SAINT PETERSBURG STATE UNIVERSITY
High School of Journalism and Mass Communications
Faculty of Journalism

Polina (Eduardovna) Maslova

Immersive Journalism: User Experience of Virtual Reality Storytelling

A case study of the VR film 'Our Home, Our People'

Master profile - «Global Communication and International Journalism»

MASTER THESIS

Scientific supervisor -
docent, Philological sciences candidate
Alexander Yakunin

№____Date_____
Secretary of the SAC_____

Saint Petersburg
2018

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Introduction

Immersive and interactive technologies such as Virtual Reality (VR) are a new milestone in the way we interact with our environment. VR and other immersive Information and Communication Technologies (ICT) have a high potential for transforming the real world and the way in which we interact with it. Thus, VR can be a powerful tool to bring about changes in social reality itself. It appears relevant to define and analyze its potential implications and influence on how new media and communication technologies can create new messages and cultural approaches.

The VR hardware that emerged in the 1980s was largely confined to specialist laboratories.[1] Yet, VR continued to expand its reach and relevancy and is now considered to be largely about 'providing understanding—whether that is understanding an entertaining story, learning an abstract concept, or practicing a real skill.'[2]

Thus, although this medium has decades of history, it is the recent surge of technical and social interest, its new relevance for storytelling, and the journalism industry's pressing need to keep innovating that have all come together to make this research opportune.

The convergence of digital technologies, the Internet, and mobile media which we witness today drastically transforms the content and storytelling possibilities of journalism, marketing, and other communication related spheres. Unique storytelling forms, such as VR, emerge in this convergent environment.

The focus in our study is the innovative ways stories are told through the relatively new technology known as virtual reality. Our research is aimed at understanding the user experience of VR storytelling. We know that users already enjoy the possibility to play video games or ride a rollercoaster using a VR headset,

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[1] Slater, M., & Sanchez-Vives, M. V. (2016). Enhancing our lives with immersive virtual reality. Frontiers in Robotics and AI, 3, 74.

[2] Jerald, J. (2015). The VR book: Human-centered design for virtual reality. Morgan & Claypool, p. 12.

but what about watching a VR feature film or a documentary? What is the potential for storytelling in virtual reality? Can this technology change the way people think about the stories and the people reported in them? Can VR impact how people see the world and affect their intentions to make it better?

To answer these questions, we begin with a discussion of the theoretical considerations of VR, immersive journalism, storytelling, and major VR-related theories and conceptualizations. Against this background, we conducted an experiment to test how users will react to a VR story compared to a regular digital video. For our research, we chose a VR film called ‘Climate Change in Fiji in VR: ‘Our Home, Our People’’. To immerse the participants into the story, we used the Google Cardboard device.

After the experiment, the users were asked to fill in a questionnaire measuring transportation, attitudes, empathy, behavioral intention, and fact recall. Those who viewed a VR story were also interviewed by the author in order to better understand the user experience of VR storytelling. Following this experiment, we extend our analysis to the broader development of VR as a potential form of storytelling in mainstream journalism or marketing, as well as other potential applications of VR.

Our study might be of interest to everybody who is excited about the cutting edge technology and its application in different industries. We hope that this research will help both VR creators and VR consumers better engage with the promising VR technology while staying aware of its opportunities and challenges.

Chapter I. Immersive Journalism and Virtual Reality

§ 1. Theoretical Background

1.1 Concept of Immersive Journalism

The concept of *immersive journalism* was introduced by de la Peña et al. (2010) as 'the production of news in a form in which people can gain first-person experiences of the events or situation described in news stories.'[1] To achieve the state of immersion, they used virtual reality (VR) technologies, such as head-mounted displays (HMDs), to enable people to enter virtual worlds and scenarios depicting real news stories.

Nonetheless, much earlier, in the 1990s, Biocca and Levy (1995) discussed the possibilities of applying VR technology for journalistic objectives. According to them, VR holds a high potential for fulfilling 'the oldest dream of the journalist, to conquer time and space'[2] by creating 'a sense on the part of audiences of being present at distant, newsworthy locations and events'. Transporting the audience from the actual physical world to the story world lies at the core of any form of storytelling. Immersion in journalism relates closely to narrative transportation theory. The theory suggests that a user's cognitive process, attitudes, and beliefs can change when the user is 'transported from the real world to a story world'[3] through an immersive narrative such as VR. (Green and Brock, 2000).

Even though modern journalism is engaged with a variety of interactive formats, such as interactive maps (Parasie and Dagiral, 2013) and news games (Bogost et al., 2012), Nonny de la Peña, the pioneer of VR storytelling, makes a distinction between these 'interactive journalism or low-level immersive journalism'

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[1] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), p. 291.

[2] Biocca, F., and Levy, M. R. (1995). Communication applications of virtual reality. *Communication in the Age of Virtual Reality*, eds F. Biocca and M. R. Levy (Hillsdale, NJ: Lawrence Erlbaum Associates), p. 137.

[3] Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of personality and social psychology*, *79*(5), p. 701.

forms and 'deep immersive journalism', in which the user can 'feel that his or her actual location has been transformed to the location of the news story.'[1]

In effect, the most common way to experience immersive journalism is via inexpensive HMDs, such as the Google Cardboard, and 360° videos which allow immersing the audience in the location of the story. One of the oldest American newspapers, *The New York Times*, is considered one of the pioneers of immersive journalism. They were the first media organization to give out the Google Cardboard viewer to their subscribers so that they could experience 360° videos, for example, *The Displaced,* one of *The New York Times'* first immersive journalism mini-documentaries about three refugee children forced to leave their homes in Lebanon, South Sudan, and Ukraine. Even more, *The New York Times* has developed a channel featuring 360° videos only.

Yet, along with visually immersing publics in the location of the story, VR researches argue that it is even more crucial that the user's 'actual body has transformed, becoming a central part of the news story itself.'[2] An experiment was hold where the head rotations of the user were tracked and then applied to the head of a virtual avatar representing a Guantanamo Bay captive, which could be seen from both a first-person perspective and a third-person perspective. The experiment was designed to test the sense of body ownership of the virtual avatar within the audience members. The concept of body ownership will be discussed in more detail later in this chapter.

However, the notion of body ownership has not been truly realized by the majority of journalists working with VR technology. Instead, immersive media, experienced by the public, lack interactivity as they do not represent the viewer's real or virtual body. 360° videos produced nowadays, as a rule, do not provide a

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[1] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), p. 293.

[2] Ibid.

possibility to gain a first-person experience. But for the 360° angle, they do not differ significantly from the regular 2D videos.

Such practices illustrate a major disconnect in the current state of immersive journalism production. Overall, to tell effective stories, journalists should better understand the capacities and limitations of immersive technologies, while VR developers need to understand the requirements imposed by journalism as well as the basics of storytelling.

In 2017, 'to address these gaps and help guide journalists and developers new to immersive journalism,'[1] Hardee and McMahan created a Framework for the Immersion-Journalism Intersection (FIJI). Inspired by various experiments with immersive technology implemented by different media outlets, this theoretical framework is designed to remind both journalists and developers of the essential requirements that converge while creating immersive journalism pieces. FIJI can be used as a guide for both journalists and developers working in the VR field nowadays.

FIJI outlines the fundamentals of immersion and how they influence various aspects of the user's experience. This framework also refers to the possibilities and limitations of the current immersive technologies employed by journalists, such as '360° videos, computer graphics (CG)-based mobile VR, room-scale VR, handheld augmented reality (AR), and head-worn AR.'[2] Finally, FIJI analyzes the foundations of journalism as a profession, including the qualifications necessary to achieve journalistic excellence.

The FIJI framework distinguishes four types of journalistic stories. They are breaking news, public service, investigative reporting, and explanatory reporting—and their core journalistic requirements. Lastly, Hardee and McMahan have used these four domains of knowledge and their intersection within FIJI to formally define

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[1] Hardee, G. M., & McMahan, R. P. (2017). FiJi: a Framework for the immersion-Journalism intersection. *Frontiers in ICT*, *4*, 21, p. 2.

[2] Ibid.

'four types of immersive journalism that are appropriate for public dissemination.'[1] They are: 360° breaking news videos, mobile immersive public service, CG-based immersive investigations, and immersive explanatory reports.

Pioneering Immersive Journalism

While the potential of immersive technologies for journalism was first publicly discussed by Biocca and Levy in 1995, Columbia University's Center for New Media was the first establishment to take measures toward the implementation of those possibilities. Using one of the first omnidirectional cameras, a team of nine students created a 360° video of the 1997 St. Patrick's Day Parade in New York.[2] The immersive video features members of the Irish Lesbian and Gay Organization demonstrating against being excluded from the parade and the police arresting many of them.

Apart from capturing 360° videos, Columbia University also pioneered the use of augmented reality (AR) technologies for journalism purposes. Feiner et al. (1997) developed the 'mobile journalist's workstation', a head-tracked, see-through HWD and handheld 2D display with stylus and trackpad, run by a wireless computer, that was capable of depicting multimedia information about an event in the spatial location and context of that event.[3] This technology was used to recreate the 1968 student revolt at the same location of the original event on Columbia University's campus through images, audio recordings, and videos.

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[1] Hardee, G. M., & McMahan, R. P. (2017). FiJi: a Framework for the immersion-Journalism intersection. *Frontiers in ICT*, *4*, 21, p. 2.

[2] Seijo, S. P. (2017). Immersive journalism: from audience to first-person experience of news. In *Media and Metamedia Management,* (p.113). Springer, Cham.

[3] Feiner, S., MacIntyre, B., Höllerer, T., & Webster, A. (1997). A touring machine: Prototyping 3D mobile augmented reality systems for exploring the urban environment. *Personal Technologies*, *1*(4), p. 208.

Immersive Journalism in *Second Life*

Second Life, an online virtual world, or 'a computer-generated alternative reality'[1] (Brennen and Dela Cerna, 2010), marked a milestone in the evolution of immersive journalism. While not fully immersive due to the third-person viewpoint, the desktop-based VR platform presented users worldwide with a virtual world to navigate within the virtual environment and interact with each other via avatars. Launched in 2003, in ten years time *Second Life* had approximately one million regular users. In many ways, *Second Life* is similar to online role-playing or life-simulator games. However, Linden Lab, the creator of *Second Life*, highlight that their product is not a game: 'There is no manufactured conflict, no set objective.'[2]

Furthermore, *Second Life* gave rise to three newspapers covering the events of the virtual world: the *Alpaville Herald*, the *Metaverse Messenger*, and the *Second Life Newspaper*. Interestingly, this virtual platform can even boast of its own weekly interview program *Metanomics,* which became so successful that Cruz and Fernandes (2011) described it as 'the seminal form of what journalism will look like in the 21st century.'[3]

Around the same time, de la Peña explored the potential of *Second Life* for interactive journalism. The first *Second Life* journalism piece involved an avatar representing detainees in American prisons. The Second Life experience was a recreation of the documentary footage from the US Department of Defense of the real-life detainees. Finally, the following work called *Cap and Trade* made users choose the aspect of their daily lives that they would need to change in order to set their annual carbon emissions: their cars, a transcontinental plane flight, or heating

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[1] Brennen, B., & Dela Cerna, E. (2010). Journalism in second life. *Journalism Studies*, *11*(4), p. 547.

[2] Kalning K. (2007, March 12). *If Second Life isn't a game, what is it?* Retrieved from http://www.nbcnews.com/id/17538999/ns/technology_and_science-games/t/if-second-life-isnt-game-what-it

[3] Cruz, R., & Fernandes, R. (2011). Journalism in virtual worlds. *Journal For Virtual Worlds Research*, *4*(1), p.6.

their house for a year. Afterwards the participants were confronted with 'virtual replicas of actual projects where questionable practices provide a glimpse behind an opaque system'[1]. A personal carbon cloud following each user's avatar was intended to stress their individual responsibilities in the engraving the pollution problem.

Immersive Journalism and First-Person experience

Continuing her work in the direction set by *Second Life,* de la Peña experimented with immersive VR technologies by putting users into first-person simulations of real-life situations. In one of her most remarkable works, a tracking system was used to match the head rotations of a Guantanamo Bay detainee avatar to the user's physical head movements. This research illustrated that body ownership was an important factor of immersive journalism.

Her next work in the field of immersive journalism was *Hunger in Los Angeles,* presented at the 2012 Sundance Film Festival. Similarly to the previous piece, each viewer was using a head-worn display (HWD) to watch a computer-generated (CG) simulation. This piece depicted a real-life situation in which a diabetic man loses consciousness and falls into a coma while standing in a line at a food bank in Los Angeles. The immersive CG video was so touching and true-to-life that many audience members were 'coming out crying'[2] (Kavner, 2012).

Following her success with using HWDs and CG-based real-life simulations, de la Peña's next major immersive journalism piece was *Project Syria* in 2014. [3]Financed by the World Economic Forum, *Project Syria* relied on actual photographs, audio, and video footage taken from an explosion during Syria's civil war. The video

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[1] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), p. 293.

[2] Kavner L. (2017, December 6). *'Hunger in Los Angeles': Virtual Reality Makes Journalism Immersive, Pixelated.* Retrieved from: https://www.huffingtonpost.com/2012/01/30/hunger-in-los-angeles_n_1241468.html

[3] Seijo, S. P. (2017). Immersive journalism: from audience to first-person experience of news. In *Media and Metamedia Management* (pp. 113-119). Springer, Cham.

centered upon the plight of the children that made up more than half of Syria's refugees. More recently, de la Peña released *Across the Line*, a piece about antiabortion protestors, and *Kiya*, a piece about domestic violence, presented to public at the 2016 Sundance Film Festival. Like her previous immersive works, these pieces reproduced real-life events.

While de la Peña was, perhaps, the first scholar experimenting with immersive technologies in journalism, she was not the only one who took interest in this booming new field. Thus, in 2014, *The Des Moines Register* developed a mixed reality (MR) production called *Harvest of Change*, which combined 360° video and a CG virtual farm. The immersive, interactive experience was a supplement to a series of printed articles analyzing the state of American farming (Jackson and Eller, 2014). In 2015, the *Los Angeles Times'* Data and Data Visualization desks developed a CG system presenting their readership with an opportunity to explore a virtual crater on Mars (Emamdjomeh, 2015). Kors et al. (2016) designed an immersive CG experience called *A Breathtaking Journey*, where the user is placed in the shoes of a refugee who is fleeing from a war-torn country, hiding in the back of a truck, to reach a safe haven.[1]

This piece went significantly beyond just immersive experience. Several mixed reality (MR) elements were incorporated as well, such as placing the user in a wooden crate to imitate the cramped back of the truck, automatically dropping a pair of mandarins in the user's lap when a virtual pair fall in the virtual world, and providing a gasmask that emitted an olfactory stimulus for the mandarins and measured the user's breathing.

Following the immersive journalism trend, numerous media outlets and press agencies established their own departments responsible exclusively for VR content, primarily 360° video. For instance, *The Associated Press* now has its AP Digital Products news channel, which includes a variety of immersive journalism

[1] Kors, M. J., Ferri, G., Van Der Spek, E. D., Ketel, C., & Schouten, B. A. (2016, October). A breathtaking journey. On the design of an empathy-arousing mixed-reality game. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play* (pp. 91-104). ACM.

experiences using CG presented in a 360° video format. One of such examples is a virtual journey inside the brain to explore scientific theories on changes that are considered to induce the progression of Alzheimer's disease. *Remembering Pearl Harbor* is an immersive journalism piece produced for the HTC Vive HWD by Deluxe VR and presented by TIME's LIFE VR.[1] This immersive CG experience enables the viewers to experience the unexpected Japanese aerial attack on Pearl Harbor in 1941 based on the recollections of Lt. Jim Downing, one of the oldest living American veterans to have witnessed the attack.

Immersive Journalism and 360° Videos

Whereas interactive experiences using CG-based virtual environments are still largely in the experimental stage, the proliferation of inexpensive VR equipment such as HWDs and 360° video cameras gave rise to what is more commonly presented as immersive journalism. The first notable 360° video journalism piece was *Clouds Over Sidra*, the story of a 12-year-old girl named Sidra in Za'atari, a Syrian refugee camp in Jordan.[2] Developed in collaboration with the United Nations and Samsung, this 360° video was warmly greeted by the documentary industry, receiving the Interactive Award at the Sheffield International Documentary Festival in 2015.

Later that year, *The New York Times* presented its first 360° video under the name *The Displaced*.[3] As described in the introduction, the mini-documentary was telling the stories of three children forced to leave their homes due to political instability in Lebanon, South Sudan, and Ukraine. Around the same time, this American newspaper hired a street artist to draw its magazine cover and published *Walking New York*, a 360° video featuring the creation process. Since 2015, *The New*

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[1] Rothman L. (2016, December 1). *The History Behind the Remembering Pearl Harbor Virtual Reality Experience.* Retrieved from http://time.com/4577616/remembering-pearl-harbor-history/

[2] Kool, H. (2016). The ethics of immersive journalism: a rhetorical analysis of news storytelling with virtual reality technology. *Intersect: The Stanford Journal of Science, Technology and Society*, *9*(3).

[3] Sirkkunen, E., Väätäjä, H., Uskali, T., & Rezaei, P. P. (2016, October). Journalism in virtual reality: opportunities and future research challenges. In *Proceedings of the 20th International Academic Mindtrek Conference* (p. 300). ACM.

York Times has published more than one hundred 360° videos and even launched its 360° video channel, covering daily news in VR format. Other media organizations have also started producing their own 360° videos, including ABC, BBC, Vice, and The Verge.

At the moment, the use of both immersive CG and 360° videos is on a grow, it is subject to discuss whether both will survive the near future. Both approaches have their advantages and limitations for immersive journalism. How effectively immersive journalists use them will ultimately decide which medium, if either, becomes the storytelling standard. Better immersive journalism practices are needed to unlock the potential of this new technology.

360° Videos: Capabilities and Limitations

As underlined previously, 360° videos are the most common technology currently being used to create immersive experiences. Unlike the rest of the technologies, 360° videos do not require any CG rendering or 3D virtual objects, and that is one of the reasons accounting for the proliferation of 360° videos in mainstream journalism. CG effects are only needed for 360° videos if information or infographics are added during the post-processing stage[1].

Nowadays a number of cameras for capturing 360° videos is available on the market. Consumer 360° cameras are among the most affordable ones. They usually cost less than $1,000 USD, for example, Samsung Gear 360.

Professional 360°cameras support higher-resolution videos and usually provide stereoscopic capabilities. Yet, they are expensive and usually require complex processes for stitching multiple camera feeds into a single 360° video. Examples of professional 360°cameras include the Jump by Google, Nokia OZO, PanoCam3D, and the non-stereoscopic GoPro Omni. Interestingly, *The New York Times* uses the Samsung Gear 360 to shoot its 360° videos, in part due to the simple stitching process that the camera supports.

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[1] Owen, T., Pitt, F., Aronson-Rath, R., & Milward, J. (2015). Virtual Reality Journalism. *Tow Center for Digital Journalism, Columbia Jorurnalism School*.

Another important benefit of using 360° videos is that they can be viewed and distributed through a variety of means, including truly affordable ones. Nearly any head-mounted display (HMD), from the most basic Google Cardboard to the sophisticated HTC Vive, can immerse the user in a 360° video. Due to the same inertial tracking technology, 360° videos can also be simply viewed on almost any modern smartphone by moving the device around like a window to the virtual world. Lastly, 360° videos can also be viewed through most web browsers by dragging to change how the current field of view (FOV) is mapped to the 360° field of regard (FOR). This wide spectrum of viewing options makes 360° videos the most accessible immersive technology for broad audience consumption.

Regarding subjective responses, 360° videos can provide comparatively high levels of presence when viewed through an HMD. However, they enable less presence when viewed on smartphones,[1] and even less when viewed through a web browser. As several studies suggest a strong relation between presence and emotion,[2] 360° videos are more likely to provoke emotions when viewed via an HMD.

While 360° videos can provide presence and emotions, they are not apt for a creating the sense of body ownership. In the majority of 360° videos, there is no representation of the viewer's body. In some videos, visual signals, such as a camera tripod or a person carrying the camera, clearly imply that the viewer's body is not present in the world of the video. The inability to provide the sense of body ownership can be considered the major limitation of 360° videos. However, there are some exceptions, such as Jane Gauntlett's work 'Dancing With Myself'.

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[1] Rupp, M. A., Kozachuk, J., Michaelis, J. R., Odette, K. L., Smither, J. A., & McConnell, D. S. (2016, September). The effects of immersiveness and future VR expectations on subjective experiences during an educational 360 video. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 60, No. 1, pp. 2108-2112). Sage CA: Los Angeles, CA: SAGE Publications.

[2] Diemer, J., Alpers, G. W., Peperkorn, H. M., Shiban, Y., & Mühlberger, A. (2015). The impact of perception and presence on emotional reactions: a review of research in virtual reality. *Frontiers in psychology*, *6*, 26.

Another shortcoming of 360° videos is the lack of interactivity. Because 360° videos are, in essence, nothing more than 2D pixels wrapped around the viewer, the environments pictured in the videos cannot be changed and interacted with (at least, not without complex computer advanced processes). Hence, viewers cannot touch or manipulate objects seen in the news story world. Furthermore, even though users can rotate their head 360°, they cannot change their viewing position within the videos, as it is determined by camera's position. According to the work by McMahan et al. (2012),[1] this lack of interactivity prevents 360° videos from affording high levels of engagement, as some other immersive technologies might be capable of.

To conclude the discussion on 360° videos, video makers, including journalists, must be cautious about capturing 360° videos, as they can cause cybersickness, especially when viewed through an immersive HWD. As discussed later in this chapter, cybersickness is likely to stem from discrepancies between the visual and vestibular senses. Such discrepancies take place with 360° videos when the camera is being moved, as the recorded visuals will indicate that the user's body is moving while from a vestibular sense it is not. Hence, moving the camera while shooting a 360° video is bound to induce cybersickness in the audience members. Design guidelines to not move the camera, even slowly, when capturing 360° video are needed to improve the user experience of an immersive 360° piece.

1.2 Definition of Virtual Reality

The term V*irtual Reality* was coined by VR pioneer Jaron Lanier, founder of Virtual Programming Languages (VPL) Research.[2] In 1987, he described virtual reality as 'virtual meaning' and 'something that exists only as an electronic representation, which has no other concrete existence.'[3]

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[1] McMahan, R. P. (2011). Exploring the effects of higher-fidelity display and interaction for virtual reality games (Doctoral dissertation, Virginia Tech).

[2] Kelly, K., Heilbrun, A., & Stacks, B. (1989). Virtual reality: an interview with Jaron Lanier. *Whole Earth Review*, *64*(108-120), 2.

[3] Ibid, p. 110.

Nevertheless, dramatic changes to the virtual reality space made defining the term more complicated since then. The variety in technology used resulted in other terms and acronyms such as *AR Augmented Reality*; (Lemley & Volokh, 2017), *MR Mixed Reality*; (Costanza, Kunz, & Fjeld, 2009), and *VEs Virtual Environments*; (Schroeder, 2002; Blascovich et al., 2002). According to Lanier[1], immersive environments can include any external reality or sensory motor experience. However, the most commonly used definition of virtual reality was proposed by Jerald (2015) who defines virtual reality (VR) as being a 'computer-generated digital environment that can be experienced and interacted with as if that environment were real.'[2]

360° video videos are considered to be a part of VR technology due to their immersive nature. This immersive nature is to substitute real-world perceptions with digitally generated ones, which creates 'the sensation of actually being in life-sized and real world environments.'[3]

That is why, 360° video video and VR have been used interchangeably. For instance, while watching a 360° video, the viewer can move his head in any direction: either left to right or top to bottom within a given spherical space. By contrast, a VR video may seem limitless, as the viewer 'interacts with and within the environment.'[4]

Both 360° video video and VR can be experienced using the same headset technology. Both 360° video and VR create the immersive environment which can be interpreted as a simulation of different senses which can provoke emotional and sensitive experiences regardless of the technical differences. Hence, people who take part in both immersive environments get unparalleled experiences which would have

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[1] Lanier, J., & Biocca, F. (1992). An insider's view of the future of virtual reality. *Journal of communication*, *42*(4), p. 160.

[2] Jerald, J. (2015). The VR book: Human-centered design for virtual reality. Morgan & Claypool, p. 9.

[3] Freeman, D., Reeve, S., Robinson, A., Ehlers, A., Clark, D., Spanlang, B., & Slater, M. (2017). Virtual reality in the assessment, understanding, and treatment of mental health disorders. *Psychological medicine*, *47*(14), p. 2394.

[4] Jerald, J. (2015)… Morgan & Claypool, p. 11.

never been possible without the technological breakthrough. From the philosophical perspective, this might make people reshape the notion of what is real in a world where 'most of significant experiences aren't real in the classic understanding of that term.'[1]

Debate on Virtual Reality

Considering the variety of definitions of the VR term, it is worth mentioning that nowadays there is an ongoing debate on what is to be understood as VR experience. The key parties of this debate are developers and designers. What constitutes virtual reality and what is not virtual reality? With the advances in Internet and VR, the terms used to describe virtual experiences, where one engages with the technology to the extent that they don't feel themselves in the actual space anymore, have also seen significant changes.

There are two main schools of thought on the definition of VR, described in *Virtual Reality: An International Directory of Research Projects.*[2] From one standpoint, what defines virtual reality is entirely theoretical; any technology that imitates the senses and/or produces interactivity constitutes VR. According to this interpretation, playing video games (even at home), real-time Internet chatting, or belonging to an Internet discussion group are all versions of VR. According to this theory, the hardware required does not play any role, since each of these activities implies a sense o f being somewhere else, outside o f the physical world. They key element in this broader framework o f understanding VR is engagement with the technological experience itself.

From the other perspective, VR is defined strictly by technology, as it requires certain hardware (usually quite complicated one) and other helping tools where the user interacts with the physical technology. This concept matches the original term 'virtual reality', conceived by Lanier as indicated previously in this work: real-time,

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[1] Lemley, M. A., & Volokh, E. (2017). The Real Law of Virtual Reality. *UCDL Rev.*, *51*, p. 55.

[2] Thompson, J. (1993). Virtual reality: an international directory of research projects. Meckler Corporation, pp. 12-13.

computer generated, three-dimensional synthetic environment accessible via hardware peripheral tools such as data gloves and head-mounted displays.

According to this interpretation of VR, only those technologies which use peripheral tools such as head-mounted displays (HMDs), three-dimensional computer graphics, and input/output devices to access the immersive, interactive realm can be considered truly virtual reality as only they 'make it possible to immerse yourself within a virtual world and to reach in and reshape it.'[1]

This study will be dealing with this second notion of VR as this definition was coined by the pioneer developers of VR and is still largely supported by the current VR community worldwide.

Virtual Reality Theories

Whereas the hardware elements enabling to experience the virtual environment have always been in the spotlight of VR engineers, certain theoretical conceptions have been proved to be equally important for the definition of VR. To start off, immersion and interaction are perceived as the basic elements of VR, giving a viewer a possibility to navigate inside the virtual environment and interact with it in ways which would be credible to human senses. However, the questions of the most significant feature of VR is subject to debate. While immersion and interaction serve as building blocks of VR, different researches underline other relevant aspects of a virtual reality space.

According to Pimental and Teixeira, interactivity and immersion are the two essential components of virtual reality technology.[2] Immersion of human senses is what differs a VR experience from a regular two-dimensional one. 'The question isn't whether the created virtual world is as real as the physical world, but whether the created virtual world is real enough for you to suspend your belief in a period of

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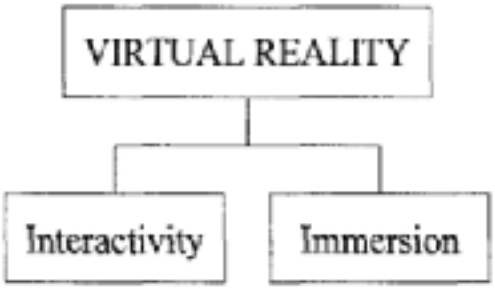
[1] Rheingold, H. (1991). Virtual Reality: Exploring the Brave New Technologies of Artificial Experience and Interactive Worlds-From Cyberspace to Teledildonics. Secker & Warburg, p. 16.

[2] Pimentel, K., & Teixeira, K. (1993). Virtual reality through the new looking glass, p.15.

time.'[1] In other words, the reactions happening in the virtual environment must be similar to those received in the real world.

The senses imitated in the virtual environment must be true-to-life and engaging enough so that they can block all sort of external distractions a user might be experiencing. The ability to interact with the virtual realm is indispensable for a truly VR experience. The boundaries existing between the screen and the user can be destroyed once the user can manipulate the VR space by interacting with it. Thus, the artificial world the user is interacting with becomes controllable. In turn, the virtual environment, in a perfect VR experience, must respond to the user's commands in alignment with the rules determining how this VR environment works.

Figure 1: Basic Elements to Virtual Reality, Pimental & Teixeira, 1993



While for these scholars the concepts of interactivity and immersion identify the essence of VR, for Hayward (1993) there are four equal and interrelated notions that form the fundamentals of VR: viewpoint, navigation, manipulation and immersion.[2] Viewpoint is where the user has a subjective point of view of the virtual realm. Navigation is the ability of the user to move through the virtual environment. Manipulation is a set of possible interactions with other objects, which include moving objects or interacting with others sharing the same environment. Last but not least, immersion is where the user is so plunged in the virtual environment that they feel as if they were actually inside it.

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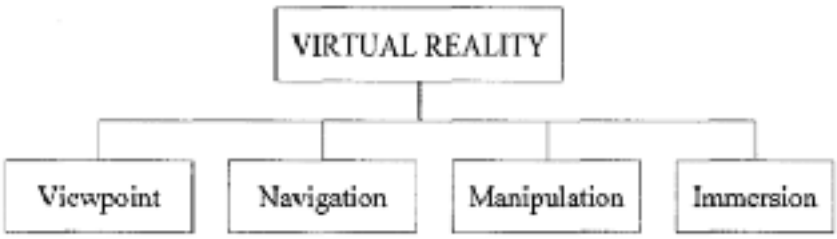
[1] Pimentel, K., & Teixeira, K. (1993). Virtual reality through the new looking glass, p.15.

[2] Hayward, T. (1993). Adventures in virtual reality (Vol. 1). Que Pub, pp. 12-21.

Overall, the VR technology is aimed at creating an impression of being elsewhere and being able to interact with what, in fact, is a static virtual environment. According to Hayward, VR experience requires each component to be present. Nevertheless, the vital feature to VR is immersion. Without visual immersion, the experience would not feel authentic, credible and realistic to the user.

Figure 2: Four Basic Concepts to Virtual Reality, Hayward, 1993



Another significant work in the domain of VR states presence, navigation, interaction and immersion as its key elements[1]. The authors claims that with advances in computer technology and the public acceptance of the Internet, what was understood to be VR has been challenged. If early definitions included the head-mounted display helmet (HMD) as indispensable for creation of the virtual environment, a more generalized definition was accepted in the 1990s that stressed immersion by using peripheral tools.

'Basically, a VR system uses real-time computer graphics in such a way to make the user believe they are part of a virtual domain. This can be accomplished using a HMD, hand-held BOOM display, CAVE, virtual table, dome or large screen based system.'[2] Like the scholars addressed above, Vince names immersion the base of VR, and it takes specific hardware in order for immersion to occur.

At present, there are no set standards describing the hardware needed to access a virtual environment. At the most preliminary level, users need equipment to contain their visual sphere and to register their movement in the real and virtual worlds, and a

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[1] Vince, J. (1998). Essential virtual reality fast: how to understand the techniques and potential of virtual reality. Springer Science & Business Media, p.8.

[2] Ibid, p.7.

computer with enough capacity to keep track of all the details. Visual stimulation and immersion is what defines the most commonly known form of VR. This is the helmet and glove model.[1] An HMD creates an impression of being visually immersed in an environment. The screens are located in front of the user's eyes in such a way that they can turn their heads at 360 degree and the image will be all around them. Thus, the real world is blocked out.

When using the head-mounted display helmet and data glove together, the user has the sensation of interacting with a virtual environment. Signals that inform the software program of the position of the user's head and arms within the scene are sent from the head-mounted display and the glove to the computer. The sensors located in the hardware provide the computer system with detailed information regarding the orientation of the body in the virtual space. The computer, in real world time, changes the image as the position and the angle of the user changes. The user interprets the scene changing as a response to their manipulation with the environment.

As stated earlier in this chapter, the debate over the definition of VR is hold between those who focus on the experience of 'being elsewhere', and those who focus on the technology which helps achieve that goal. According to Steuer, telepresence is the defining quality of virtual reality that 'comes closest to resolving the conflict.'[2] For Steuer, telepresence is the sense of being within a virtual environment, where the user has the realistic perception that they are somewhere else separate from the physical world. 'Telepresence is defined as the experience of presence in an environment by means of a communications medium.'[3] This experience can be successful only provided that the user is capable of setting aside knowledge of the physical world. The degree of immersion in the virtual environment must be high enough for the individual to ignore the physical world.

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[1] Sherman, B., & Judkins, P. (1992). Glimpses of heaven, visions of hell: Virtual reality and its implications. London: Hodder & Stoughton, p. 20.

[2] Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of communication*, *42*(4), 73-93, p. 75.

[3] Ibid.

Immersion addresses the vividness of the medium to the individual's senses. According to Steuer, it relates to the degree to which the user feels sensory engagement with the environment. Two components define the immersion: depth and breadth. The depth of sensory immersion characterizes the quality of the senses being engaged. The senses that are involved in viewing a story should be highly or fully engaged by the VR experience. Breadth describes the range of senses being engaged, i.e. how many of the senses are engaged by the VR environment in a credible way.

Interactivity refers to how users are able to manipulate, navigate, and react to the environment. It is shaped by the factors that allow users to have an influence on the medium. For Steuer, interactivity comprises three principal elements: speed, mapping, and range. While speed focuses on how quickly the environment responds to the user's actions, mapping is the degree to which the physical actions of the user correspond to those in the virtual environment. A high degree of mapping means a close match of the virtual environment to human actions in nature. Finally, range represents the amount of change that the user can exercise on the virtual realm. A high range would suggest that the user can alter a larger number of variables.

All conceptualizations considered, what is, after all, virtual reality? As this section has illustrated, the debate regarding the nature of virtual reality is far from over. In many ways, the debate that divides the definition of VR into a theory of engagement, or a technology with hardware requirements, is artificially constructed. What makes VR unique is the combination of sensory immersion (vividness) with subjective interaction, which give the user the impression of being somewhere other than the physical realm (telepresence).

Users must have the ability to alter the environment and its objects to a certain degree (range), and have the environment respond quickly in the real world time (speed). These responses must adequate to the physical world and correspond to the naturalistic reactions experienced by the user in real life (mapping). In other words, the user must have a feeling that they are able to navigate through this environment and manipulate it the way they want. The user must be oriented towards a subjective

viewpoint in the virtual environment (presence/viewpoint). They must have a minimal number of their senses engaged with the virtual environment (breadth), to a necessary level of quality (depth).

According to the community of VR developers, these elements can be experienced only with the software that can realistically generate the virtual realm, the hardware to run the virtual reality system (i.e., a computer with a fast processor and large size memory), or the peripheral tools (i.e., a head-mounted display, game controllers, joysticks, or wired gloves).

The debate over the definition of what constitutes the VR technology stems from the unique history of this technology and its application. How people understand and interpret VR is changing and evolving over time. This research will be dealing with 360° videos that have become the most widespread form of VR in media. While this technology may not correspond to all criteria proposed by the scholars and explained previously, it remains the most accessible and easy-to-use in comparison to other VR experiences.

It has to be said that the Google Cardboard used to view the 360° story in our experiment does not create a truly VR experience due to the lack of immersion, this basic equipment has become popular among media consumers, especially in the US where the New York Times even sent these cardboards as a gift to its most loyal subscribers. That is why, we believe that using this equipment, left alone its technological drawbacks, still matches a definition of VR experience to a certain degree. Our study researches the experience of VR storytelling in conditions close to those that the user has at home, for VR content being consumed on a daily basis is still a matter of future.

1.3 VR as a Storytelling Medium

Immersive and interactive technologies such as Virtual Reality (VR) open the new unprecedented ways in which users interact with the environment and even conceive new approaches in their relationship with reality. Virtual reality and other

immersive Information and Communication Technologies (ICT) have a high potential for altering the real world and our interaction with it.

Nowadays the major challenge of technologies and applications based on VR is to conceive new ways to design information, new narratives and storytelling for a medium in which opportunities have not been fully explored and studied. This is why, the challenge of VR has to do not only with the technology itself, but also with the way this medium is going to develop its own dynamics for interaction with users with potential applications in new fields. This work attempts at understanding the user experience of VR storytelling within the technology available.

There are several conceptualizations of VR as a medium. The first approach was described in 1935 in 'Pigmalion's Spectacles', a short story written by an American science fiction author Stanley G. Weinbaum, which is often called the first comprehensive and specific fictional model for VR. In the story, the main character meets an elfin professor who invented a pair of goggles which enabled 'a movie that gives one sight and sound [...] taste, smell, and touch'[1]. As the author points it out, 'you are in the story' and 'the story is around you'. Both these phrases are two fundamentals of approaches to defining the idea of VR.

More recently, the immersive nature of media was used to understand the nature of the technology itself. Its inherent features require definitions, standards, and approaches. Researches such as Sherman and Craig refer to design, interface and applications as relevant factors for understanding the medium and the technology.[2] They describe the VR medium as 'composed of interactive computer simulations that sense the participant's position and actions and replace or augment feedback to one or

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[1] Weinbaum, S. G. (2015). *Pygmalion's Spectacles*. Booklassic.

[2] Sherman, W. R., & Craig, A. B. (2002). Understanding virtual reality: Interface, application, and design. Elsevier, p. 441-442.

more senses, giving the feeling of being mentally immersed or present in the simulation (a virtual world).'[1]

The User Experience (UX) Research

In the early 2000s, the idea of a real-time simulation and the multisensorial dimension was in the spotlight of a number of researchers. For instance, Burdea et al. [16] also define VR as 'a high-end user-computer interface that involves real-time simulation (not precomputed, computed as time is passing) and interactions through multiple sensorial channels (visual, auditory, tactile, smell and taste).'[2]

Yet, the conceptualization of VR evolves to the extent that technology evolves and nowadays includes a higher range of human factors and larger possibilities for interacting with the environment, due to advances in areas such as brain interfaces and their relationship with virtual reality, immersive environments and videogames. Whereas VR is related to immersive environments, 3D spaces and game engines, there is also a strong connection with user interfaces. While our study is focused on analyzing the user experience (UX) of one particular VR story and a certain VR technology, further research in the domain of UX will enable us to access a wider range of human factors and explore new natural user interfaces.

The UX research can increase the storytelling potential of the VR technology which hasn't been fully explored yet. The essential storytelling factors associated with VR, according to contemporary VR studies[3], are listed below.

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[1] Sherman, W. R., & Craig, A. B. (2002). Understanding virtual reality: Interface, application, and design. Elsevier, p. 441-442.

[2] Burdea, G., Richard, P., & Coiffet, P. (1996). Multimodal virtual reality: Input−output devices, system integration, and human factors. *International Journal of Human−Computer Interaction*, *8*(1), p. 5-24.

[3] Rubio-Tamayo, J. L., Gertrudix Barrio, M., & García García, F. (2017). Immersive Environments and Virtual Reality: Systematic Review and Advances in Communication, Interaction and Simulation. *Multimodal Technologies and Interaction*, *1*(4), 21, p. 11.

Storytelling-Narrative Dimension: associated with the virtual environment and the power to articulate it as well as with the story created by users themselves while interacting with the virtual world.

Narrative: associated with the events VR developers want to convey and the elements we are going to use to relate to these events. It is the reality that we want to happen in a VR space.

Storytelling: associated with the dramatic approach that we are going to use to describe the facts.

Interactivity: some authors define it as 'the extent to which users can participate in modifying the form and content of a mediated environment in real time.'[1] Interactivity can be also defined as the possibility to receive information from the ensemble of our senses to construct a reality different from the physical one. Moreover, it is the possibility to influence (in real time) the objects and the narrative framed in it within the digital environments. In contrast to communication in traditional media, interactivity is multidirectional and covers a wide range of cognitive patterns.

Experiencing VR in future will largely depend on the advances made in the following interdisciplinary research fields:

Human Computer-Interaction (HCI). An interdisciplinary field which analyses digital information and environment in order to improve interaction between users. Ie examines the user's behavior in certain contexts in order to design relevant experiences in virtual environments.

Interaction design. The design of interfaces and digital objects in order to improve the process of interaction and broaden the range of adequate responses within the digital environment.

User experience. The interdisciplinary field focused on conceiving and developing interactive experiences which are based in a natural user interface, and improve its interactive process.

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[1] Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of communication*, *42*(4), 73-93, p. 94.

Representation. Being a technology, VR is also a medium with its own potential expressive power. VR as a communication medium will be the primary focus of our research. To represent means to position ideas and concepts in a specific medium, as for example words represent ideas in literature. It is still to be researched how this medium can communicate and develop its own dynamics.

Gameplay. As VR is becoming more and more interactive, it is playable, so, a relevant factor is to integrate research into game and play possibilities, even for experiences based on physical environments.

Technological Evolution. VR is advancing at the same rate that computer graphics technology and processors do. Overall, its storytelling potential will heavily depend on the progress made in the digital field.

Virtual reality as the new media has the power to represent ideas and make users interact with information through new channels and approaches. New expressive theoretical models, both in technological and communicational senses, are emerging along with the advances in the VR technology. Since the 90s, VR technology, due to its expressive power, has made it possible to represent abstract or non-figurative ideas and concepts such as metaphors, even though, in some way, this technology is to simulate real world components.

The expressive power of this new media and technology may determine the way in which VR is going to evolve in the upcoming years. The presentation of information in immersive environments will be defined by concepts associated with embodiment, human perception and cognitive approaches, and proprioception. VR has the potential to develop its own language and dynamics and represent not only physical elements derived from the real world but also more complicated abstract concepts and ideas, such as love, patriotism, faith, etc.

Since immersive environments, VR including, are characterized by objects built into them, embodiment and proprioceptive focus are equally relevant components. A significant number of studies suggests using VR as a tool for research in cognitive sciences or experimental psychology, as this technology allows going

into depth about the connection between sense of self, cognitive and sensitive approaches, and understanding the other.

VR as an Immersive Environment

In parallel to virtual reality and augmented reality, immersive environments received different definitions in the 90s. Slater and Wilbur propose a framework to define presence and other factors in virtual environments.[1] In the early 2000s, experiments are hold to construct an immersive world based on data coming from the physical world and draw an analogy between both.

Presence in virtual spaces is often compared to presence in the physical world by adding the main sensory inputs 'such as vision, sound, proprioception, and smell.'[2] Making users interact with the digital information by involving different senses through devices is typical for VR and immersive environments. Although VR and immersive environments are not the same notion, they have certain concepts such as presence, interaction and immersion in common. In the context of our research, the terms 'immersive environment' and 'VR environment' will be used interchangeably.

Storytelling and the Digital Age

Numerous definitions of the notion of storytelling exist. Yet, all of the different definitions have common elements, and thus storytelling can be seen as 'the effort to communicate events using words (prose or poetry), images, and sounds often including improvisation or embellishment.'[3] Although some scholars use the word 'narrative' as a synonym for 'story', narrative can be defined as predominantly factual, whereas stories are reflective, creative and value-loaded, usually sharing something

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[1] Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *6*(6), 603-616.

[2] Kalawsky, R. S. (2000, March). The validity of presence as a reliable human performance metric in immersive environments. In *proceedings of the Presence Workshop'00*.

[3] Haigh, C., & Hardy, P. (2011). Tell me a story—a conceptual exploration of storytelling in healthcare education. *Nurse education today*, *31*(4), 408-411, p. 409.

important about people and the world around them. Indeed, as Winterson (1997) says, 'Stories are always true; it's the facts that mislead.'[1] In turn, narrative journalism can be broadly defined as 'the genre that takes the techniques of fiction and applies them to nonfiction.'[2]

VR allows constructing spatial narratives. They can be defined as storytelling in which the physical and temporal dynamics of the scene—who moved where, and when, and their relative positions at each moment—are fundamental to fully understanding what happened'. VR breaks with the tradition of visual cinematic representation and takes the spatial construction that is intrinsic to the digital medium to its maximum expression. 'For the first time, space becomes a media type.'[3]

Cutting edge technology, which already gave rise to digital media, has an even larger potential to influence journalism practices in several beneficial ways. These new forms of storytelling may increase civil engagement and provide more context, nuance, and empathy to reported events and issues. Among all other digital storytelling media, VR, arguably, holds the highest potential to engage an audience which is in large part disengaged from traditional news and stories. VR is poised to transform the storytelling of twenty-first-century journalism in the same fashion as photography of 150 years before.

Digital technology, the Internet and mobile media is what shapes journalism and media landscape on a national and international scale. Other factors contributing to this shift are economic processes, political transition, and cultural trends. Other forces that affect shifts in the media landscape include economic turmoil, political transition, and cultural shifts worldwide. The focus of our study is the development and utilization of a technology known as virtual reality (VR) in journalism and

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[1] Winterson, J., (1997). The Stone Gods. Penguin Books, London, p. 64.

[2] Nieman Foundation for Journalism at Harvard (2013): *Narrative Journalism*. Retrieved from http://nieman.harvard.edu/NiemanFoundation/ProgramsAndPublications/NarrativeJournalism.aspx

[3] Manovich, L. (2001). The language of new media. MIT press, p. 251.

communications, with priority given to the implications of VR as a new form of immersive storytelling unique to traditional journalism.

Technological change affects media and journalism in general in at least four crucial ways[1].First, it revolutionizes the way journalists and other media professionals do their work which includes the way they gather, edit, and produce new and other media content. As a rule, the advances in technology presents an opportunity to improve productivity, efficiency, and information accessibility.

Second, technological forces transform newsrooms as well as business practices and models. Digital technology makes media organizations reconsider the delivery of news by significantly reducing the cost of content delivering. In turn, the media industry and its business model undergo a profound change.

Third, the relationship between media and their audiences is redefined as publics move from passive receivers to active producers of news and other user generated content. This transformation can potentially improve the connection between media professionals on one hand and their audiences on the other due to a greatly increased interaction among them.

Since the vast publics that mass media used to enjoy have become disengaged from traditional news formats and have turned to social media and mobile communications to learn about the world, VR may become the new storytelling tool which can help journalists bring their audiences back. In our study, we will try to establish whether the VR technology can be beneficial for experiencing a feature story.

Rogers's Diffusion Model

To understand the emergence of VR technology in the field of journalism, we will adapt the theoretical model developed by a pioneering social science scholar Everett M. Rogers, whose major focus was upon the adoption and diffusion of

[1] Pavlik, J. V., & Bridges, F. (2013). The emergence of augmented reality (AR) as a storytelling medium in journalism. *Journalism & Communication Monographs*, *15*(1), 4-59, p. 5.

innovations.[1]Built on the ideas of the scholars before him, Roger's concepts remain pertinent for modern researches.

Diffusion of innovations is a theory which attempts at explaining how, why, and at what rate new ideas and technology spread. This theory was popularized by Rogers in his book 'Diffusion of Innovations', first published in 1962. In this work, the author describes the stages which innovations (both products and ideas) must go through before they are ultimately adopted, or rejected, by individuals or organizations. Rogers divided the process of adoption of an innovation into five stages. These stages are: 1) knowledge, 2) persuasion, 3) decision, 4) implementation, and 5) confirmation.

During the knowledge stage, the individual is first exposed to an innovation, but lacks information about it. The individual is not inspired yet to research this innovation. In the persuasion stage, potential users become interested in the innovation and start actively seeking more information on it. In the decision stage, the user evaluates the innovation by weighing its advantages and disadvantages and decides whether to adopt or reject the innovation. In case of adoption, the implementation stage involves employing the innovation to a varying degree during which its overall usefulness of the innovation and whether it should be used on a larger scale are measured. Finally, in the confirmation stage the individual finalizes his/her decision on the innovation and adopts it to its fullest potential.

Rogers's diffusion model can be applied to VR and journalism in at least two different ways. First, to adopt VR as a storytelling form, news and media organizations need to go through these five stages. They need to learn about VR and its application to journalism and storytelling, followed by the other four stages, persuasion, decision, implementation, and confirmation. In parallel, the audience itself must pass through these five stages as well for VR to become a technology utilized by news consumers.

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[1] Rogers, E. M. (2010). Diffusion of innovations. Simon and Schuster.

The diffusion model also illustrates five factors which define the rate of adoption of an innovation. These factors are 1) the perceived relative advantage of the innovation, 2) compatibility, 3) complexity or simplicity, 4) trialability, and 5) observability. Each of these five factors is of crucial importance for VR to both diffuse rapidly among media organizations and be adopted by media audiences.

VR needs to prove its advantage over other storytelling tools available to both content producers and content consumers. Publics' perceptions of the relative advantage of VR-enhanced stories will also increase the likelihood of the use of VR in mobile media applications. The simpler VR is seen by the audience, the more likely it is to be adopted. If VR is easy and accessible to try out and if it is obvious that others are using VR, the rate of adoption of VR in journalism is bound to rocket.

Aside from the factors defining the diffusion of innovations, Rogers also identified five types of adopters of new technologies. The earliest adopters of a new technology, 'innovators', comprise only about 2.5 percent of all potential adopters of an innovation. It is these individuals, or organizations, who will also become advocates for the innovation they adopted. So-called early adopters account for about 13.5 percent of the population, while the early majority represents about one-third, or 34 percent. The late majority represents another one-third, or about 34 percent. Laggards, or late adopters, constitute the final 16 percent.

In applying Rogers's model to journalism, research suggests it is only the leading 2.5 percent of news organizations, or innovators, that have adopted VR as a storytelling medium. Among the earliest adopters of VR in the form of 360° videos are the newspapers *The New York Times, The Guardian*, *USA Today, and BBC*. The adoption of VR technology by the leading news organizations only can be explained by the high costs of the technology itself.

However, as indicated by research, adopting innovations can pose a dilemma for large news organizations because the cost of the investment in new technologies

for news corporations may be higher than for newer entrants.[1] At the same time, to *not* adapt might be an end point. Thus, a flexible work environment open to innovations becomes a must for any media organization. Research also suggests that early adopters of a technology 'receive less of a benefit than later adopters do.'[2]

Virtual Reality Components

VR as a medium is distributed in a variety of ways. However, receiving any VR experience requires at least three components: a smartphone, a mobile application, and a VR headset.

The first requirement is increasingly being met in most countries of the developed world. Newzoo's 2017 Global Mobile Market Report shows the percentage of the population owning a smartphone.[3] These numbers come from Newzoo's Global Mobile Market Report, April 2017, and are based on a model which takes into account a country's economic progression, demography, online population, and inequality. The country with the highest smartphone penetration is United Arab Emirates where 80,6% of the population own a smartphone. The three countries with the highest number of smartphone owners are China, India, and the USA: 717,310,000; 300,124,000; and 226,289,000 respectively. Furthermore, as reported by the Pew Center's PEJ already seven years ago, 'in 2011, the digital revolution entered a new era. The age of mobile, in which people are connected to the web wherever they are, arrived in earnest.'[4]

Second, a VR mobile application should be installed on a smartphone. *The New York Times, USA Today,* and *The Guardian* were among the first newspapers to

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[1] Christensen, C. (2013). The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business Review Press.

[2] Lievrouw, L. (2006). New media design and development: Diffusion of innovations vs. social shaping of technology. *The handbook of new media*, 246-265.

[3] *Top 50 Countries by Smartphone Users and Penetration.* Retrieved from: https://newzoo.com/insights/rankings/top-50-countries-by-smartphone-penetration-and-users/

[4] *Project for Excellence in Journalism.* Retrieved from http://stateofthemedia.org/.

introduce applications featuring news, entertainment and discovery stories. When looking at the installs of news applications, by far the highest number of downloads of the app are for The New York Times VR, not surprisingly due to their early activity in promoting VR to their readers.[1]

However, 360° videos are also available on the Youtube application which is reported to be among the five most often downloaded applications, as of April 1, 2018.[2] Youtube mobile application also allows watching 360° videos through Google Cardboard. When the user presses the cardboard icon visible on a 360 video played in the Youtube application, the screen splits into two parts, and it becomes possible to watch this video through the cardboard. However, the most popular and most often downloaded VR applications are game- and entertainment-orientated such as Apollo 15 Moon Landing VR or Titans of Space.

Finally, it takes a device that provides VR experience for the user. Virtual reality as a news medium is distributed in a variety of ways. These devices vary from the most basic ones (such as the Google Cardboard viewer) to more sophisticated VR headsets like the Oculus Rift, HTC Vive, Sony Morpheus, Carl Zeiss VR One. The latter, however, still have not reached the everyday consumer.

The Google Cardboard is the most accessible and easy-to-use equipment. Google Cardboard is a virtual reality (VR) platform developed by Google for use with a head mount for a smartphone. Called after its fold-out cardboard viewer, the platform is designed as a low-cost system ($12.99 USD on Amazon) to encourage interest in VR applications. Users can either build their own viewer from simple, inexpensive components using directions published by Google, or purchase a pre-manufactured one.

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[1] Sirkkunen, E., Väätäjä, H., Uskali, T., & Rezaei, P. P. (2016, October). Journalism in virtual reality: opportunities and future research challenges. In *Proceedings of the 20th International Academic Mindtrek Conference* (pp. 297-303). ACM, p. 298.

[2] Hartmans A. (2018, May 3). *The Most Downloaded iPhone App in the World Right Now is One You've Probably Never Heard Of.* Retrieved: http://www.businessinsider.com/most-downloaded-iphone-apps-worldwide-tik-tok-q1-2018-5

In November 2015, *The New York Times* distributed a million of Google Cardboard devices to its most loyal print subscribers as part of the celebration around its then-new NYT VR application. Later, in April 2016, this media corporation gave out another 300,000 Cardboard viewers, this time to the most loyal digital subscribers.

By March 2017, over 10 million Cardboard viewers had shipped and over 160 million Cardboard app downloads had been made. Following the success of the Cardboard platform, in November 2016 Google launched an enhanced VR platform, Daydream.

Our research will be using the Google Cardboard due to its affordability and a relatively high rate of diffusion in western countries (in particular, in the US).

Whereas Google Cardboard suffices to view a 360° video, it does not meet the criteria of a fully VR experience, due to the simplicity of technology.VR HMD mount, such as does not contain any electronics or screen itself, but rather enables users to insert a smartphone or other device in it and place it on the head.

Unlike VR headsets, VR head-mounted display display mount, like the Google Cardboard viewer, does not contain any electronics or screen in itself but rather allows users to insert a smartphone or other device in it. As a matter of fact, VR headsets, due to their more complex technology, hold a greater potential to engage audiences by entirely immersing them into virtual environment. However, they are quite bulky and cumbersome and, most importantly, quite expensive. As a result, VR headsets are still far from being a mainstream device.

VR Storytelling: Domains of Application

VR applications for hard news or political reporting will probably not be the first areas where news or media organizations apply innovative storytelling techniques. More likely are entertainment-related venues, including sports and travel, as suggested by the authors' interviews with editors at forward-thinking newspapers and magazines that have already used VR. These domains also lend themselves to the

visual storytelling capabilities of VR. Moreover, the fifth stage of Rogers's diffusion model, observability, has implications here. Editors who are in the early adopter stage of Rogers's model and have considered the use of VR will probably notice other early adopters of VR who use this innovation for sports and travel reporting. Consequently, they are more likely to follow their lead.

Another domain where VR has a high potential to be used as a storytelling medium is feature stories on a social, political, or ecological problem. By comparing the existing 360° videos available shot by the leading media organizations, one can easily noticed that the majority of them is dedicated to the refugee crisis. The innovativeness of the technology presents a unique chance to engage the audiences who already watched or read numerous stories on human sufferings in remote parts of the world with the help to the medium. As a famous aphorism by Marshall McLuhan goes, 'medium is a message.'[1] VR is the medium capable of bringing back the interest of the audiences to forgotten or neglected subjects.

[1] McLuhan, M., & Fiore, Q. (1967). The medium is the message. *New York*, *123*, 126-128.

§ 2. Context and Research Questions

2.1 Literature Review

Virtual reality has a long history in both the popular imagination and a wide range of scholarly experimentation and commercial development.

Yet, there is a noticeable gap in VR research regarding its usage as a storytelling medium and how viewers are affected by VR compared to traditional broadcast video. Although observations have been made on how users react to highly interactive journalistic VR experiences, little research has analyzed behaviors and reactions of users to widely distributed VR mediums such as those released by *The New York Times* and other mass media outlets.

Thereby, VR as a storytelling method remains unexplored in academic literature. Much of the research concerning VR focuses upon technology and communication, including its effects on changing health behavior (Ahn, 2015), video game engagement (Gee, 2010), and communication patterns among shy people in VR environments (Hammick, 2014). Some research has also examined the effects of such technologies as 'news games' as a way to engage audiences.

In particular, Gee (2010) suggests that learning is inherently different between content-driven and choice-driven media, where the latter turns out more effective in encouraging audiences to consider all sides of an issue during the decision making process within the interaction.[1] These choices within game and game-like experiences thus enable users to make decisions based on their own firsthand experiences within the immersive environment. From a storytelling perspective, 'digital media enable journalists to devise games as a platform for sharing news.'[2] This platform, arguably, has the capacity to affect learning and absorption in a positive way.

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[1] Gee, J. P. (2010). Video games: What they can teach us about audience engagement. *Nieman reports*, *64*(2), p. 52.

[2] Ibid, p. 54.

Within the theoretical framework of VR and its uses as a storytelling medium, a number of communication-related theories appear relevant.

Transportation Theory

Recent studies exploring media effects are often based upon transportation theory, which examines changes of emotions and attitudes when viewers 'get into' a story. Transportation explains what viewers take away from narratives and how their opinion can alter depending on their level of immersion in a story (Gerrig, 1993; Green and Brock, 2000). According to the definition proposed by the authors, transportation is a process which occurs when events depicted in a narrative absorb the viewer's 'mental systems and capacities.'[1] Even though traditional transportation theory centers on literary texts, transportation effects are not confined to printed words, and can be applied more broadly to other media, like video.[2]

Bilandzic and Busselle (2008) use transportation theory to research how viewers of films or television shows acquire certain perceptions, tastes, and knowledge when experiencing high levels of transportation. As stated in their work, during heightened transportation, viewers possess less capacity to think in a critical ways toward the narrative viewed. Thus, they are more bound to consume the narrative's core messages and carry them over to beliefs and behaviors in real life. Moreover, they found that higher levels of transportation, at least in certain visual genres tested, were associated with 'positive changes in attitudes.'[3]

A research by Oliver, et al. (2012) discovered that narrative news formats provoked more empathic feelings and positive attitudes toward stigmatized groups, resulting from the medium's higher levels of transportation compared to non-narrative based stories. By adopting the viewpoint of the stigmatized groups through

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[1] Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of personality and social psychology*, *79*(5), p. 701.

[2] Ibid, p. 702.

[3] Bilandzic, H., & Busselle, R. W. (2008). Transportation and Transportability in the Cultivation of Genre−Consistent Attitudes and Estimates. *Journal of Communication*, *58*(3), 508-529, p.523.

narrative-based stories, viewers were more likely to show compassion and develop more favorable attitudes, even as far as 'behaving in ways that benefitted the group.'[1]

The potential usage of empathy in storytelling has been explored in a number of studies. More specifically, empathy is often related to changing attitudes toward specific groups. Batson's (1997) three-experiment research on attitudes toward stigmatized groups found that increased empathy for some members of a represented group can improve overall attitudes toward the group as a whole.[2] Desire to take action, in other words, intention to act, has also been asserted to be affected by other immersive media, such as video games, where narratives are featured in a way in which the consumer takes a more active role (Peng, et al. 2010).[3] According to the findings of this research, participants who played a role game in the Darfur crisis expressed greater willingness and readiness to help the Darfurian people than those who interacted with text material.

The literature on immersive media shows that transportive media can promote greater feelings of empathy and even spur the desire to behave in certain ways or feel certain attitudes toward represented groups. Considering that immersive media can profoundly affect feelings and behavior of consumers, journalists could influence people's perception and action toward subjects.[4] The same argument supports the idea that the transportive effects and narrative engagement of VR storytelling may have a tangible impact on how people choose, perceive, and act on the media content they consume.

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[1] Oliver, M. B., Dillard, J. P., Bae, K., & Tamul, D. J. (2012). The effect of narrative news format on empathy for stigmatized groups. *Journalism & Mass Communication Quarterly*, *89*(2), 205-224, p. 216.

[2] Batson, C. D., Chang, J., Orr, R., & Rowland, J. (2002). Empathy, attitudes, and action: Can feeling for a member of a stigmatized group motivate one to help the group?. *Personality and Social Psychology Bulletin*, *28*(12), 1656-1666.

[3] Peng, W., Lee, M., & Heeter, C. (2010). The effects of a serious game on role−taking and willingness to help. *Journal of Communication*, *60*(4), 723-742.

[4] Oliver, M. B., Dillard, J. P., Bae, K., & Tamul, D. J. (2012). The effect of narrative news format on empathy for stigmatized groups. *Journalism & Mass Communication Quarterly*, *89*(2), 205-224.

Sensorimotor Contingencies

To apply transportation theory to the potential effects of VR, it is worth bringing up Slater's (2009) explanation of why people respond realistically in virtual environments. In other words, 'how' and 'why' viewers react to VR technology based on mental and physical signals. Immersive environments such as VR feature stories 'can be characterized by the sensorimotor contingencies (SCs) that they support,'[1] meaning the physical actions taken by the user to 'perceive' things, such as bending down or turning upward to look under something. VR is immersive in its essence because it promotes SCs, which are the physical reactions people experience when they are recognizing and interpreting something they see.

For SCs to occur, 'place illusion' and 'plausibility illusion' must be present in the experience. 'Place illusion' (PI) can be defined as 'the strong illusion of being in a place in spite of the sure knowledge that you are not there'[2] and 'plausibility illusion' (Psi), as 'the illusion that what is apparently happening is really happening (even though you know for sure it is not).'[3] The author postulates that, with the right combination of PI and Psi, the body will react to the experience as if it is really in the space which is being simulated. This results in RAIR, 'response as if real', by the user of the VR system (Slater, 2009; de la Peña et al., 2010).

Other studies examine how the realistic effects of VR can be used to change attitudes or behavior. One such study integrated VR elements into the promotion of healthy eating habits along with traditional methods, like print leaflet distribution. The study by Ahn used VR as a means to 'reduce social distance and increase personal relevancy of the risk'[4] of obesity following poor eating habits. During the

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[1] Slater, M. (2009). Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1535), 3549-3557, p. 3550.

[2] Ibid, p. 3551.

[3] Ibid, p. 3553.

[4] Ahn, S. J. (2015). Incorporating immersive virtual environments in health promotion campaigns: A construal level theory approach. *Health communication*, *30*(6), 545-556, p. 546.

VR experience, participants enter the VR space through a head-mounted display (HMD) and are shown their avatar, who is holding a soft drink bottle. Afterwards, the avatar drinks the soft drink while a digital clock in the background ticks off the passing of time, until 2 years pass and the avatar (representing the participant) has gained 10 kilograms, which is also visually displayed through piles of yellow fat accumulated on a scale next to the avatar.

The research discovered that participants, after viewing VR pictures of the negative consequences of soft drink consumption, generally reduced soft drink consumption 1 week following the experiment.[1] Findings also suggested that using the VR in combination with 'traditional messages in health promotion campaigns yielded longer lasting message effects.'[2]

A literature review on VR and its implication in storytelling can not be considered relevant without mentioning the name of Nonny de la Peña, one of the first pioneers of immersive journalism. In both her theoretical and practical work (such as VR short movies), VR is utilized as as a form of immersive journalism in which users can enter reality-inspired scenarios and make choices based on their firsthand experiences using an HMD.

In one such experiment, she exposed users to a VR scenario simulating that of a Guantanamo Bay prisoner, however, users were not told beforehand that the model was created from evidence released by the U.S. government from the prison.[3] In the experience, which was completely computer generated using audio and video from actual sounds gathered from prison media, the user is introduced to their avatar, who, in turn, represents a prisoner, in a stressful position, crouched over, standing on a wooden crate. The experience begins by allowing the user to view the avatar in third

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[1] Ahn, S. J. (2015). Incorporating immersive virtual environments in health promotion campaigns: A construal level theory approach. *Health communication*, *30*(6), 545-556,, p. 552.

[2] Ibid.

[3] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), 291-301.

person, then switches angle to first-person, enabling the user to see the avatar in a mirror if they turned and faced in that direction with the headset.

Nonny de la Peña found that the immersive environment simulated the physical effects of 'being there' described by Slater's virtual immersion research, which gave users a sense of actually being in the place depicted by the VR system. She claims that VR journalism allows facts to be represented in such a way that viewers are also able to experience them in active ways, versus the passive nature of traditional media, which risks to 'underrepresent'[1] reality.

Immersion

In this section, we discuss the fundamentals of immersion and how it influences different aspects of the user's experience, such as presence, body ownership, engagement, emotion, and cybersickness.

According to Slater and Wilbur (1997), *immersion* refers to 'the extent to which the computer displays are capable of delivering an inclusive, extensive, surrounding and vivid illusion of reality to the senses of a human participant.'[2] 'Inclusive' in this context is defined as 'the extent to which physical reality is shut out'. For example, most modern VR headsets are entirely inclusive as they completely enclose the user's view preventing the real world from being seen even in the user's periphery.

Slater and Wilbur (1997) describe 'extensive' as 'the range of sensory modalities accommodated.'[3] Multiple forms of multimedia provide visuals and audio; yet, immersive media also provide proprioception, which is 'a person's sense of the

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[1] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), 291-301, p. 299.

[2] Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *6*(6), 603-616, p. 606.

[3] Ibid, p. 610.

position and orientation of his body and limbs.'[1] Proprioception becomes possible by permitting users to physically look and move around the virtual world.

In the study by Slater and Wilbur (1997) the term 'surrounding' was used to address the degree to which an immersive experience is panoramic. Nearly all modern VR headsets provide a full 360° field of regard (FOR), which is the total area that can be captured by a movable sensor. Within this full FOR, many modern VR headsets provide approximately a 90° field of view (FOV), which is the extent of the observable world that is seen at any given moment).

Finally, the term 'vivid' applied in the same research by Slater and Wilbur (1997) represents 'the resolution, the fidelity, and variety of energy simulated within a particular modality.'[2] This notion relates to a broad spectrum of aspects, including display resolution (Ni et al., 2006), visual realism (Lee et al., 2013), visual complexity (Ragan et al., 2015), and many others.

More generally, immersion is defined as the feeling that someone has left his or her immediate, physical world and entered into a virtual environment.[3] In the VR field, the state of immersion is accomplished via a headset or spaces known as Cave Automatic Virtual Environments (CAVEs). A number of works have proposed a variety of characteristics and technological requirements for creating immersive environments. For instance, the study by Witmer and Singer identifies immersion as 'a feeling of being enveloped by, included in, or in interaction with a digital

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[1] Mine, M. R., Brooks Jr, F. P., & Sequin, C. H. (1997, August). Moving objects in space: exploiting proprioception in virtual-environment interaction. In *Proceedings of the 24th annual conference on Computer graphics and interactive techniques* (pp. 19-26). ACM Press/Addison-Wesley Publishing Co., p. 23.

[2] Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *6*(6), 603-616, p. 610.

[3] Aronson-Rath, R., Milward, J., Owen, T., & Pitt, F. (2016). *Virtual reality journalism*. Columbia Journalism School, p. 22.

environment.'[1] The researchers define certain factors responsible for provoking immersion: the ease of interaction, image realism, duration of immersion, social factors within the immersion, internal factors unique to the user, and system factors such as equipment sophistication.

Other scholars are more technologically deterministic, centering their research on the specific technology requirements necessary to achieve the state of immersion. They say that if an experience blocks the outside world, relates to many senses with high fidelity, surrounds the user, and corresponds to the user's bodily movements, it will provide a sense of physical reality and will be highly immersive.

The notion of immersion is largely used outside of virtual reality literature and is often utilized to characterize a wide range of digital journalism projects involving interactive 2D and gaming. From this viewpoint, the extent of immersion can be interpreted on a wide range from scenarios in which the user is offered a first-person perspective to the full VR experience where the user is entirely immersed in the media and acquires a sense of altered reality.

In the upcoming sections, we define and explain subjective responses promoted by immersive VR systems, such as presence, body ownership, engagement, emotion, and cybersickness.

Presence

Presence is a term that defines the psychological sense of being in a virtual space and having a first-person experience of a computer-generated world or simulation. Presence is 'a state of consciousness' experienced during the sense of 'being there' in a virtual world.[2] Presence is a result of place illusion and plausibility.

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[1] Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence*, *7*(3), 225-240, p. 227.

[2] Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *6*(6), 603-616, p. 607.

‘Place illusion’ is the feeling of an embodied transformation into the virtual environment, whereas ‘plausibility illusion’ is the belief that events are actually taking place, although the user realizes that the events are not real.[1] Following prior empirical evidence, Slater (2009) has argued that individuals will respond realistically to a VR experience when both place illusion and plausibility illusion occur. Thereby, it is through place illusion and plausibility illusion that VR presents an opportunity to fulfill the journalist’s dream which consists in transporting the public from the real world to the story world.

Presence is a concept most often evoked in the context of immersive VR. Indeed, Witmer and Singer argue that there is a correlation between a greater feeling of immersion and a greater potential for feeling presence.[2] While literature suggests a range of definitions of presence, they all describe a state in which the user is taken elsewhere through technology and feels truly transported. Differing theoretical constructs place differing importance on the need for an absolute sense of detachment from the physical world. More specifically, Kim and Biocca perceive presence as a combination between the 'departure' from physical reality and the 'arrival in a virtual environment.’[3] The study by Zahorik and Jenison postulates that presence is experienced when one reacts to a virtual environment as they would react to the physical world.[4]

As illustrated by a number of studies, presence is affected by immersion in a variety of ways. Barfield et al. (1999) discovered that the introduction of stereoscopy — the display of images to each eye to provide an additional depth cue — led to

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[1] Slater, M. (2009). Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1535), 3549-3557, p. 3552.

[2] Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence*, *7*(3), 225-240, p. 239.

[3] Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. *Journal of computer-mediated communication*, *3*(2), JCMC325.

[4] Zahorik, P., & Jenison, R. L. (1998). Presence as being-in-the-world. *Presence*, *7*(1), 78-89.

increased levels of reported presence, in spite of not improving user performance for a 3D wire tracing task. Similarly, according to the findings by Freeman et al. (2000), stereoscopy increases the feeling of presence when experiencing virtual scenes.

Lin et al. (2002) used a three-screen driving simulator to control field of regard (FOR) and found that the higher the degree of FOR was, the greater presence was reported by the users. Furthermore, McMahan et al. (2012) used a six-sided CAVE - Cave Automatic Virtual Environment which is a room-sized display environment. They found that a 360° FOR caused an undoubtedly higher presence than a 90° FOR.

The same study determined that a higher fidelity interaction resulted in far greater presence than a low-fidelity keyboard and mouse interaction technique. The concept of fidelity refers to how closely a virtual environment matches the look-and-feel of the physical world. Fidelity can vary in the areas of interactivity, visuals, and content and commands.

Tan et al. (2003) assessed the effects of display size by controlling the FOV and display resolution of two displays located at different distances from the user. They found that the larger display provided greater presence than the smaller display for an orientating in space task. Meehan et al. (2002) addressed the effects of frame rate on presence in a stressful virtual environment and discovered that the feeling of presence drastically improved with faster frame rates and decreased latency.

These findings suggest several factors affecting presence, including stereoscopy, FOR, display size, and frame rate. These are only an example of ways in which immersion interacts with presence. Many more are reported throughout the literature, but such an extensive survey is beyond the scope of this study.

As illustrated above, the core value of VR for journalism lies in this possibility for presence. Presence might gibe rise to an emotional connection to a story and its characters. It may also provide audiences with a greater understanding of stories when the spatial elements of a location are crucial for comprehending the depicted events. Nonny de la Peña, the pioneer of VR storytelling, identifies a reaction when

users respond to a media experience as if they are actually living through it, even though they know it is not real. They call this 'Response As If Real' (RAIR)[1].

The RAIR effect is the principal distinguishing characteristic between interactive and immersive media. What is especially particular about RAIR is the fact that it requires a very low level of fidelity. Even when the fidelity of the technology is limited or the sophistication is not sufficient, users react to immersive experience in very real ways. This, in part, explains why relatively low-quality headsets (such as Google Cardboard) remain powerful VR tools despite their technological inferiority to more expensive systems like VR headsets.

For de la Pena, et al., a combination of three variables determine the journalistic value of the RAIR effect: the representation of the place in which the experience is located, the feeling that events being experienced are real, and the transformation of the user's positionality into a first-person participant.

It has not escaped our notice that much of the early work dedicated to immersive environments was carried out utilizing computer-generated visuals, primarily in Cave Automatic Virtual Environments (CAVEs), which provided room for manipulation by researchers. They do not necessarily replicate or fully mirror reality and generally rely on computer-generated avatars and scripted communication.

CAVE-based experiences are linked to an entirely different generation of VR, and they operate in a way that distinct significantly from the current wave of VR devices. Aside from the evident alterations between immersive media delivered into rooms versus head-mounted displays, advances in camera and post-production technology now make it possible to film live-motion VR much more readily. While 360° video videos still require a complex, time-consuming computational post-production, we hypothesize that its effects on audiences is creating a new category for research. As this kind of video emerges as light from the physical world, captured by

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[1] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), 291-301.

a sensor, it attempts to mimic the human eye. The final result is as different from computer-generated environments as photography was different from illustration. And so there remains an immense opportunity for a new phase of virtual reality research.

Body Ownership

Body ownership is defined as 'the special perceptual status of one's own body, which makes bodily sensations seem unique to oneself.'[1] Research suggests that body ownership might be of crucial importance within the somatosensory nervous system, which processes internal signals from the body (Tsakiris, 2010).

Nevertheless, a number of studies have indicted that immersive VR systems can be engaged to create body ownership illusions, in which healthy subjects experience an artificial body as if it were their own physical body (Maselli and Slater, 2013). More precisely, users may unconsciously accept an avatar representation of themselves as their own body and react to events with the participation of their avatar, such as possible harm (González-Franco et al., 2014), uncontrolled movements (Pomes and Slater, 2013), and expected social behaviors (Kilteni et al., 2013). If immersive media can be used to promote such body ownership illusions, time travel in particular, they can clearly be used to place the viewers within a news or feature story.

It has been demonstrated that various aspects of immersion have been affect the overall success of body ownership illusions. According to the research by Petkova et al. (2011), a first-person perspective is needed for the body ownership illusion to occur. Later an experiment conducted by Maselli and Slater (2013) has confirmed that a first-person perspective was indeed a necessary condition for the body ownership illusion to occur. The same study has also determined that seeing a realistic virtual body in the same location and posture as the physical body suffices to evoke the body ownership illusion, without the need for visual sensorimotor cues,

[1] Tsakiris, M., Hesse, M. D., Boy, C., Haggard, P., & Fink, G. R. (2006). Neural signatures of body ownership: a sensory network for bodily self-consciousness. *Cerebral cortex*, *17*(10), 2235-2244.

such as rotating one's head to look around. Using HMDs, Petkova and Ehrsson (2008) showed that the body ownership illusion could occur even when the appearance of the virtual body was like a simple mannequin or even a different gender from the user. Other similar studies suggest that the illusion can even occur when the virtual body is of different skin color (Kilteni et al., 2013) or even posses an unnatural member, such as a tail, when viewed from a third-person perspective (Steptoe et al., 2013). Yet, according to the results obtained by Maselli and Slater (2013), the more closely the virtual body resembles the user in terms of skin color and clothes, the stronger the body ownership is.

Engagement

Engagement, like presence, is a state of consciousness, but one in which the user's attention is attracted to, involved with, and occupied by a user interface or piece of multimedia. Engagement is described as 'a quality of user experience that depends on several factors, including the esthetic appeal, novelty, and usability of the system, the ability of the user to attend to and become involved in the experience, and the user's overall evaluation of the salience of the experience.'[1] As such, engagement is undoubtedly relevant for immersive journalism. For a story to engage with the publics, it must attract, involve, and occupy the attention of the audience, otherwise the information will not be encoded and instead will be lost.[2] (Chun and Turk-Browne, 2007).

Considering its multifaceted nature, engagement depends on several variables,. Based on the evidence from previous research, variables may include the interestingness of the content, the user's gender, the user's motives for selecting a VR activity, and how well the skills of the user match the challenges presented by the activity (Sutcliffe, 2009). Nevertheless, some characteristics of immersion have been

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[1] O'Brien, H. L., & Toms, E. G. (2013). Examining the generalizability of the User Engagement Scale (UES) in exploratory search. *Information Processing & Management*, *49*(5), 1092-1107, p. 1195.

[2] Chun, M. M., & Turk-Browne, N. B. (2007). Interactions between attention and memory. *Current opinion in neurobiology*, *17*(2), 177-184.

reported to affect engagement. Freeman et al. (2000) found that stereoscopy increased users' subjective ratings of involvement when viewing a virtual scene.

Lugrin et al. (2013) compared a CAVE-based implementation of a first-person shooter, which used a six-degree-of-freedom (6-DOF) tracked device for 3D shooting and hand-directed steering, to a traditional desktop version that used keyboard and mouse. The concept of six degrees of freedom (6DoF) refers to the freedom of movement of a rigid body in three-dimensional space. They found that the CAVE-based implementation provided greater evidence of engagement than the desktop version. Furthermore, McMahan et al. (2012) found that increased display fidelity (through increased field of regard (FOR) and added stereoscopy) led to greater reported engagement, and so did increased interaction fidelity (through a 6-DOF tracked device, as opposed to a keyboard and mouse metaphor). Moreover, they determined that increasing both display fidelity and interaction fidelity resulted in the highest levels of reported engagement.

Emotion

As defined by Barrett et al. (2007), 'experiences of *emotion* are content-rich events that emerge at the level of psychological description, but must be causally constituted by neurobiological processes.'[1] Shih and Liu (2007) underline that users can no longer be pleased with usability and usefulness, but they also want 'emotional satisfaction' from their systems. Consequently, design processes have recently focused much more on the emotional aspect of systems (Hartson and Pyla, 2012). Apart from satisfaction, emotions are found to affect the cognitive processing of information by users (Barrett et al., 2007). Therefore, emotions will influence how each viewer interprets a story.

Similarly to engagement, several processes and variables are known to influence emotional states (Barrett et al., 2007), including immersion. Treatment for

[1] Barrett, L. F., Mesquita, B., Ochsner, K. N., & Gross, J. J. (2007). The experience of emotion. *Annu. Rev. Psychol.*, *58*, 373-403, p. 373.

phobia is an example of one of the early successful applications of immersive VR systems. By contrast, Chittaro et al. (2014) discovered that the sense of fear can be engendered by providing high-fidelity images of emergency situations, such as an aircraft evacuation simulation. Yet, Volante et al. (2016) found that lower-fidelity cartoon and sketch-based systems caused greater negative emotions (e.g., anger, fear, and guilt) than a high-fidelity system, when interacting with a deteriorating virtual patient.

In other research, Riva et al. (2007) established that the audiovisual features of a VR environment could be manipulated to provoke anxiety and relaxation on purpose. Recently, Naz et al. (2017) investigated how the visual aspects of VR space affected emotional states and found that color influenced warmth, brightness influenced spaciousness, and both color and brightness shaped excitement. Additionally, Kruiff et al. (2016) have analyzed how multi-sensory cues relate to emotion in immersive environments. Their findings indicate that surprise can be elicited by low-frequency sounds and back vibrations while happiness could be elicited by wind and smells.

Cybersickness

Cybersickness is the feeling of 'physical discomfort brought on by the use of immersive technologies.'[1] It is also often addressed as 'simulator sickness', or simply 'motion sickness'. The following symptoms of cybersickness are known: disorientation, difficulty with focusing, nausea, blurred vision, dizziness, vertigo, fatigue, headache, eye strain, increased salivation, sweating, stomach awareness, and burping[2] (Kennedy et al., 1993).

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[1] LaViola Jr, J. J. (2000). A discussion of cybersickness in virtual environments. *ACM SIGCHI Bulletin*, *32*(1), 47-56, p. 47.

[2] Kennedy, R. S., Lane, N. E., Berbaum, K. S., & Lilienthal, M. G. (1993). Simulator sickness questionnaire: An enhanced method for quantifying simulator sickness. *The international journal of aviation psychology*, *3*(3), 203-220.

There are three primary theories explaining the possible causes of cybersickness. They are the poison theory, the postural instability theory, and the sensory conflict theory (LaViola, 2000). The poison theory postulates that the body misreads the stimuli induced during the VR experience as if it had swallowed a sort of toxic substance, which leads to 'an emetic response'[1]. The postural instability theory relies on the premise that one of the major behavioral goals of humans is to maintain postural stability. Hence, continuous postural instability results in motion sickness symptoms. Finally, 'the most longstanding and popular explanation for cybersickness' is the sensory conflict theory (Davis et al., 2014), which is built on the idea that discrepancies among the senses regarding the body's orientation and motion cause a perceptual conflict that the human body does not know how to resolve.

Whereas the body's processes responsible for the feeling of cybersickness are not fully researched, several factors are known to contribute to the state of cybersickness. In particular, Davis et al. (2014) outlined three categories of factors affecting cybersickness. They are individual factors, device factors, and task factors. Individual factors comprise user-specific aspects, such as age, gender, preexisting illness, and posture. Device factors refer to issues caused by the immersive hardware being used. Finally, task factors are defined by the level of control enjoyed by the user as well as the duration of the specific task that the user is undergoing.

To conclude, it is worth noting that while journalists working with immersive systems like VR have little control over individual factors and device factors, they can make effort to ensure that the audience's task does not induce or contribute to cybersickness.

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[1] LaViola Jr, J. J. (2000). A discussion of cybersickness in virtual environments. *ACM SIGCHI Bulletin*, *32*(1), 47-56, p. 49.

2.2 Research Questions

Due to its heightened engagement, VR storytelling can have the power to change attitudes, improve fact recall and possibly increase intent to act through civic engagement.

There is a noticeable gap in VR research regarding its uses as a storytelling tool and how viewers are affected by VR experiences. This study aims to find connection between potential transportation effects of VR as a storytelling medium, and changes in attitude, empathy, and fact-recall compared to traditional video.

VR's value for storytelling is largely hypothetical. Hence, the industry desperately needs evidence of the platform's benefits. What is the potential for journalism, storytelling in particular, in VR? Can VR technology change the way audiences think about video stories and the people reported in them? Can VR impact how people perceive the world around them and affect their intentions to make it better?

Based on the literature and gaps in the understanding of VR as a storytelling medium, this study aims to answer four research questions:

RQ1: How does 360° video affect *attitudes* in relation to regular digital video?

RQ2: How does 360° video affect *empathy* in relation to regular digital video?

RQ3: How does 360° video affect *behavioral intention* in relation to regular digital video?

RQ4: How does 360° video affect *knowledge recall* in relation to regular digital video?

Definitions

Below are the definitions of the terms employed in our research questions.

360° video

Three hundred and sixty degree video is described as ‘a photorealistic video of a scene that updates based on head-orientation but is not otherwise interactive.’[1] 360° video is recorded using multiple cameras and stitched together through software to form a total surround scene. When the user views such an immersive 360° clip, he sees a 360° view from where the video was originally shot.

A 360° video is recorded using multiple cameras and stitched together through software to form a total surround scene. In this sense, creating content for immersive video is fairly straightforward, and consequently there is a wealth of content publicly available on social media sites.[2] (Multisilta, 2014).

While authors argue whether the term '360° video' and 'VR video' can be used interchangeably, most of them agree that 360° videos are ‘one powerful and realistic aspect of VR’[3]. Furthermore, 360° videos are also referred as 'the most common technology currently being used to create immersive experiences.’[4] Finally, there is only a limited amount of VR content readily available to the early adopters of the technology. One diverse category of content is the 360° video. Based on this evidence, 360° videos can be used to research VR storytelling as they constitute a significant, affordable and, by far, the most poplar form of experiencing VR.

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[1] Slater, M., & Sanchez-Vives, M. V. (2016). Enhancing our lives with immersive virtual reality. *Frontiers in Robotics and AI*, *3*, 74.

[2] Niemi, H., Harju, V., Vivitsou, M., Viitanen, K., Multisilta, J., & Kuokkanen, A. (2014). Digital storytelling for 21st-century skills in virtual learning environments. *Creative Education*, *5*(9), 657.

[3] Li, B. J., Bailenson, J. N., Pines, A., Greenleaf, W. J., & Williams, L. M. (2017). A Public Database of Immersive VR Videos with Corresponding Ratings of Arousal, Valence, and Correlations between Head Movements and Self Report Measures. *Frontiers in psychology*, *8*.

[4] Hardee, G. M., & McMahan, R. P. (2017). FiJi: a Framework for the immersion-Journalism intersection. *Frontiers in ICT*, *4*, 21, p. 4.

Regular digital video

Regular digital video can be defined as 'digitally recorded content that has sound and motion that can be stored or delivered live, and can be streamed to a variety of devices.'[1]

Video usage currently dominates the Internet. 'Globally, total Internet video traffic (business and consumer, combined) will be 77% of all Internet traffic in 2019, up from 59% in 2014.'[2] High quality video can be streamed faster than ever before into mobile devices. Whereas it took 12.5 minutes to download a song on-line in 2002, in 2014 it only took 18 seconds. When YouTube reports that '300 hours of video are uploaded to YouTube every minute'[3], this astonishing statistic does not come as a surprise to anybody. What is more, continuing technological developments allow video to be accessible more easily, faster, and across multiple platforms and devices. The increasing prevalence of video in daily life is makes it relevant to investigate how new technologies, such as VR, can compete with the most popular form of content nowadays.

Attitudes

Attitudes refer to 'postures or positions adopted or expressions of views or thoughts that have an effect on behavior, ideas or emotions.'[4] These three components have led to a tripartite view of attitude, stemming from Hovland's Learning Theory Model (Hovland, Irving & Kelly, 1963). This model divides attitudes into affective, cognitive and behavioral aspects. This separation has been both helpful and confusing and there does appear to be as much overlap as division, with interaction occurring between the way people feel and the way they think and act. Indeed, it can be

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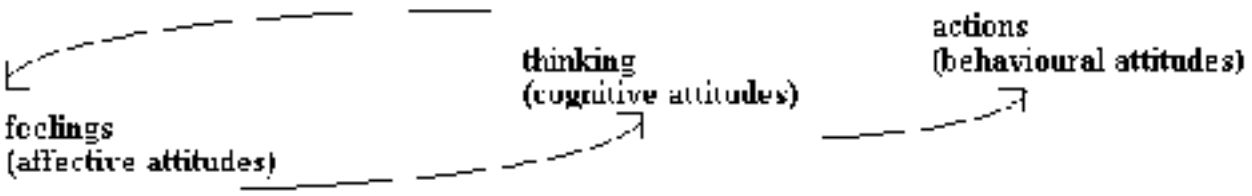
[1] Woolfitt, Z. (2015). The effective use of video in higher education. Lectoraat Teaching, Learning and Technology. Inholland University of Applied Sciences. Rotterdam, p. 5.

[2] Cisco Visual Networking Index: Forecast and Methodology, 2016–2021. Retrieved from https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/complete-white-paper-c11-481360.html

[3] Ibid.

[4]Johnston, J. (1997). Measuring Attitudes in Science: What Exactly are we Measuring and Why?

postulated that affective attitudes are the root of both cognitive and behavioral attitudes, so that how we behave is a result of how we think and an inter-relation of how we feel and think.



Empathy

Empathy can be conceived 'an other-oriented emotional response congruent with the perceived welfare of another.'[1] According to Batson, if the other is oppressed or in need, empathic feelings include sympathy, compassion, tenderness, and the like. These feelings can be stimulated by adopting the perspective of a person in need, imagining how that person is affected by his or her circumstances.

Empathy appears to affect attitudes. This idea was supported by the three-step empathy-attitude model suggested by Batson et al. (1997). First, this model claims that taking the perspective of an individual in need results in increased empathic feelings for this individual. Second, these empathic feelings bring about a perception of increased valuing of this individual's welfare. Lastly, inducing empathy for a member of a stigmatized group can improve attitudes toward the group as a whole. Hence, the increased valuing generalizes to the group as a whole and is reflected in more positive attitudes toward the group. The authors (1997) found support for each step of their model.

Behavioral intention

Behavioral intention (BI) can be defined as 'goal states in the expectancy value tradition that are the result of a conscious process that takes time, requires some

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[1] Batson, C. D., Chang, J., Orr, R., & Rowland, J. (2002). Empathy, attitudes, and action: Can feeling for a member of a stigmatized group motivate one to help the group?. *Personality and Social Psychology Bulletin*, *28*(12), 1656-1666, p. 1659.

deliberation, and focuses on consequences.'[1] Intention to act on one's beliefs is an important step in enacting change.

The construct of BI as a proximal antecedent to action is the focus of a number of theories, the most cited of which are *the Theory of Reasoned Action* (TRA; Fishbein & Ajzen, 1975) and its spinoff *the Theory of Planned Behavior* (TPB; Ajzen, 1991). TRA/TPB describe intentions as 'the amount of effort one is willing to exert to attain a goal' and 'behavioral plans that...enable attainment of a behavioral goal.'

Knowledge (fact) recall

Recall relates to the mental process of retrieval of information from the past. Along with encoding and storage, it is one of the three core processes of memory.

In turn, for something to count as knowledge the following criteria must hold: a) it must be true; b) the perceiver must believe this to be the case; 3) the perceiver must be in a position to know this to be the case[2].

Knowledge is internally organized into abstract mental structures. They are abstract in the sense that they summarize information about objects, events, and situations and structured in the sense that they represent associations among their elements[3]. Yet, they are not static, but are continually constructed through the processes of assimilation and accommodation. Comprehension is the result of the interpretation of new information, and the assimilation and accommodation of this information into memory structures. Understanding occurs from the interaction of the new information presented by a source and an individual's memory structure.

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[1] Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological bulletin*, *127*(2), 267, p. 10.

[2]Biggam, J. (2001, January). Defining knowledge: An epistemological foundation for knowledge management. In *System Sciences, 2001. Proceedings of the 34th Annual Hawaii International Conference on* (pp. 7-pp). IEEE, p. 3.

[3] Brown, A. L., Armbruster, B. B., & Baker, L. (1986). The role of metacognition in reading and studying. *Reading comprehension: From research to practice*, 49-75.

2.3 Hypothesis

The goal of the current research was to assess the user experience of VR storytelling compared to experiencing a story told by a regular digital video.

Due to the immersive nature of VR, it was hypothesized that a 360° video would augment levels of transportation than a regular digital one. In turn, greater levels of transportation induce changing attitudes or behavior, based on findings from the previous transportation research (Green and Brock, 2000).

Our study aims at testing the following hypothesis:

H1: 360° video will result in greater *transportation* than a regular digital video format.

Our hypothesis is based on the previous studies in transportation theory, notably *The Role of Transportation in the Persuasiveness of Public Narratives* (Green and Brock, 2000). Transportation was proposed as 'a mechanism whereby narratives can affect beliefs.'[1] Conceived in this research as 'absorption into a story', transportation involves imagery, affect, and attentional aspects. The experiment demonstrated that extent of transportation increased story-consistent beliefs and favorable evaluations of protagonists. Reduced transportation resulted in reduced story-consistent beliefs and evaluations.

If 360° videos do provide a higher level of transportation as we hypothesize it, this may explain inducing greater feelings of empathy, and even willingness to behave in certain ways toward represented groups (Oliver, et al., 2012).

Transported viewers may experience strong emotions and motivations, even when they know the events in the story are not real. For example, when transported into narratives with unhappy endings, transported individuals are likely to engage in

[1] Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. Journal of personality and social psychology, 79(5), 701.

what Gerrig (2018) termed *anomalous replotting: '*actively thinking about what could have happened to change an outcome.'[1]

Another consequence is that people return from being transported somewhat changed by the experience. Our research attempts to measure, among other things, how much viewer's attitudes are changed after watching a 360° video compared to a regular digital one.

Transportation often relates to a narrative, or a story. Our research is centered explicitly on public narratives. Although informal storytelling and other forms of personal narratives are widespread, our hypothesis refers to the effects of external narratives, those to which numerous people could be exposed on different occasions or at the same time.

Furthermore, our research has focused on stories rather than rhetorical materials because transportation is less likely to occur with rhetorical passages and because stories may be held to different truth standards than rhetorical messages (Bruner, 1986).

Lastly, although other forms of communication might also elicit transportation, for example, an emotional and moving speech, transportation more commonly occurs in response to narratives.

[1]Gerrig, R. (2018). Experiencing narrative worlds. Routledge, p. 177.

Chapter II. Methodology and Findings

§ 1 Methodology

1.1 Method

This study employed a between-subject experiment in April 2018 with two conditions as the independent variable: 360° video and a regular digital video. The research design represents a comparison between the subjects in one condition (viewing a 360° video) with the subjects in the other condition (viewing a regular video).

The methodology employed in this study combines an experiment using a survey method and a qualitative in-depth interview. The data were collected through survey and interview methods. By combining these methods, we can measure the user experience (UX) and analyze the authentic experience of VR immersion. Previous studies had limitations measuring real experience using a single method. As the UX of a virtual environment can be dynamic and changing, the combined method allows us to understand the user's experience better.

Participants

Participants were recruited, for the most part, among the English-speaking employees of the IT-company *Wrike.* The experiment took place at the company's office in Saint Petersburg.

In total, 30 participants completed the experiment, 15 females (50 percent) and 15 males (50 percent), between the ages of 18 and 40. 19 participants (63 percent) are aged between 25 and 29, 5 participants (17 percent) - between 18 and 24, 4 participants (13 percent) - between 30 and 35, 2 participants (6 percent) - between 36 and 40. For 24 participants (80 percent), Russian is the native language. English, Ukrainian, Armenian, Dutch, and Portuguese are among other native languages cited. Among the participants, 17 (57 percent) hold a Bachelor degree, 10 (33 percent) hold a Master degree, and 3 (1o percent) graduated from high school. 19 participants (63 percent) claimed to have experienced Virtual Reality (VR) before. Entertainment was

reported the primary aim of using VR by 12 participants (63 percent), the other 7 participants (37 percent) used this technology to receive information, for example, by viewing news pieces or documentaries.

As our experiment was fully conducted in English, fluency in English (C1 CEFR level) was prerequisite to participation.

1.2 Procedures

Participants were randomly split into two groups of 15 each, using Microsoft Excel's random number generator. The first group watched the story in virtual reality using a Google Cardboard device, the other group watched the story in traditional broadcast-style video on a computer monitor. The first video was played in the Youtube mobile application, the other was played in the desktop version of Youtube.

Both groups were assigned to view exactly the same video content, only the physical medium varied. The participants in the second group, that watched a regular video, were asked to not change the viewing angle by dragging with the mouse. Both groups were completing the experiment under the author's control. We also made observations while watching the participants view the VR film.

Participants were told that the purpose of the study was to measure effects of various storytelling methods, but were unaware of the other modes being tested. After watching the story, each participant filled out the same online questionnaire, which included a total of 26 questions regarding 1) demographics, 2) transportation, 3) empathy, 4) story-specific attitudes, 5) behavioral intent, and 6) knowledge (fact) recall. The filled in questionnaires were submitted anonymously. The group viewing the 360° video also participated in a qualitative in-depth interview conducted by the author as 'a follow-up to the questionnaire to further investigate respondents' responses'[1].

[1] McNamara, C. (1999). General guidelines for conducting interviews, Minnesota. *Missouri Institute of science*.

VR Hardware

For our experiment, to view a 360° video, we employed the Google Cardboard device. Google Cardboard represents a virtual reality (VR) platform developed by Google for use with a head mount for a smartphone. As illustrated previously, this viewer is the most accessible and easy-to-use VR device. Participants in the 360° video condition viewed the story using the standard cardboard viewer v.1, the iPhone 6 placed inside it, and a set of headphones. Participants in the regular digital video condition viewed the story using a computer/laptop monitor. Some of the subjects expressed willingness to be seated in a swivel chair to allow for an unrestricted range of motion during the simulation.

While designing the research, we considered the following hardware limitations. The Google Cardboard, even though a popular device to experience VR, does not provide a sense of immersion due to the lack of interactivity and the simplicity of the technology used. Yet, in VR studies it is rated as a reliable device to view 360° videos.[1] It is worth noting that the screen of the smartphone placed inside the Google Cardboard is less convenient for watching a video than a computer monitor. In addition, since the cardboard can not be mounted to the user's head, it might be tiresome to hold the device in your hands while viewing the story. Lastly, the very innovativeness of the cardboard technology can be distractive, in comparison to a computer monitor which participants use in their every day life.

Overall, the Google Cardboard suffices to view 360° videos, and, considering our limited resources, its usage in our experiment is seen relevant.

360° video

We used a publicly available 6.26 minute 360° film played on YouTube in 1080s HD resolution and titled 'Climate Change in Fiji in VR: 'Our Home, Our People''. This film is a part of a *Our Home, Our People* project launched by the

[1] Hardee, G. M., & McMahan, R. P. (2017). FiJi: a Framework for the immersion-Journalism intersection. *Frontiers in ICT*, *4*, 21.

Fijian government to share Fiji's climate change story with global leaders at the 2017 United Nations Climate Change Conference (COP23), which took place in Bonn (Germany) from 6–17 November 2017.

The film takes viewers to communities across Fiji to experience the stories of four people whose lives have already been dramatically affected by climate change, including through last year's devastating tropical cyclone Winston. The VR experience comprises a story of Vunisavisavi, a remote coastal community which has already seen massive relocation caused by the impacts of rising sea levels.

The VR film project is produced by the Fijian Government, COP23 Secretariat and the World Bank, in partnership with the Global Facility for Disaster Reduction and Recovery (GFDRR) and VR specialists from Australian creative technology agency S1T2. Speaking about why VR was selected as the storytelling method, Michel Kerf, World Bank Country Director Papua New Guinea and the Pacific Islands, said: 'VR is extraordinarily effective at taking audiences to another place, into other people's lives. *Our Home, Our People* transports audiences – including decision makers who can take action to change the course of climate change – to the true heart of the issue in the Pacific'[1]. The VR film was launched alongside the *Climate Vulnerability Assessment: Making Fiji Climate Resilient* report presented by Fiji at COP23. 'The report is designed to connect with the head; and the Virtual Reality production with the heart'[2].

We decided to use this 360° video out of many others available online for a variety of reasons. First, this film was chosen for its production quality. It was shot by S1T2, an Australia's most sought after creative technology agency specializing in experiential marketing, virtual reality, data visualization and augmented reality.

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[1] Fiji to Use Virtual Reality to Highlight Impact of Climate Change to Global Decision-Makers (2017, November 1). Retrieved from: http://www.worldbank.org/en/news/press-release/2017/11/01/fiji-to-use-virtual-reality-to-highlight-impact-of-climate-change-to-global-decision-makers

[2] Climate change virtual reality project returns home to Fiji (2018, April 4). Retrieved from: http://www.worldbank.org/en/news/press-release/2018/04/04/climate-change-virtual-reality-project-returns-home-to-fiji

The video is available on Youtube in different HD resolution and is ideally suited for being viewed through the Google Cardboard device. In addition, it can be watched as a desktop video as well, which is essential for our between-subject experiment.

Second, we found the content of the film most appropriate for testing our hypothesis and answering our research questions. The video features a remote country which nobody among the participants has any personal relation to. Its focus on the climate change allows us to measure the participants' attitudes and level of sympathy toward the Fijians whose stories are told. Furthermore, the video contains a number of accurate facts which makes it possible to measure the knowledge (=fact) recall. Lastly, this film has English subtitles which helps us achieve two goals. They are a) facilitate the comprehension of the film for the participants who are not native English speakers; b) find whether the VR technology distracts from reading and understanding texts inside the video. In addition, this film contains text fragments revealing some interesting facts about Fijian people and their lifestyle. These text fragments enable us to examine how VR affects text comprehension and text recall.

Finally, we aspired to make our experiment exciting for the participants. Therefore, we were looking for a VR film which would be interesting to watch. We considered Youtube as the platform to watch the VR video due to the possibility to watch it both through the Goggle Cardboard using the Youtube mobile application and as a regular digital video on the desktop version. Among the 360° videos available on the website, the most viewed ones are entertainment-orientated.

Yet, 'Climate Change in Fiji in VR: 'Our Home, Our People'' stands out among other similar films due to an impressive number of views - 237,033, as of May 17, 2018. In addition, as reported on the World Bank webpage, by April 2018 this VR film project has been seen by more than 600,000 people worldwide, including many global leaders at COP23, and has been named as a finalist in the United Nations' Sustainable Development Goals (SDGs) Action Awards[1]. These

[1] Climate change virtual reality project returns home to Fiji (2018, April 4). Retrieved from: http://www.worldbank.org/en/news/press-release/2018/04/04/climate-change-virtual-reality-project-returns-home-to-fiji

accomplishments give evidence of the film's excellence, in terms of both technology and storytelling. At the same time, this VR video has never been employed in a VR study before.

We realize that this VR film was not recorded by journalists. Instead of journalism purposes, this project pursues marketing ones. Yet, journalism and marketing are related fields both using communication tools. Besides, the goal of this study is to explore VR as a storytelling method. In today's world, stories are no longer the prerogative of journalists and writers. Stories can be told by different subjects for different goals. Considering the advantages of the video cited above, we believe it is relevant for our research to employ a VR film whose creators have a motto: 'We tell stories, with new technology'[1].

1.3 Measures

The independent variable for this study was the storytelling mode – VR (360°) or regular video. Various dependent measures based on Likert-type scales were employed to answer the hypothesis and research questions, all derived from previous research (Oliver et al., 2012; Peng, W., et al. 2010; Batson, C. D., et al., 2002; Green, M. C., & Brock, T. C., 2000).

Transportation. Transportation was measured through a modified version of Green and Brock's (2000) Transportation Scale, which, in turn, relies on Gerrig's (1993) exposition of transportation. As in the Green and Brock's (2000) study, all items were measured on a seven-point scale anchored by 1 (not at all) and 7 (very much). The four-item index included such statements as 'I could picture myself in the scene of the events described in the story'. (See scale items in Appendix 1.)

Attitudes. This index comprised the mean of the scores for five statements regarding attitudes toward climate change, rated from 1 (strongly disagree) to 7 (strongly agree). All statements were positive worded and expressed positive attitudes toward recognizing climate change as an important problem. Each statement started

[1] Retrieved from https://www.s1t2.com.au/about-us

with words linking it to the film watched, such as 'the video made me think' and 'after watching this film'.

Questions included ‘After watching this film I doubt that climate change as a problem is much exaggerated and politicized’ and ‘This film convinced me that if we don’t do anything about climate change, a miserable future is ahead of us’. (See scale items in Appendix 2.)

Empathy. The scale we used to measure empathy is based on the Emotional Response Questionnaire (ERQ) developed by Batson, McDavis, Felix, Goering, & Goldman[1] to assess both empathic concern as well as personal distress. It consisted of 23 adjectives which were chosen for their apparent face validity. The empathy adjectives used were *moved, softhearted, sorrowed, touched, empathic, warm, concerned, and compassionate.* The distress adjectives were *alarmed, perturbed, disconcerted, bothered, irritated, disturbed, worried, uneasy, distressed, troubled, upset, anxious, and grieved.* Since then, this initial Emotional Response Questionnaire has been used and tested extensively by many researchers to assess state empathy and distress.

In our study, a modified scale derived from Batson et al. asked participants to rate five feeling descriptors on a scale from 0 (not at all) to 7 (extremely). These descriptors are *sympathetic, compassionate, neutral, worried, and irritated.* Two of them (*sympathetic* and *compassionate*) are taken from the six adjectives proposed by Batson et al. (1987) to measure empathic concern: *sympathetic, moved, compassionate, tender, warm* and *softhearted.* Other two adjectives (*worried* and *irritated*) are derived from the distress adjectives suggested by the Emotional Response Questionnaire discussed above. Finally, the adjective *neutral* was added by the author to designate the baseline which will allow us to tell empathy feelings from the distress ones.

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[1] Coke, J. S., Batson, C. D., & McDavis, K. (1978). Empathic mediation of helping: a two-stage model. *Journal of personality and social psychology*, *36*(7), 752.

Behavioral intention. Behavioral intent measures, five in total, were modified from the index proposed by Peng, Lee, and Heeter (2010). This index was designed to measure willingness to help the Darfurian people among those who played the *Darfur is Dying* game.

In our research, the participants were asked to use a 7-point scale (1 - not at all, 7 - very much) to rate how likely it was that they would: a) donate money to the regions affected by the natural disaster caused by the climate change; b) sign a petition to push for government leniency towards environmental policy; c) discuss climate change issues with friends and family; d) forward links to advocacy groups to friends and family on social media; and e) watch other videos/documentaries on climate change.

Knowledge recall. Finally, fact recall consisted of five story-specific multiple-choice questions coded as 0 (incorrect) and 1 (correct). The correct answers were summed to create a total score, from 0 to 5. (M = 6.05, SD = 1.53). (See scale items in Appendix 5.)

Demographic and attitudinal control items included age, gender, native language, degree, and previous experience with VR technology.

VR Ethics

Although general VR studies have been around since the early 1990s, it is worth briefly outlining the ethical and practical considerations that have arisen during the experiments alongside evolution of the technology. Behr, K., Nosper, A., Klimmt, C., & Hartmann, T. (2005) identify four potential risks to the safety of research subjects in VR experiments: (1) motion sickness, (2) information overload, (3) intensification of experience, and (4) re-entry into the real world. Motion sickness, also labeled 'cybersicknes', can occur when the VR experience is physically different from the reality of the viewer[1]. For instance, if the viewer is stationary in reality, a

[1] Behr, K. M., Nosper, A., Klimmt, C., & Hartmann, T. (2005). Some practical considerations of ethical issues in VR research. *Presence*, *14*(6), p. 670.

VR experience with them running through a field could induce motion sickness. Similarly, information overload occurs when the viewer is unable to handle all the visual information coming at them in a 360 experience, which can cause stress and disillusionment. If users find the experience too intense or real, they can also experience 're-entry' problems, and have trouble coping with reality for a bit after they exit the headset[1].

While this experiment utilized VR video and the Google Cardboard device, there was no element of choice, role-play, or body replacement through avatars in the technology utilized, therefore there was no risk of psychological issues with re-entry or information overload. However, motion sickness is a problem common across all VR practices and modes and that risk was made known to participants before they informed their consent.

In-depth semi-structured qualitative interview

In-depth interviewing is a qualitative research technique that consists of conducting 'intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation.'[2]

Qualitative research interview was conducted as a follow up to the questionnaire to further investigate respondents' responses (McNamara, 1999) and the overall experience of viewing a VR film. Since the interview was aimed at deepening the understanding of the VR storytelling experience, only the subjects in VR condition participated in the interview. To conduct 20-minute interviews, we used meeting rooms located in the *Wrike* office. This allowed us to have a tete-a-tete conversation between the author and the interviewee to exclude the possibility of external factors interfering. In order to have the interview data captured more effectively, we used the MacBook Air voice recorder.

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[1] Behr, K. M., Nosper, A., Klimmt, C., & Hartmann, T. (2005). Some practical considerations of ethical issues in VR research. *Presence*, *14*(6), p. 671.

[2] Boyce, C., & Neale, P. (2006). Conducting in-depth interviews: A guide for designing and conducting in-depth interviews for evaluation input, p. 3.

The primary goal of the interview was to measure the user experience (UX) of VR storytelling and technology, since these data are not reflected in the questionnaire. To measure it, we selected five statements, each of which is worded positively toward the VR experience. These five statement were: 1) I enjoyed watching this VR film through the Google Cardboard; 2) I had a feeling of being inside the story, close to the Fijian people; 3) I would rather watch this video using VR equipment than on a regular flat screen; 4) It was easy to follow the story, including the subtitles; 5) I didn't have any uncomfortable feelings (headache, eye pressure, etc.). Each statement was then coded with 'yes' equaling 1, and 'no' equaling 2. The total sum of scores was calculated for each statement with the maximum of 15 scores.

To explore respondents' VR experience more systematically and comprehensively, we employed a semi-structured interview method. Semi-structured interviews are based on semi-structured interview guide, which is a schematic presentation of questions or topics and need to be explored by the interviewer. We employed the findings of the Google News Lab study entitled 'Storyliving: an Ethnographic Study of How Audiences Experience VR and What That Means for Journalists' (2017)[1] as our interview guide. In order to explore how people experience VR and what makes it distinct from other forms of storytelling, this study conducted in-depth interviews with VR consumers and creators.

The research suggested three directions of VR interviews. They are: a) Storyliving, Shapeshifting and Emotional Authenticity. How do people experience VR? What makes it distinct from other forms of storytelling? b) Participation, Emotional Management and Embodiment.What makes VR alluring to audiences? c) Emotional Resonance, Playing with Perspective and Embracing Vulnerability. What factors are important to consider for effectively communicating in an immersive medium?

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[1] Google News Lab (2017, July 28). *Storyliving: an Ethnographic Study of How Audiences Experience VR and What That Means for Journalists.* Retrieved from https://newslab.withgoogle.com/assets/docs/storyliving-a-study-of-vr-in-journalism.pdf

Since creating VR experience is beyond the scope of this study, we replaced the third domain with technology-related questions. How did it feel to use the Google Cardboard? What challenges did you experience regarding the hardware? What can be improved about this technology? If you were to choose how to watch this film - using the Google Cardboard or the regular computer monitors - which mode would you choose?

While we were guided by the core questions employed in the Google News Lab study, many other related questions arose alongside the interview. The semi-structured interview method enabled us to be flexible about questions and keep conversion vivid, relaxed, and interesting for both parties involved.

§ 2. Findings & Empirical Discussion

2.1 Results of the experiment and the in-depth interview

To see the results in tables, see the Appendices 1-5.

Experiment

Based on previous studies in transportation theory, we hypothesized, that those in the VR condition would demonstrate greater transportation than those in the regular digital video format.

In this section, the largest range was observed in the first statement 'I could picture myself in the scene of the events described in the story'. The mean for the VR group on a 1-7 scale with 7 indicating more transportation was 5.06 (SD=1.48) and the mean for the regular video group was 3.80 (SD=1.74). The second statement 'After finishing the story, I found it easy to put it out of my mind (=stop thinking about it)' suggested a significantly higher transportation effect for the subjects in VR group: M=3.93 (SD=1.48) vs. M=3.00 (SD=1.30). The third statement 'The story broke me emotionally (=shocked)' (M=3.40 (SD=1.63) in VR condition vs. M=3.66 (SD=1.17) in the regular video condition) as well as the last statement 'I found my mind wandering (=being somewhere else) while watching the story' (M=4.20 (SD=2.14) in VR condition vs. M=4.26 (SD=1.62) in the regular video condition) indicated a virtually similar transportation effect, even though the regular group's score was slightly higher.

Overall, our hypothesis was supported: the subjects in VR condition expressed higher transportation (M=4.14 (SD=0.69)) in comparison to those in the regular video condition (M=3.68 (SD=0.52)).

The first research question asked how VR video would affect attitudes toward the presented issue in relation to regular video. Even though transportation is believed to affect attitudes, the regular video group averaged a higher mean than the VR group for each of five items. On a scale of 1 to 7 with 7 indicating more positive attitudes

toward the presented issue (climate change), the mean of the regular video group reached M=4.67 (SD=0.37) while the mean of the VR group was M=4.42 (SD=0.37).

The second research question asked how VR video would affect empathy toward represented groups (the Fijian people) in relation to regular digital video. Similar to previous findings, the VR group appeared slightly more empathetic toward the Fijians. For the empathy states, those in the VR group averaged a mean of 5.53 (SD = 0.46) and the regular video group averaged 5.49 (SD = 0.23). Yet, for the distress states, the mean for those in the regular video condition was 3.09 (SD=2.49) while the mean for the participants in VR condition was only 2.56 (SD=1.64). Finally, for the neutral state, the VR group averaged a mean of 3.13 (SD=1.76) and the regular group averaged a mean of 2.80 (SD=1.47) which are virtually the same results. It is worth noting that the feeling of 'irritated' virtually was not induced at all for both the VR and the regular video groups.

The third research question asked how VR video would affect the intentions of participants to act in regards to the represented groups, as compared to those in the regular digital video conditions. Again, those in the VR group reported little differently than those in the other condition. Those in the VR group averaged a mean of 3.53 (SD=1.67) and the regular video averaged 3.61 (SD=1.37) Yet, each statement had a differing 'load' which will be observed in the 'Discussion' section.

Finally, the last research question asked how VR video would affect knowledge recall in relation to regular digital video. Again, those in the VR group reported little differently than those in the regular video condition. The maximum score if a participant replied correctly to all five questions was five points. Thus, the maximum knowledge recall mean would be qual to 5. The VR averaged 3.6 (SD = 0.82), the regular video averaged 3.4 (SD = 1.24). In the VR group, two participants achieved the maximum result (5 out of 5); in the regular video group, this result was obtained by three participants. Yet, the smallest score (1 our of 5) was as well achieved by a subject in the regular video condition.

Interview

The semi-structured in-depth interview method was employed in our study to better understand the user experience of VR storytelling and technology per se. The findings speak in favor of using VR as a storytelling medium. The total number of respondents was 15, 13 out of them agreed that they enjoyed watching this VR film through the Google Cardboard.12 respondents would prefer watching this video using VR equipment to watching it on a regular flat screen. 11 respondents confirmed that they had a feeling of being inside the story, close to the Fijian people. Aside from one respondent, everybody else claimed having experienced no uncomfortable feelings such as headache while viewing the video. However, only 6 respondents found it easy to follow the story, and the subtitles in particular.

Overall, the respondents pointed out similar advantages and shortcomings of experiencing VR as a storytelling medium. Since the majority of the participants never used the Google Cardboard before, many were surprised that this simple box could provide such a unique immersive experience. Some respondents mentioned that such accessibility and affordability of VR technology may replace traveling in future, especially to far away and dangerous places. Interestingly, for certain respondents it took some time to realize that they move their head in different direction and see the video 360° around them. A number of respondents preferred to view the film in a swivel chair which allowed them to easily rotate their body in space.

In general, the technology proved to be a decisive factor in viewing this film. One of the respondents confessed that, but for the novelty of the technology, he would not have watched the video till the end and would have stopped as soon as he realized that it was dealing with the environmental issues. Yet, the VR format made him interested in watching it. A few other respondents agreed that if they had watched this film on a regular screen, they would have never been as touched by the story of Fijian people as they were after viewing it through the Google Cardboard. On the day following the interview, one of the respondents revealed to the author that he was still thinking about the story and was discussing it with his friends. Finally, one person

even suggested creating all modern videos in the VR format only, since it is so much more beneficial than the regular one.

However, not all respondents agreed that they would rather watch this video using the Google Cardboard than on a regular 2D screen. Among the reasons why they were not satisfied with the VR experience, the poor quality of the equipment was cited most often. Some participants pointed out that it was distractive to hold the cardboard the whole time in your hands. Others underlined that the image was not stable due to unstable lenses.

The absolute majority of the respondents agreed that it was difficult to understand the storyline, especially the subtitles, while viewing the video. 'The technology allows you to look all around, and you may want to enjoy the view of the beautiful Fiji or look at some particular detail which is is not in the focus of the camera. You get distracted, miss the information which was written in another part of the screen and start feeling lost,' - explained one of them. The time-consuming process of setting up the video was also mentioned among the drawbacks of the VR experience. Lastly, two respondents rejected the technology because of being 'old-fashioned' in general and not willing to accept the latest change.

2.2 Empirical Discussion

The findings of this study, in general, support previous research regarding the connection between transportation and the effects of VR, hence, our hypothesis was supposed. This study, however, indicates an intriguing and counter-intuitive revelation about VR as a storytelling medium.

Based on previous transportation research, the higher the transportation, the more likely people will change thought or opinion based on the narrative. Due to the immersive nature of VR, VR stories did produce greater levels of transportation than a regular digital video. However, a greater level of transportation did not result in heightened positive attitudes toward the issue discussed in the video, as findings from previous transportation research suggest. Our experiment found no such relationship.

Furthermore, there was no statistically significant difference in feelings of empathy for the VR group. Those in VR condition demonstrated a slightly higher score for the states of empathy ('sympathetic', 'compassionate'), wheres those in the regular video condition averaged a higher mean for the states of distress ('worried', 'irritated'). This difference can be explained by the fact that VR is still perceived by the majority as an entertainment provider and, therefore, the content shown does not provoke distress feelings.

No connection was found between the medium of storytelling and behavioral intention. Only one participant (surprisingly, in the regular video group) agreed with the statement requiring most effort out all proposed ones: 'Donate money to the regions affected by the natural disaster caused by the climate change'. Those in VR condition chose more often to watch other related videos, while those in the regular video condition were willing to discuss climate change with their family and friends. The choice of the VR group to view similar videos may suggest that it is the VR technology that attracts them and not the issue discussed in the video.

Finally, contrary to our intuitive expectations, the level of knowledge recall was higher among those in the VR condition. The VR technology did not distract viewers' attention from the facts presented in the story, including those that were written on the screen. However, as it follows from the interviews conducted after the experiment, it was somewhat hard to follow the story and the subtitles in particular. Hence, VR has the potential to tell stories different from entertaining ones, as users proved to be capable of recalling facts presented in such a unique and innovative way. Yet, the difficulties encountered by the VR users while reading the subtitles suggest that a VR story should be designed considering the peculiarities of a human eye.

Overall, virtual reality's lack of effect in attitudes, empathy, and behavioral intention might be explained by the simple fact that the newness and novelty of the technology might have overwhelmed the participants' ability to immerse themselves in the story. The wonder of the electronics overshadowed the narrative itself.

For most people, VR as a storytelling medium is still a curious delivery mode of stories. Many of the participants in this study revealed in the interview that they had actually never used a VR headset like Google Cardboard before. The equipment itself caused astonishment among some respondents, since they did not expect a simple unremarkable cardboard to provide such a strong immersive effect. We assume that participants ooh'd and ahh'd at the ability to look up, look down, look all around, might have distracted them from the actual narrative. If this is the case, the novelty and mild shock factor of VR equipment could prevent viewers from fully receiving the storytelling experience.

Also, it should be noted that the VR technology used in this study (the Google Cardboard viewer), as disseminated by *The New York Times* and other media companies, differs from the technology used in other research that supports 360° experiences. The Google Cardboard does not give the viewer agency within the experience via a computer-generated avatar. Thus, the experience is less choice-based, which could have contributed to the lack of 'response as if real' effects typical of more immersive experiences.

Furthermore, when speaking about what could be improved about the technology, a number of respondents evokes lack of interactivity with the people features in the story. While viewing the video, some participants were moving their hands as if trying to touch the surroundings. Yet, since their hands were not displayed in the virtual space, they did not fully immerse in the story. Additionally, several respondents shared the view that they were lacking other senses in the story such as wind, smells, and temperature. Experiencing these senses required a more sophisticated VR equipment which is far from being a mainstream device nowadays. Thus, the inaccessibility of high-quality VR headsets for most people might be an obstacle for VR to become a wide spread storytelling medium.

What do these findings mean for media practitioners and the future of VR technology in storytelling? Considering the experiment results as well as the responses during the interviews, this study would suggest that, while VR holds a high

potential to engage users in the story, it is currently not, on its own, an effective storytelling method. These results also explain why entertainment-orientated VR videos dominate the Internet in comparison to news, feature, and documentary stories. The novelty of the technology and the difficulties with setting up the equipment might be the factors deterring potential VR users. Media organizations might instead consider it as a supplement to their reporting, boosting print articles and broadcast-news video.

However, as our findings reveal, VR might help public organization draw attention to the subjects which are not, in general, alluring to audiences, such as climate change or refugee problem. Disengaged audiences may embrace VR as a new, more exciting way to tell stories which, otherwise, would not have been heard. In our example, a number of participants confirmed that they would not have watched a film on climate change in regular conditions. They were pleasantly surprised to discover that a video on a topic which does not interest them a lot might still be exciting and moving.

Additionally, VR can be an effective storytelling tool for helping audiences to be exposed to hard-to-reach places or potentially ambiguous scenarios which could benefit from being seen in complete 360°. Perhaps, someday, VR technology will be so routine in everyone's lives that users will pay more attention to the story rather than to the medium. Or, perhaps, in journalism, VR will continue to play the role as a vivid supplement to let users view a panoramic scene of an event in addition to reading the key facts of a story in writing and viewing a video narrative in the style of broadcast-news or film.

2.3 Limitations of the Study

Limitations of our experiment can be divided into two categories: technology-wise and human-wise. First, from the technological angle, the Google Cardboard viewer used in the research does not provide a truly immersive experience as it, for instance, does not enable users to interact with the virtual world and be present there

as a virtual avatar. An experiment employing participants fully experienced in VR technology might yield different results, although would be less generalizable to today's online content consumer who is still likely to be unfamiliar with this relatively new technology. Thus, the conditions of our experiment were brought nearer to the home-like ones.

Second, our study does not take into account individual characteristics of the participants. Due to time considerations, we did not conduct a pre-study to measure their immersion tendency as suggested in the research by Shin and Biocca (2017)[1]. We did not measure the participants' attitude toward the climate change issue in general. However, we tried to achieve a random sample, and participants did not know the topic of the video before they started to watch it. Doubtlessly, opinions and psychological peculiarities affect the story perception. Yet, when designing a VR film for vast audiences, VR content creators do not have the possibility to measure individual characteristics of each viewer, which makes our generalized results relevant for the VR industry.

Lastly, it is worth mentioning that the topic used in this study – climate change - might be of little interest to young people working in the IT sphere. Perhaps, a more controversial subject would produce different results. However, we chose this subject for a good reason: it allowed us to measure the effectiveness of the storytelling method excluding, where possible, external factors such as personal views.

[1] Shin, D., & Biocca, F. (2017). Exploring immersive experience in journalism. *New Media & Society*, 1461444817733133.

Conclusion

Innovative opportunities driven by the convergence of virtual reality (VR) and social media such as Youtube are in rapid development. Media and marketing organizations are experimenting with VR and consumers are beginning to learn about the features, qualities, and possibilities of this technology. Early efforts to embrace the storytelling potential of VR have been made by major newspapers such as *The New York Times* or *The Guardian* which were among the first to launch a mobile application for viewing 360° news and feature videos.

As head-mounted displays (HMDs) enter the marketplace, VR-enhanced content, such as a documentary or a travel diary, may enter mainstream media. If these developments occur, this engaging technology may be used not only for entertainment, which is the case nowadays, but also for reporting on matters of public importance. Our study revealed that, while the majority of users are still overwhelmed with the novelty of the VR technology, VR holds a high potential to convey stories whose main purpose differs from entertainment.

VR has emerged as a technology that may disrupt and transform traditional methods of storytelling. The findings of this study indicate that transformation induced by the VR technology can benefit storytelling by making it more engaging and alluring to the audience. Furthermore, sophisticated VR equipment allows creating first-person narrative in contrast to the conventional third-person approach common to most video stories. Lastly, the newness of the technology might help regain the interest of the disengaged audiences toward issues which are becoming neglected, such as the climate change.

At the same time, our research has demonstrated that non-choice based, passive viewing VR video does not lead to either heightened empathy or discernible changes in behavior or attitudes compared to a more traditional storytelling method, like a regular digital video. That, however, does not mean VR is not valuable or useful for creating narratives. Although the novelty of VR technology might have

contributed to its lack of performance within a transportation theory framework, in terms of storytelling VR appears here to stay, making the possibilities for further research exciting and rich.

For the future research, we suggest the following hypotheses derived from Rogers's diffusion model:

1. The greater the perceived relative advantage of VR as a storytelling form, the greater its adoption by content creators and its use by consumers.

2. The simpler VR technology becomes, the faster it will be adopted by content creators and users.

3. The more VR is seen in use among other media and marketing organizations, the more rapid will be the adoption of VR as a storytelling medium.

Additionally, future research could compare VR media to themselves, rather than across mediums, like in our study. Similar research has already been done in a non-storytelling capacity, comparing VR experiences that include an avatar versus those who do not have an avatar. It could be interesting to apply this to a storytelling dimension, comparing experiences like de la Peña's VR work[1] to more passive viewing experiences without an avatar like in the short VR documentary 'The Displaced' by *The New York Times*.

It also could be relevant to test transportation levels between VR as experienced on a headset versus mobile VR accessed on a computer monitor. This could have an effect on participants' abilities to become more fully immersed in the story itself, rather than the novelty of the technology.

Future experiments also should test VR effects on focus groups selected by a certain, for instance, demographic parameter. Also, it would be useful to explore VR in relation to other storytelling medium such as print. Alternatively, to achieve a true

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[1] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., ... & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and virtual environments*, *19*(4), 291-301.

multimedia experience, the effects of a VR video could be tested in a package with print and broadcast video methods. Finally, future research should test a much longer story, perhaps 15 minutes or longer, to provide more opportunity for immersion and 'getting into' the narrative.

To conclude, VR provides both exciting opportunities and considerable challenges for the future of storytelling. Yet, its current application leaves much to be desired.

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Appendices

Appendix 1. Transportation

For each question, please rate to what extent you agree with each statement on a scale of 1 (not at all) to 7 (very much).

Statement 1. I could picture myself in the scene of the events described in the story.

Statement 2. After finishing the story, I found it easy to put it out of my mind (=stop thinking about it). (R)

Statement 3. The story broke me emotionally (=shocked).

Statement 4. I found my mind wandering (=being somewhere else) while watching the story. (R)

*R - reverse-coded

Results for the VR group: **M=4.14 (SD=0.69)**

Participant	Statement 1	Statement 2	Statement 3	Statement 4
1	5	5	4	5
2	1	5	3	3
3	5	4	1	5
4	4	2	2	5
5	6	5	5	1
6	6	5	5	2
7	6	4	2	1
8	5	4	4	6
9	6	1	1	7
10	7	6	5	6
11	3	4	6	2
12	6	5	4	7
13	6	4	2	2
14	5	1	2	5

Participant	Statement 1	Statement 2	Statement 3	Statement 4
15	5	4	5	6
M	5.06	3.93	3.40	4.20
SD	1.48	1.48	1.63	2.14

Results for the regular video group: **M=3.68 (SD=0.52)**

Participant	Statement 1	Statement 2	Statement 3	Statement 4
1	3	2	3	3
2	7	3	5	4
3	1	2	4	2
4	4	5	5	2
5	5	2	4	4
6	6	4	5	6
7	5	4	4	3
8	2	2	3	6
9	2	2	2	4
10	5	3	3	4
11	2	2	4	4
12	5	2	5	5
13	2	2	1	3
14	4	6	3	7
15	4	4	4	7
M	3.80	3.00	3.66	4.26
SD	1.74	1.30	1.17	1.62

Appendix 2. Attitudes

For each question, please rate to what extent you agree with each statement on a scale of 1 (not at all) to 7 (very much).

Statement 1. This video made me think that climate change is as important as other global problems we face today (such as terrorism, poverty, starvation).

Statement 2. After watching this film I doubt that climate change as a problem is much exaggerated and politicized.

Statement 3. After watching this film I am likely to start caring about climate change even if it affects such remote places as Fiji.

Statement 4. After watching this film I feel that people all over the world should change their everyday habits to help environment.

Statement 5. This film convinced me that if we don't do anything about climate change, a miserable future is ahead of us.

Results for the VR group: **M=4.42 (SD=0.37)**

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
1	7	4	4	7	6
2	3	6	1	3	3
3	4	4	2	5	3
4	4	3	4	5	5
5	5	5	5	5	5
6	6	5	6	7	7
7	4	4	4	4	4
8	6	6	5	5	4
9	4	4	1	4	4
10	5	4	5	5	3
11	2	2	4	3	2
12	5	6	5	5	5

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
13	5	5	3	6	5
14	3	3	3	3	3
15	7	5	6	6	6
M	4.66	4.40	3.86	4.86	4.33
SD	1.44	1.18	1.59	1.30	1.39

Results for the regular video group: **M=4.67 (SD=0.37)**

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
1	3	6	2	1	4
2	7	7	6	7	7
3	5	4	2	2	2
4	7	7	6	6	6
5	4	4	5	5	3
6	7	6	6	6	6
7	4	4	4	7	4
8	3	2	2	4	2
9	4	7	2	3	4
10	5	1	4	5	5
11	4	4	4	3	3
12	6	6	4	7	5
13	4	5	3	3	4
14	5	4	4	7	7
15	7	6	7	7	7
M	5.00	4.86	4.06	4.86	4.60
SD	1.46	1.80	1.66	2.06	1.72

Appendix 3. Empathy

Please rate to what extent each adjective describes the way you feel toward people in Fiji after watching this video on a scale from 1 (not at all) to 7 (extremely).

Sympathetic

Compassionate

Neutral

Worried

Irritated

Results for the VR group:

For the empathy states, **M = 5.53 (SD=0.46)**

For the distress states, **M = 2.56 (SD=1.64)**

Participant	Sympathetic	Compassionate	Neutral	Worried	Irritated
1	6	5	2	5	1
2	6	5	7	2	2
3	7	5	4	2	1
4	4	4	4	1	1
5	6	6	3	3	1
6	6	6	3	6	2
7	6	4	4	1	1
8	6	6	2	6	1
9	5	5	6	1	1
10	7	7	1	5	1
11	7	6	1	5	2
12	7	6	1	7	1
13	5	5	3	5	4
14	4	3	4	3	1
15	6	5	2	4	1
M	5.86	5.20	3.13	3.73	1.40
SD	0.99	1.01	1.76	2.01	0.82

Results for the regular video group:

For the empathy states, **M = 5.49 (SD=0.23)**

For the distress states, **M = 3.09 (SD=2.49)**

Participant	Sympathetic	Compassionate	Neutral	Worried	Irritated
1	5	5	3	3	2
2	7	7	1	7	1
3	5	5	2	6	1
4	6	6	2	6	1
5	6	5	4	5	1
6	7	5	4	5	1
7	6	5	1	4	1
8	3	3	5	2	3
9	4	4	2	5	2
10	6	6	3	5	2
11	7	7	4	4	1
12	6	5	4	5	1
13	5	5	5	4	1
14	5	5	1	5	1
15	7	7	1	7	1
M	5.66	5.33	2.80	4.86	1.33
SD	1.17	1.11	1.47	1.35	0.61

Appendix 4. Behavioral Intention

On a 7-point scale (1 - not at all, 7 - very much), please rate how likely it is that you would:

Statement 1. Donate money to the regions affected by the natural disaster caused by the climate change.

Statement 2. Sign a petition to push for government leniency towards environmental policy.

Statement 3. Discuss climate change issues with friends and family.

Statement 4. Forward links to advocacy groups to friends and family on social media.

Statement 5. Watch other videos/documentaries on climate change.

Results for the VR group: **M=3.53 (SD=1.67)**

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
1	1	7	7	1	4
2	1	2	2	2	6
3	1	1	7	2	2
4	1	7	7	3	5
5	1	2	2	3	6
6	2	7	3	7	7
7	1	3	2	2	7
8	2	7	7	7	3
9	1	1	4	1	6
10	1	2	2	3	7
11	1	1	1	3	6
12	1	7	3	2	7
13	1	1	2	5	7
14	1	1	2	2	7
15	1	7	7	4	7
M	1.13	3.73	3.86	3.13	5.80
SD	0.35	2.81	2.38	1.88	1.61

Results for the regular video group: **M=3.61 (SD=1.37)**

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5
1	1	1	2	7	1
2	1	7	7	7	2
3	1	2	6	2	2
4	1	7	1	2	2
5	1	1	2	3	7
6	2	7	7	1	7
7	1	2	3	3	7
8	1	1	2	2	6
9	1	1	7	4	2
10	1	7	7	7	7
11	1	2	7	3	3
12	2	7	7	2	1
13	1	5	7	2	2
14	1	1	6	1	7
15	5	6	6	7	7
M	1.40	3.80	5.13	3.53	4.20
SD	1.05	2.75	2.35	2.29	2.62

Appendix 5. Knowledge recall

Please answer the following questions on the video you just watched.

Question 1. What is the main reason for many Fijian villages being flooded?

1) Sea storm
2) Heavy rainfalls
3) King tides (correct)

Question 2. What's the name of the cyclone which in 2016 affected more than 60% of the Fiji population?

1) Winston
2) Wilson
3) Catarina

Question 3. What is the percentage of Fijians living in the areas of high disaster risk?

1) 10%
2) 30%
3) 70%

Question 4. What type of building severely damaged by the cyclone was featured in the video?

1) School
2) Hospital
3) Kindergarten

Question 5. What does the word 'vielomani' mean?

1) Respecting each other
2) Loving each other
3) Caring for each other

Coding:

0 - incorrect;

1 - correct

Results for the VR group: **M = 3.6 (SD = 0.82)**

Participant	Question 1	Question 2	Question 3	Question 4	Question 5	Total
1	1	1	0	1	1	4
2	0	1	0	1	1	3
3	0	1	0	1	1	3
4	0	1	1	1	1	4
5	1	1	1	1	1	5
6	1	1	0	1	1	4
7	0	1	0	1	1	3
8	1	1	0	1	1	4
9	1	1	1	1	1	5
10	0	1	0	1	1	3
11	0	1	1	0	0	2
12	0	1	1	1	1	4
13	0	1	0	1	1	3
14	1	1	0	1	1	4
15	0	1	0	1	1	3

Results for the regular video group: **M = 3.4 (SD = 1.24)**

Participant	Question 1	Question 2	Question 3	Question 4	Question 5	Total
1	1	1	1	1	1	5
2	1	1	0	1	1	4
3	1	1	0	1	1	4
4	0	1	1	1	0	3
5	1	1	1	1	1	5
6	0	0	0	0	1	1
7	1	1	1	1	0	4
8	0	0	0	1	1	2
9	0	1	0	1	0	2
10	1	1	1	1	1	5
11	1	1	0	0	1	3
12	0	1	0	1	1	3

Participant	Question 1	Question 2	Question 3	Question 4	Question 5	Total
13	0	0	1	0	1	2
14	1	1	1	1	0	4
15	0	1	1	1	1	4