83	15	30.00	2	3.92
	30–34	16	15.84	15	30.00	1	1.96
	35–39	7	6.93	7	14.00	0	0
	40 or older	9	8.91	7	14.00	2	3.92
Race/Ethnicity	White	24	23.76	0	0	24	47.06
	Black	61	60.40	50	100.00	11	21.57
	Hispanic	8	7.92	0	0	8	15.69
	Asian	5	4.95	0	0	5	9.80
	Multi-racial/ethnic	3	2.97	0	0	3	5.88

Demographic Characteristic		*Total (N = 101)*		*Nigeria (N = 50)*		*US (N = 51)*	
		F	*%*	*F*	*%*	*F*	*%*
Monthly disposable income	Less than $100	30	29.70	10	10.00	20	39.22
	$100–$199	22	21.78	11	22.00	11	21.57
	$200–$299	17	16.83	9	18.00	8	15.69
	$300–$399	12	11.88	8	16.00	4	7.84
	$400 or more	20	19.80	12	24.00	8	15.69
Previous VR experience	Yes	40	39.60	13	26.00	27	52.94
	No	61	60.40	37	74.00	24	47.06
VR headset ownership	Yes	8	7.92	0	0	8	15.69
	No	93	92.08	50	100.00	43	84.31

We ensured that (1) data collection sequence was randomized and (2) experimental conditions were consistent within each location. Each participant was assigned a unique identifying number upon their arrival at the lab on the first day. For example, as displayed in Table 1, Participant 1 was assigned to the VR condition on Day 1 and the TV condition on Day 2 at both locations (i.e., run order 1). Participant 2 was assigned to the TV condition on Day 1 and the VR condition on Day 2 at both locations (i.e., run order 2). This alternating combination applied to the rest of the participants, and therefore, 51 participants were assigned to run order 1 and 50 participants were assigned to run order 2. Each participant was exposed to both experimental conditions, resulting in 202 runs in total.

Procedures

Approval from the Institution Review Board (IRB) was obtained from both institutions before data collection. The experiments took place in a lab equipped with an HMD, a laptop, and a TV. On arrival at the lab, participants were told to sit in front of a table and remain seated until the entire process was finished. Next, participants were informed about the consent process and provided with an overview of the IRB policies. The documentary is approximately five minutes long; however, in the VR version, participants can interact with the virtual environment, potentially extending the viewing time. We manipulated technology type by showing participants the documentary using either a VR headset or 2D screen TV for five minutes each time. Sickness, such as nausea, dizziness, and blurred vision, tends to increase in virtual environments, especially after 10 minutes of using HMDs (Moss and Muth 2011; Saredakis et al. 2020). While extensive interactive tests typically ranging from 10 to 15 minutes are appropriate for gauging participants' affective states (Vlahovic, Suznjevic, and Skorin-Kapov 2022), the duration of the documentary in this study aligns with safety and ethics guidance to protect participants from potential health risks.

In the VR condition, participants watched the documentary using *Oculus Rift S*, which provides 1280 × 1440 resolution, 110-degree field of view, and an 80 Hz refresh rate. In the TV condition, participants were exposed to the stimuli via a 2D TV screen, which was a 75" LCD

that provides 3840 × 2160 resolution. The experimental environment remained consistent across both conditions, with the only difference being the devices used. The research assistants assisted participants in properly wearing the VR headset to ensure comfort and clear vision during the VR condition. Participants also received brief instructions from research assistants on how to use the VR headset and maneuver the controller when attempting to reach and grab objects in the virtual world before using the headset. Immediately, each time after watching the documentary, participants completed an online survey to indicate their perceptions of Empathy, Engagement, Enjoyment, and Usage Intentions.

Measures

We measured Empathy, Engagement, Enjoyment, and Usage Intentions using existing scales (see Tables 3 and 4). More specifically, we measured empathy ($\alpha = 0.92$) with eight items adopted and modified from Davis (1983) and Schutte and Stilinović (2017). Engagement ($\alpha = 0.93$) was measured with seven items adopted and modified studies of Schutte and Stilinović (2017) and Wiebe et al. (2014). We measured enjoyment ($\alpha = 0.92$) using three items adopted from Davis et al. (1992). We also measured usage intentions ($\alpha = 0.92$) using three other items adopted from Cronin et al. (2000). Both empathy and engagement were measured using a 5-point Likert scale while enjoyment and usage intentions were measured using a 7-point Likert scale.

Table 3: Measured Response Variables and Survey Items

Variables	*Items*
Empathy ($\alpha = 0.92$)	1. I imagined myself to be in Anna's situation. [a] 2. I felt as if I were in Anna's shoes. [a] 3. I felt touched by Anna's situation. [b] 4. I felt sorry for Anna. [b] 5. I tried to see things from Anna's point of view. [a] 6. I felt compassion for Anna. [b] 7. I tried to take Anna's perspective. [a] 8. I felt protective toward Anna. [b]
Engagement ($\alpha = 0.93$)	1. I was absorbed. 2. I blocked out things around me. 3. The time just slipped away. 4. I lost track of the world around me. 5. I was so involved that I lost track of time. 6. During this experience, I let myself go. 7. I lost myself in this experience.
Enjoyment ($\alpha = 0.92$)	1. I found watching this documentary to be enjoyable. 2. The actual process of watching the documentary was pleasant. 3. I had fun watching this documentary.
Intentions ($\alpha = 0.92$)	1. The probability that I will use a VR headset[a]/TV[b] again is high. 2. The likelihood that I would recommend a VR headset/TV to a friend is high. 3. If I had to do it over again, I would use a VR headset/TV in the future.

Note: [a]Empathic perspective-taking. [b]Empathic concern.

Table 4: Means and Standard Deviations of Measurements

Sample	*Group*	*Empathy*		*Engagement*		*Enjoyment*		*Intentions*	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total	TV	3.36	0.82	2.74	0.92	4.59	1.31	4.58	1.71
(N = 101)	VR	4.18	0.65	4.16	0.72	5.95	1.26	6.43	0.88
Nigeria	TV	3.39	0.86	2.92	1.09	4.60	1.45	4.77	1.86
(n = 50)	VR	4.21	0.68	4.21	0.64	5.67	1.38	6.64	0.53
US	TV	3.33	0.79	2.56	0.70	4.59	1.16	4.39	1.54
(n = 51)	VR	4.15	0.62	4.11	0.80	6.24	1.08	6.22	1.09

Results

Using JASP, a one-way ANOVA was conducted to determine whether technology type (i.e., TV vs. VR headset) affects the level of participants' (1) empathy, (2) engagement, (3) enjoyment, and (4) usage intentions.

Main Effects of Technology Type on Empathy

One-way ANOVA results reveal that overall, a main effect of technology type was significant for Empathy on Day 1, $F(1,99) = 6.17$, $p < .05$, $\eta^2 = 0.06$ (see Table 5). Post hoc analysis showed that the participants who watched the documentary using a VR headset ($M = 4.00$, $SD = 0.64$) reported a slightly higher level of empathy than did those on TV ($M = 3.64$, $SD = 0.81$) on Day 1 (see Table 6). This difference increased on Day 2, as those who watched the documentary using the VR headset ($M = 4.36$, $SD = 0.60$) also showed a higher level of empathy than did those on TV ($M = 3.08$, $SD = 0.75$), $F(1,99) = 90.05$, $p < .001$, $\eta^2 = 0.48$.

Table 5: Main Effects of Technology Type: Means, Standard Deviations, and Factorial ANOVA in Empathy, Engagement, Enjoyment, and Intentions

Measure	*Time*	*TV*		*VR*		*F*	η^2
		M	*SD*	*M*	*SD*		
Empathy	Day 1	3.64	0.81	4.00	0.64	6.17	0.06*
	Day 2	3.08	0.75	4.36	0.60	90.05	0.48***
Empathic Perspective-Taking	Day 1	3.38	0.95	4.04	0.73	15.48	0.14***
	Day 2	2.82	0.91	4.36	0.68	91.91	0.48***
Empathic Concern	Day 1	3.81	0.75	3.98	0.70	1.30	0.01
	Day 2	3.30	0.82	4.25	0.64	42.41	0.30***
Engagement	Day 1	3.06	0.98	3.94	0.78	25.34	0.20***
	Day 2	2.42	0.75	4.38	0.58	217.85	0.69***
Enjoyment	Day 1	5.05	1.15	5.26	1.36	0.73	0.01
	Day 2	4.15	1.30	6.66	0.60	156.33	0.61***
Intentions	Day 1	5.15	1.52	6.30	1.01	19.88	0.17***
	Day 2	4.02	1.70	6.55	0.72	95.23	0.49***

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

Table 6: ANOVA Post Hoc Results: Main Effects of Technology Type

Day	*Dependent Variable*	*Group*	*Comparison*	*Mean Difference*	*SE*
1	Empathy	TV	VR	–0.36*	0.15
	Empathic Perspective-Taking			–0.66***	0.17
	Engagement			–89***	0.17
	Intentions			–1.15***	0.26
2	Empathy	TV	VR	–1.28***	0.14
	Empathic Perspective-Taking			–1.54***	0.16
	Empathic Concern			–0.95***	0.15
	Engagement			–1.96***	0.13
	Enjoyment			–2.51***	0.20
	Intentions			–2.53***	0.26

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

Nigerian Sample

Day 1: As presented in Table 7, there was no significant difference in the level of empathy between the Nigerian participants who watched the documentary on TV and using a VR headset on Day 1, $F(1,48) = 3.96$, $p < .001$, $\eta^2 = 0.08$ (see Table 8). Of the two aspects of empathy, however, the main effect of technology type was found to be significant on empathic perspective-taking for the Nigerian participants on Day 1, with $F(1,48) = 6.34$, $p < .05$, $\eta^2 = 0.12$. Post hoc analysis showed that the Nigerian participants who watched the documentary using the VR headset ($M = 3.97$, $SD = 0.85$) felt a higher level of empathic perspective-taking than those who did on TV ($M = 3.28$, $SD = 1.08$). There was no significant difference, however, in the level of the other aspect of empathy (empathic concern) between the Nigerian participants who watched the documentary on TV and using a VR headset on Day 1, $F(1,48) = 1.09$, $p = .30$, $\eta^2 = 0.02$.

Day 2: A main effect of technology type was significant on Empathy for the Nigerian participants, on Day 2, $F(1,48) = 35.64$, $p < .001$, $\eta^2 = 0.43$. Post hoc analysis revealed that the Nigerian participants who watched the documentary using the VR headset ($M = 4.38$, $SD = 0.54$) felt a higher level of empathy than those who did on TV ($M = 3.22$, $SD = 0.80$). More specifically, those who watched the documentary using the VR headset ($M = 4.36$, $SD = 0.64$) felt a higher level of empathic perspective-taking than those who did on TV ($M = 2.96$, $SD = 0.97$), $F(1,48) = 35.64$, $p < .001$, $\eta^2 = 0.43$. Similarly, those who used the VR headset ($M = 4.40$, $SD = 0.56$) also reported a higher level of empathic concern compared to those who watched it on TV ($M = 3.48$, SD = 0.89), $F(1,48) = 19.08$, $p < .001$, $\eta^2 = 0.28$.

Table 7: Main Effects of Technology Type: Means, Standard Deviations, and Factorial ANOVA in Empathy, Engagement, Enjoyment, and Intentions (Nigerian Sample; $N = 50$)

Measure	*Time*	*TV (n = 25)*		*VR (n = 25)*		*F*	η^2
		M	*SD*	*M*	*SD*		
Empathy	Day 1	3.56	0.90	4.03	0.76	3.96	0.08
	Day 2	3.22	0.80	4.38	0.55	35.64	0.43***
Empathic Perspective-Taking	Day 1	3.28	1.08	3.97	0.85	6.34	0.12*
	Day 2	2.96	0.97	4.36	0.64	36.50	0.43***
Empathic Concern	Day 1	3.83	0.85	4.08	0.84	1.09	0.02
	Day 2	3.48	0.89	4.40	0.56	19.08	0.28***
Engagement	Day 1	3.22	1.19	3.99	0.73	7.65	0.14**
	Day 2	2.61	0.89	4.43	0.44	83.82	0.64***
Enjoyment	Day 1	5.13	1.38	4.47	0.89	4.10	0.08
	Day 2	4.07	1.34	6.87	0.29	104.80	0.69***
Intentions	Day 1	5.29	1.74	6.52	0.63	10.95	0.19**
	Day 2	4.25	1.86	6.76	0.39	43.45	0.48***

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

Table 8: ANOVA Post Hoc Results: Main Effects of Technology Type (Nigerian Sample; $N = 50$)

Day	*Dependent Variable*	*Group*	*Comparison*	*Mean Difference*	*SE*
1	Empathic Perspective-Taking	TV	VR	–0.69*	0.27
	Engagement			–0.77**	0.28
	Intentions			–1.23**	0.37
2	Empathy	TV	VR	–1.16***	0.19
	Empathic Perspective-Taking			–1.40***	0.23
	Empathic Concern			–0.92***	0.21
	Engagement			–1.82***	0.20
	Enjoyment			–2.80***	0.27
	Intentions			–2.51***	0.38

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

US Sample

Day 1: A main effect of technology type was not significant on Empathy among US participants on Day 1, $F(1,49) = 2.12$, $p = .15$, $\eta^2 = 0.04$ (see Table 9). Regarding the two aspects of empathy, US participants who watched the documentary using the VR headset ($M = 4.12$, $SD = 0.61$) felt a higher level of empathic perspective-taking than those who did on TV ($M = 3.48$, $SD = 0.81$), $F(1,49) = 10.08$, $p < .01$, $\eta^2 = 0.17$ (see Table 10). There was no significant difference, however, in the level of empathic concern between US participants who watched the documentary on TV and using a VR headset on Day 1, $F(1,49) = 0.26$, $p = .62$, $\eta^2 = 0.01$.

Table 9: Main Effects of Technology Type: Means, Standard Deviations, and Factorial ANOVA in Empathy, Engagement, Enjoyment, and Intentions (US Sample; $N = 51$)

Measure	*Time*	*TV*		*VR*		*F*	η^2
		M	*SD*	*M*	*SD*		
Empathy	Day 1	3.72	0.71	3.97	0.51	2.12	0.04
	Day 2	2.94	0.67	4.34	0.67	55.64	0.53***
Empathic Perspective-Taking	Day 1	3.48	0.81	4.12	0.61	10.08	0.17**
	Day 2	2.69	0.86	4.36	0.74	55.26	0.53***
Empathic Concern	Day 1	3.79	0.66	3.88	0.54	0.26	0.01
	Day 2	3.12	0.71	4.09	0.68	24.94	0.34***
Engagement	Day 1	2.89	0.70	3.90	0.84	21.34	0.30***
	Day 2	2.24	0.52	4.33	0.69	148.16	0.75***
Enjoyment	Day 1	4.96	0.88	6.03	1.30	11.58	0.19**
	Day 2	4.22	1.29	6.45	0.75	57.60	0.54***
Intentions	Day 1	5.01	1.29	6.09	1.25	9.22	0.16**
	Day 2	3.80	1.54	6.35	0.91	52.30	0.51***

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

Table 10: ANOVA Post Hoc Results: Main Effects of Technology Type (US Sample; $N = 51$)

Day	*Dependent Variable*	*Group*	*Comparison*	*Mean Difference*	*SE*
1	Empathic Perspective-Taking	TV	VR	–0.64**	0.20
	Engagement			–1.01***	0.22
	Enjoyment			–1.07**	0.31
	Intentions			–1.08**	0.36
2	Empathy	TV	VR	–1.40***	0.19
	Empathic Perspective-Taking			–1.67***	0.23
	Empathic Concern			–0.97***	0.20
	Engagement			–2.09***	0.17
	Enjoyment			–2.23***	0.30
	Intentions			–2.55***	0.36

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

Day 2: The US participants who watched the documentary using the VR headset ($M = 4.34$, $SD = 0.67$) felt more empathy than those who did on TV ($M = 2.94$, $SD = 0.67$), on Day 2, $F(1,49) = 55.64$, $p < .001$, $\eta^2 = 0.53$. More specifically, of the two aspects of empathy, US participants who watched the documentary using the VR headset ($M = 4.36$, $SD = 0.74$), felt a higher level of empathic perspective-taking than those who did on TV ($M = 2.69$, $SD = 0.86$), $F(1,49) = 55.26$, $p < .001$, $\eta^2 = 0.53$. Those who watched the documentary using the VR headset ($M = 4.09$, $SD = 0.68$) also felt a higher level of empathic perspective-taking than those who did on TV ($M = 3.12$, $SD = 0.71$), $F(1,49) = 24.94$, $p < .001$, $\eta^2 = 0.34$.

Hypothesis 1 posits that engaging in the perspective of a character through an immersive VR experience will lead to greater empathy compared to perspective-taking while watching a character on a TV screen. This hypothesis has been accepted.

Main Effects of Technology Type on Engagement

One-way ANOVA results reveal that overall, a main effect of technology type was significant on Engagement on Day 1, $F(1,99) = 25.34$, $p < .001$, $\eta^2 = 0.20$. Post hoc analysis shows that the participants who watched the documentary using a VR headset ($M = 3.94$, $SD = 0.78$) reported a higher level of engagement than did those on TV ($M = 3.06$, $SD = 0.98$) on Day 1. This difference was magnified on Day 2, as those who watched the documentary using the VR headset ($M = 4.38$, $SD = 0.58$) also demonstrated a higher level of engagement than did those on TV ($M = 2.42$, $SD = 0.75$), $F(1,99) = 217.85$, $p < .001$, $\eta^2 = 0.69$.

Nigerian Sample

Day 1: Those who used the VR headset ($M = 3.99$, $SD = 0.73$) compared to those who watched on TV ($M = 3.22$, $SD = 1.19$) had a significantly more engaging experience while watching the documentary for the Nigerian participants on Day 1, $F(1,39.78) = 7.65$, $p < .01$, $\eta^2 = 0.14$.

Day 2*:* This difference was magnified on Day 2, as the Nigerian participants who watched the documentary using the VR headset ($M = 4.43$, $SD = 0.44$) demonstrated a significantly higher level of engagement compared to those who watched it on TV ($M = 2.61$, $SD = 0.89$) on Day 2, $F(1,34.83) = 83.82$, $p < .001$, $\eta^2 = 0.64$.

US Sample

Day 1: US participants who watched the documentary using the VR headset ($M = 3.90$, $SD = 0.84$) compared to those who watched it on TV ($M = 2.89$, $SD = 0.70$) demonstrated significantly higher Engagement on Day 1, $F(1,49) = 21.34$, $p < .001$, $\eta^2 = 0.30$.

Day 2*:* This difference in engagement was even more pronounced for the US sample on Day 2 than Day 1. The US participants who used the VR headset ($M = 4.33$, $SD = 0.69$) were significantly more engaged than those watched it on TV ($M = 2.24$, $SD = 0.52$) when viewing the documentary on Day 2, $F(1,49) = 148.16$, $p < .001$, $\eta^2 = 0.75$.

The results support Hypothesis 2 that the level of engagement with the virtual character and experience will be higher in VR than through on-screen TV.

Main Effects of Technology Type on Enjoyment

There was no significant main effect on enjoyment between the participants overall who watched the documentary using a VR headset versus those who watched it on TV on Day 1, $F(1,99) = 0.73$, $p = .39$, $\eta^2 = 0.01$. On Day 2, however, those who watched the documentary using the VR headset ($M = 6.66$, $SD = 0.60$) demonstrated a higher level of enjoyment than did those on TV ($M = 4.15$, $SD = 1.30$), $F(1,70.39) = 156.33$, $p < .001$, $\eta^2 = 0.61$.

Nigerian Sample

Day 1*:* There was no significant main effect on enjoyment between the participants who watched the documentary on TV versus those who watched it using the VR headset on Day 1, $F(1,40.87) = 4.10$, $p = .05$, $\eta^2 = 0.08$.

Day 2*:* Conversely, the Nigerian participants who watched the documentary using the VR headset ($M = 6.87$, $SD = 0.29$) enjoyed it more than those who watched it on TV ($M = 4.07$, $SD = 1.34$) on Day 2, $F(1,26.23) = 104.80$, $p < .001$, $\eta^2 = 0.69$.

US Sample

Day 1*:* US participants who watched the documentary using the VR headset ($M = 6.03$, $SD = 1.30$) enjoyed it more than those who watched it on TV ($M = 4.96$, $SD = 0.88$) on Day 1, $F(1,49) = 11.58$, $p < .01$, $\eta^2 = 0.19$.

Day 2*:* The difference in enjoyment was amplified for US participants on Day 2. US participants who watched the documentary using the VR headset ($M = 6.45$, $SD = 0.75$) enjoyed it more than those who watched it on TV ($M = 4.22$, $SD = 1.29$) on Day 2, $F(1,40.27) = 57.60$, $p < .001$, $\eta^2 = 0.54$.

Hypothesis 3 is partially accepted, as on Day 1, the Nigerian sample enjoyed the documentary more on TV, although this difference was not statistically significant.

Main Effects of Technology Type on Intentions

The results of the one-way ANOVA test indicate that, overall, participants who used the VR headset to watch the documentary on Day 1 ($M = 6.30$, $SD = 1.01$) reported a greater intention to use the device in the future compared to those who watched it on TV ($M = 5.15$, $SD = 1.52$), with a significant difference, $F(1,84.89) = 19.88$, $p < .001$, $\eta^2 = 0.17$. This difference became more pronounced on Day 2, as participants who used the VR headset ($M = 6.55$, $SD = 0.72$) reported even higher intentions to use the device in the future compared to those who watched it on TV ($M = 4.02$, $SD = 1.70$), with a highly significant difference, $F(1,67.78) = 95.23$, $p < .001$, $\eta^2 = 0.49$.

Nigerian Sample

Day 1*:* Nigerian participants who watched the documentary using a VR headset ($M = 6.52$, $SD = 0.63$) reported a higher level of intentions to use the device in the future than the intentions to use TV for those who watched it on TV ($M = 5.29$, $SD = 1.74$), $F(1,30.21) = 10.95$, $p = .01$, $\eta^2 = 0.19$.

Day 2*:* The difference in usage intentions was magnified for Nigerian participants on Day 2. Nigerian participants who watched the documentary using a VR headset ($M = 6.76$, $SD = 0.39$) reported a higher level of intentions to use the device in the future than the intentions to use TV for those who watched it on TV ($M = 4.25$, $SD = 1.86$), $F(1,26.12) = 43.45$, $p < .001$, $\eta^2 = 0.48$.

US Sample

Day 1*:* US participants who watched the documentary using a VR headset ($M = 6.09$, $SD = 1.25$) reported a higher level of intentions to use the device in the future than the intentions to use TV for those who watched it on TV ($M = 5.01$, $SD = 1.29$) on Day 1, $F(1,49) = 9.22$, $p < .01$, $\eta^2 = 0.16$.

Day 2*:* The contrast in future usage intentions became more pronounced among US participants on Day 2. Those Nigerian participants who viewed the documentary through a VR headset ($M = 6.35$, $SD = 0.91$) expressed stronger intentions to use the VR device in the future compared to individuals who watched it on TV ($M = 3.80$, $SD = 1.54$), $F(1,40.83) = 52.30$, $p < .001$, $\eta^2 = 0.51$.

Overall, the intention to use VR was significantly higher than TV; we therefore accept Hypothesis 4.

Discussion

The primary aim of this study was to determine whether technology type (TV vs. VR headset) affects the level of empathy, engagement, enjoyment, and usage intentions. Each participant was exposed to both devices after completing their second session.

Empathy

Our findings suggest that the vivid, immersive visuals, and interactive features make VR a rich medium, offering users experiences akin to physical presence. Consequently, users feel more empathy, encompassing both empathic perspective-taking and empathic concern. The findings particularly highlight the effectiveness of VR in enhancing conscious and effortful mental processes, such as empathic perspective-taking (Martingano, Hererra, and Konrath 2021). The immersive nature of VR allows the user to be 'transported' into another's situation or experience in a way that they come closer to others through perspective-taking (Barbot and Kaufman 2020; Bujić et al. 2020). VR brings users closer to otherwise distant or hard-to-understand experiences (Herrera et al. 2018). Some researchers have questioned the role of VR in enhancing the effortful aspect of empathy. For example, VR's capacity to evoke empathy might not inherently lead to prosocial responses (Carey et al. 2017), as empathy is a 'neutral' attitude that does not guarantee subsequent compassion or social action (Martingano et al. 2023). Despite these skepticisms, our study makes a case for enhancing empathy through VR, which is a necessary sine qua non trait that must precede prosocial actions.

Given that empathic concern is more intuitive and demands fewer mental resources for processing than empathic perspective-taking (Raine, Chen, and Waller 2022), it appears that the level of immersion or the type of technology did not significantly impact the elicitation of empathic concern on Day 1. When the participants were initially exposed to the stimulus on Day 1, they naturally felt empathic concern for Anna regardless of the technology they used, indicating

that both devices similarly triggered their emotional response. After viewing the documentary with either a less immersive or more immersive device, participants then compared their experiences. In other words, on Day 2, the intensity of their documentary-watching experience may have changed as they had a reference point with different technology. Those who used the less immersive device (TV) on Day 2 after experiencing a more immersive device (VR) on Day 1 found their Day 2 experience less intense, reducing their empathic concern. Conversely, participants who used a less immersive device on Day 1 and a more immersive device on Day 2 found their second experience more intense, increasing their empathic concern. These findings suggest that the interactive and immersive qualities of VR effectively elicit emotional responses in participants, specifically eliciting empathic concern from users, following the participants' exposure to both devices. That is, VR headsets allow users to view the world from another person's perspective, which might, in turn, trigger an emotional reaction to that perspective (Davis 1983).

Engagement

The perceptual and physiological systems work in VR in the same way that they do in the real world (Bailenson 2018). Users are more likely to be engaged when the device can engage the user in authentic perspective-taking, not primarily due to technologically driven immersion (Barbot and Kaufman 2020). As Shin and Biocca (2018) suggested, users voluntarily initiate their inherent cognitive processes in VR, as they find it meaningful and worthwhile to engage in and derive enjoyment from demanding cognitive tasks. In our study, the participants' role was limited to being a passive viewer in the TV condition. Contrary to the TV condition, they had greater autonomy, embodying Anna through a first-person perspective in the VR condition. This allowed them to interact with objects (e.g., a plate, a coffee cup, a paper airplane) and control viewing angles within the VR space as if the participants were in her shoe.

The present study confirms VR's interactivity and ability to enhance users' feeling of presence, which detaches users from physical reality, and thus they have a more engaging experience when using a VR headset than on TV. The level of user engagement notably increases when using a VR headset through the combination of high-quality visuals and emotional engagement (Shin 2018; Shin and Biocca 2018). It is also important to note that VR users' experience and engagement may have been similar to the TV users if the interactive features were not supported by the VR headset. For example, the interactive features of Is Anna Okay are supported by Oculus Rift S, but not by a more recent version, Oculus Quest 2. Although Oculus Quest 2 supports higher sound, visual, and haptic quality than Oculus Rift S, it allows users for less autonomy than Oculus Rift S as they do not have control over objects in the video.

The difference in the level of engagement between VR and TV could also be attributed to the extent of distraction. Specifically, participants might have been more prone to distraction by their surroundings when watching the documentary on TV, as the TV was integrated into the lab environment with external lighting and the presence of a researcher (Yoo, Ohu, and Ohu 2022). In contrast, when they viewed the documentary using a VR

headset, they were isolated from their immediate environment and could exclusively focus on the story presented by the device (Herrera et al. 2018).

Enjoyment and Usage Intentions

The findings of the present study highlight the effectiveness of VR headsets to elicit enjoyment from users. Specifically, while VR demands users to put forth conscious effort and intentionally work toward immersion, they enjoy the efforts and experiences (Shin 2018; Shin and Biocca 2018). One unanticipated finding was that on Day 1, the Nigerian participants in the TV group enjoyed their experience more than the VR group. We presume that the Nigerian participants in the TV group's experience was immersive enough when they were watching the documentary on TV on Day 1 because they were already familiar with TV. Their enjoyment level was not only higher than the VR group on Day 1 but also magnified when they switched to a VR headset on Day 2. That is, this immersive and enriched experience was strengthened when they switched their device to a VR headset, and therefore, their experience was more enjoyable.

The Nigerian participants in the VR group's enjoyment level was lower than the TV group on Day 1 and actually reduced when they switched to TV on Day 2. It should be noted that most Nigerian participants (74%) had no previous VR experience while more than a half (52.94%) of US participants did. The Nigerian participants who watched the documentary using a VR headset on Day 1 may have been overwhelmed by the realistic and vivid experience in the VR environment due to high-quality visual, sound, and haptic effects. The Nigerian participants in the VR group, therefore, may have been distracted by the novel VR headset and needed time to get used to the device on Day 1. They may also have been disoriented between reality and the VR environment due to their lack of familiarity with a VR headset. Both a VR headset and the documentary were novel to the participants until their first research session, and they could have developed their expectations based on their documentary-watching experience on Day 1. We surmise that their experience may have been underwhelming due to a lack of immersive and interactive features when they watched the documentary on their second day on TV.

Considering VR's ability to enhance empathy, engagement, and enjoyment, users' intentions to use and recommend a VR headset was foreseeable. Users actively desire to persist in their efforts to become acclimated to the immersive virtual space and strive to understand the characters portrayed in the device, believing that their efforts are indeed worthwhile (Shin and Biocca 2018). With advancing technology and more affordable devices available on the market, it is highly likely that the VR market will continue to grow.

Many of the findings reported above provide evidence for the superiority of VR with respect to the outcome variables of empathy, engagement, enjoyment, and intention to use. The result of the Nigerian participants on enjoyment may help to further buttress this. Consider that on Day 1 there was no significant difference in the enjoyment between those who used TV

and those who used VR, but that on Day 2, those who used VR enjoyed it the most. Consider further that since the participants were alternating between TV and VR, it is the same participants who on Day 1 (using TV) but who on Day 2 (using VR) had a more enjoyable experience, VR can be adduced as the major contributor to the increased enjoyment.

Theoretical and Practical Implications

The findings confirmed that VR generates superior media effects compared to those generated by TV. According to MRT, these findings support the classification of VR as a 'rich medium' and TV as a 'lean medium,' given VR's capacity to effectively convey meaning and messages (Ishii, Lyons, and Carr 2019; Yoo and Drumwright 2018). Previous studies have explored how technology affects empathy using powerful but poignant narratives like *Clouds Over Sidra* (e.g., Shin 2018) and *iAnimal* (e.g., Cecil 2021). Some researchers argued that emotional mirroring-induced altruism is a rudimentary form of empathy and not morally significant (Nakamura 2020; Rueda and Lara 2020). Solely focusing on the emotional aspect of empathy does not enhance morality effectively (Rueda and Lara 2020). Additionally, media content, whether empathy-inducing or not, does not significantly affect the user's empathy (Barbot and Kaufman 2020). Although the stimulus, *Is Anna Okay*, of the current study did not appear to excessively emphasize emotion, the immersive and interactive nature of VR, as a rich medium, underscores its effectiveness in eliciting emotional, cognitive, and behavioral responses.

The results also broaden the scope of the ecological approach's relevance to visual perception (Gibson 2015). According to the ecological approach, perception is influenced by the observer's ability to carry out intended actions (Witt and Riley 2014). Considering VR as a rich medium, its affordances improve users' perception of empathy, engagement, and enjoyment. More specifically, VR surpasses traditional TVs in terms of its ability to elicit emotional, cognitive, and behavioral responses because it affords high levels of immersion and replicates real-world experiences in terms of size, distance, depth, and action capabilities (Bhargava et al. 2020). VR achieves greater immersion than TV by, among other means, fully covering the eyes with the HMD, which blocks out external light sources and envelops the user within the medium. It also offers a 360-degree view that is more multidimensional than the planar view of a TV. The controllers offer a level of interactivity with the virtual objects and environment that TV does not have. This immersion and interaction contribute to the affordance of VR whereby a user can be transported into a different situation or experience as if they were there (Shin 2019). This sense of presence in VR, therefore, leads to increased perspective-taking and hence a greater possibility of putting oneself in the shoes of another—empathy.

The study makes major contributions to our understanding of how VR might be deployed in education and learning. There are different learning styles: auditory, visual, and kinesthetic. VR engages all these senses, more than TV does. Those who engaged with the experience in VR could hear, see, and touch, the latter using the VR controllers to move objects in the room.

According to the sensory theory of learning (Laird 1985), engagement of the senses is more likely to result in more learning and longer retention of learned materials.

Empathy is an important and desired trait for healthcare professionals because it enables them to better understand and identify with the experiences of their patients. VR experiences will give them a first-person perspective of what their patients are going through. They are thus able to adopt a more humane approach, based on an improved understanding. Family members of patients who are exposed to a VR depiction of patient conditions would also benefit from this increased understanding. These (for both healthcare professionals and family members) should lead to improved patient compliance as well as improved prognosis in medical conditions and outcomes.

Compared to US participants, the Nigerians enjoyed the experience on TV more on Day 1 than on Day 2, when they considered the VR experience more pleasant. It thus appeared that there was a necessary 'getting used to' familiarization period for the VR device. The participants' unfamiliarity with the technology may have acted as a distraction. This would suggest that in deploying VR for any interventions—either in training or real-life scenarios, it may be necessary to 'onboard' especially first-time users. This onboarding, or introduction can take the form of teaching them the parts of the device and controls, as well as internal scenarios that get them familiar with the experience itself.

The comparison between TV and VR, with the result that participants experienced greater empathy and engagement in VR compared to TV also confirms the superiority of spatial computing, which is what VR and other immersive technologies promise us. People who tell stories using TV would rely increasingly on VR in order to achieve the desired engagement with the audience. 3D stories presented in VR would be more engaging, also due to providing increased agency to the user. 3D stories presented in extended reality (of which VR is a part) could be presented in a greater space and not limited to the size of a physical screen, because the user can turn and oscillate around a physical space in order to engage with more digital elements. This holds promise for changing the future of TV as we currently know it. Understanding what increased the engagement of users within a digital experience is key to ensuring both prolonged and repeated experience of the medium. The study advances our understanding of what makes for a more engaging viewing experience.

Limitations and Future Research

A few limitations exist in the study despite the potential contribution of the study to the body of literature. We gathered data from two different geographic regions using a cross-sectional approach. The factorial and random designs implemented in our experiment, however, serve as a counterbalance to the potential drawbacks of the cross-sectional design. Although the results were consistent across the samples (i.e., Nigeria and the US), it would be interesting to see if longitudinal design would still reveal consistent results both within and between the countries.

For example, considering that most Nigerian participants were not familiar with VR, it would be interesting to observe whether the results differ as the Nigerian participants become more acquainted with the VR device.

This study confirms that technology can serve as a positive tool for enhancing empathy, showing the greater impact of the immersive technology of VR. Nevertheless, it is important to note that participants might have come to the study already in possession of varying levels of empathy prior to their involvement in the study. Therefore, future studies should consider taking into account participants' baseline empathy when investigating the impact of technology on empathy.

The study demonstrates that by taking on the perspective of a virtual character, participants can improve their understanding of others' emotions as well as increase their motivation to act. This, in turn, leads to increased care and concern for the target, which may result in meaningful behavioral changes (Rueda and Lara 2020). It would therefore be interesting if future studies could examine (using different scenarios) whether such an intervention can result in changes in behaviors such as participants deciding to donate or to support a social cause.

Conclusion

This study showed that overall, experiencing another's reality through VR, compared to TV, leads to higher empathy and higher engagement, which has implications for more future adoption of immersive technologies. The findings for enjoyment and intention to use for participants from both countries were similar irrespective of the medium of consumption, with TV and VR showing comparable values. This suggests that there may be other factors at play in explaining both enjoyment and intention to use. As the world increasingly adopts immersive and spatial computing for work and play, this study makes some valuable contributions to our understanding of what works in VR and why it does.

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The authors declare that generative AI or AI-assisted technologies were not used in any way to prepare, write, or complete essential authoring tasks in this manuscript.

Informed Consent

The authors have obtained informed consent from all participants.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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