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THROUGH THE LOOKING GLASS

An experimental study of 360° video experienced through difference lenses

THE USC ANNENBERG NORMAN LEAR CENTER
MEDIA IMPACT PROJECT

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EXECUTIVE SUMMARY

Immersive technologies present an opportunity to engage with audiences on a level previously unavailable. As media producers at such outlets as the *Huffington Post*, *New York Times*, *the Guardian*, *Frontline*, *National Geographic*, and Associated Press are rapidly moving into the immersive journalism space[1], there exists a need for research on the new medium. Does the cost of creating immersive journalism outweigh the benefits? Further, does experiencing immersive journalism on a high-tech headset influence a viewer's attitude, perspective or knowledge differently than viewing the same material on a cardboard visor, a smartphone or a computer?

This report describes research examining whether experiencing 360º immersive videos on different platforms influences viewer knowledge, attitudes, and behavior towards the content. For this study, 186 participants were randomly assigned to view one of three *Huffington Post* 360º videos about neglected tropical diseases[2] on one of four different devices: Samsung Gear, Google Cardboard, cell phone, or laptop. Before and after the viewing experience, participants answered survey questions designed to address their impressions as well as their knowledge, attitudes, and behavior towards the issues presented in the story.

The Samsung Gear, a dedicated 360º video device, was perceived more positively and seen as more immersive than the other platforms. In most cases, viewing through a cell phone made little difference compared to a laptop, and participants reported several technical issues with using the Google Cardboard, which detracted from the users' impressions. Participants were more likely to accurately recall information in the video after using the laptop rather than the other devices. When examining whether the use of these devices influenced participants' behavioral intentions, none of the devices produced a distinguishable difference.

These findings indicate that, while platform should be a consideration affecting user *experience*, the *impact* of the content is not lost if immersive technology is unavailable. The 360º video platform is a viable medium despite limited diffusion of dedicated 360º devices. This research represents one study; these findings should not be viewed as decisive, but rather point to the need for larger studies (e.g., with a more diverse sample of adults) to better clarify if and when the use of 360º video may meaningfully improve viewer engagement with media content.

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[1] Jones, S. (2017). Disrupting the narrative: immersive journalism in virtual reality. *Journal of Media Practice*, 18(2-3), 171-185.

[2] The World Health Organization has identified 18 different neglected tropical diseases (NTDs). The WHO defines these as "a diverse group of communicable diseases that prevail in tropical and subtropical conditions in 149 countries – affect more than one billion people and cost developing economies billions of dollars every year." Populations living in poverty, without adequate sanitation and in close contact with infectious vectors and domestic animals and livestock are those worst affected.

INTRODUCTION

Immersive media presents a unique and powerful opportunity for social impact. Research has found that because of its ability to draw audiences into the content, immersive media (which can include virtual reality and 360º video) is often seen as more engaging and more credible[3] than traditional electronic storytelling. Immersive video has also been found to elicit greater empathy[4] and perspective[5]. It has the ability to establish a greater sense of presence, and to make a more powerful impact on audience attitudes and behavior.[6] These effects indicate that immersive media presents a new tool to help users develop a greater understanding of others than previously possible.

Prior research indicates engagement with immersive video is often related to feelings of:

A. Emotional involvement, or a sense of emotional connection
B. Presence, or the degree to which users feel the experience is unmediated
C. Agency, or feeling that a viewer has the ability to control their local environment
D. Immersion within the experience, or a feeling of transportation in the experience[7]
E. Attitude change and future behavioral intentions.[8]

INFLUENCE OF DELIVERY PLATFORMS

Most of the stated benefits of immersive media are based on prior studies of the most immersive technologies available, such as head mounted displays (HMD) like the Samsung Gear. While there is a growing body of research examining the benefits of immersive media on audience engagement (see MIP's *Does Medium Matter?* report[9]), there has been limited study of the effects of viewer platform on audience outcomes. Users may not feel the same level of engagement if they experience a story through an HMD, view it on their cell phone, or watch through a cardboard visor.

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[3] Bracken, C. C. (2006). Perceived source credibility of local television news: The impact of television form and presence. *Journal of Broadcasting & Electronic Media*, 50(4), 723-741.

[4] Formosa, N. J., Morrison, B. W., Hill, G., & Stone, D. (2018). Testing the efficacy of a virtual reality-based simulation in enhancing users' knowledge, attitudes, and empathy relating to psychosis. *Australian Journal of Psychology*, 70(1), 57-65.

[5] De la Peña, N., Weil, P., Llobera, J., Giannopoulos, E., Pomés, A., Spanlang, B., Friedman, D., Sanchez-Vives, M. V., & Slater, M. (2010). Immersive journalism: immersive virtual reality for the first-person experience of news. *Presence: Teleoperators and Virtual Environments*, 19(4), 291-301.; Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence*, 7(3), 225-240.

[6] Lu, A. S., Baranowski, T., Thompson, D., & Buday, R. (2012). Story immersion of videogames for youth health promotion: A review of literature. *Games For Health: Research, Development, and Clinical Applications*, 1(3), 199-204.

[7] McMahan, A. (2003). Immersion, engagement and presence. *The Video Game Theory Reader*, 67, 86.

[8] Attfield, S., Kazai, G., Lalmas, M., & Piwowarski, B. (2011, February). Towards a science of user engagement (position paper). In WSDM workshop on user modelling for Web applications (pp. 9-12).; Passmore, P. J., M. Glancy, A. Philpot, A. Roscoe, A. Wood, and B. Fields. "Effects of viewing condition on user experience of panoramic video." In Proceedings of the 26th International Conference on Artificial Reality and Telexistence and the 21st Eurographics Symposium on Virtual Environments, pp. 9-16. Eurographics Association, 2016.; Fonseca, D., & Kraus, M. (2016, October). A comparison of head-mounted and hand-held displays for 360° videos with focus on attitude and behavior change. In Proceedings of the 20th International Academic Mindtrek Conference (pp. 287-296). ACM.

[9] Karlin, B., Kim, H., Kelly, R., Blakley, J., Brenner, C., & Riley, P. (2018). Does Medium Matter? Exploring the Role of Virtual Reality in Journalism. USC. www.mediaimpactproject.org/uploads/5/1/2/7/5127770/frontlinevrreport_final.pdf

Existing research on the effects of platform have been mixed. One study that interviewed participants after watching 360º video content found that participants reported feeling a greater sense of presence and immersion after using an HMD than a cellphone or a computer screen[10]. The same study reported viewers had a greater ability to interact with content when using a cell phone or headset, but that learning was easier while using the laptop. Other studies have found that using an HMD did not significantly impact how much participants enjoyed watching the content and did not elicit greater empathy, narrative engagement, or interest in the video.[11]

Does the cost of creating immersive journalism outweigh the benefits? The relative scarcity of HMDs currently limits their effectiveness in comparison to the vast numbers of smartphones, laptops, and cardboard visors currently available. As media producers are rapidly moving into the immersive journalism space,[12] the need for further research exists.

THE MIP STUDY OF HUFFINGTON POST IMMERSIVE VIDEOS

This study grew out of a partnership between online content creator the *Huffington Post* and the Bill and Melinda Gates Foundation to create a new series, known as *Project Zero*, designed to help audiences develop a deeper understanding of neglected tropical diseases. These online articles were supplemented with three, 360º videos, comprising its *Out of Sight* immersive series. Here users can witness the effects of diseases, visit communities battling them, and travel alongside professionals who have dedicated their lives to curing them. The hope was that the reporting could help combat illnesses that afflict the most vulnerable people often ignored by the Western world.

This research explores the impact of viewing the *Out of Site* series on four platforms: the immersive HMDs,cardboard visors, smart screens and computers. Our aim was to determine if delivery method affects viewers' perceptions of content. While content developers may create videos intended for sophisticated viewing platforms such as the Samsung Gear, this may not reflect actual use. Moreover, because immersive experiences require substantially more investment than written content, it is important to identify which mediums are best-suited for which types of stories.

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[10] Passmore, P. J., M. Glancy, A. Philpot, A. Roscoe, A. Wood, and B. Fields. "Effects of viewing condition on user experience of panoramic video." (2016) In Proceedings of the 26th International Conference on Artificial Reality and Telexistence and the 21st Eurographics Symposium on Virtual Environments, pp. 9-16.

[11] Tse, A., Jennett, C., Moore, J., Watson, Z., Rigby, J., & Cox, A. L. (2017). Was I There?: Impact of Platform and Headphones on 360 Video Immersion. In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (pp. 2967-2974).

[12] Macquarrie, A., & Steed, A. (2017, March). Cinematic virtual reality: evaluating the effect of display type on the viewing experience for panoramic video. In IEEE Virtual Reality 2017 (Vol. 24, pp. 45-54). IEEE.
Jones, S. (2017). Disrupting the narrative: immersive journalism in virtual reality. *Journal of Media Practice*, 18(2-3), 171-185.

METHODS

This study was a randomized experiment of 360° viewing platform on knowledge, attitudes, and behavioral intention.

PARTICIPANTS

Participants included 186 college students ranging in age, education level (undergraduate and graduate), and level of experience with virtual reality. The sample consisted of 77% women and 33% men. Participants were recruited through on-campus flyers and classroom emails. Participants were offered a $5 gift card and/or course credit in exchange for their participation in the 20-minute study. Data collection was conducted from April 3 to April 18, 2018 at the University of Southern California and from May 25 to June 7, 2018 at the University of California, Irvine.

PROCEDURE

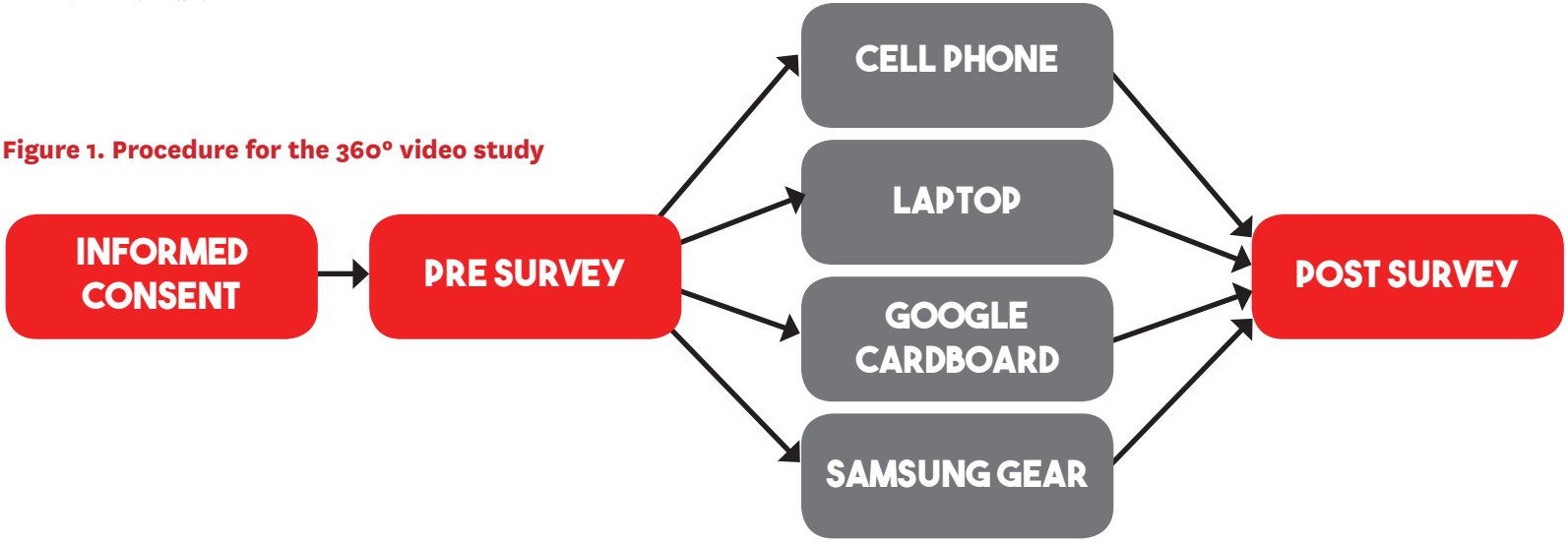
Respondents answered a series of questions about their familiarity and experiences with 360° video devices, their views of and interest in science and technology products, their scientific curiosity, and their intentions to purchase a 360° video device in the near future. Roughly 39% of the sample had a prior experience with 360° video in the past year (44% no, 17% not sure), but only 35% had ever used a 360° video player. Of those who had experienced a video player, 31 had done so at a museum, gallery, or special event. Just 10 respondents owned a 360° video player; five of these owned a Google cardboard, while three owned a Samsung Gear (two indicated other, one of which listed an iPhone as their device).

Participants were randomly assigned to view a 360° video on one of the four devices tested about one of three neglected diseases: Elephantiasis, Sleeping Sickness, or River Blindness. This variation was performed to ensure against results being attributable to one specific of video. Table 1 provides the assignment of participants across condition and video type.

Table 1. Frequency counts of participants across condition and video type

	Elephantiasis	Sleeping Sickness	River Blindness	**Total:**
Laptop	14	20	13	**47**
Cell Phone	15	13	18	**46**
Google Cardboard	20	15	16	**51**
Samsung Gear	12	16	14	**42**
Total:	**61**	**64**	**61**	**186**

Figure 1. Procedure for the 360° video study



After viewing the video, participants took a post survey with questions designed to measure their knowledge (information recall from the video), attitudes (impressions of the video and immersion in the experience), and behavior (intention to take action).

MEASURES

After watching the video, participants were asked about their knowledge, attitudes, and behavior towards neglected tropical disease and 360° content.

KNOWLEDGE

Three multiple choice items assessed the extent to which participants accurately recalled information from the video. Each of the items was designed to assess a similar-to-identical issue in each story in order to maintain similar levels of difficulty across items.[13] Each item was scored as either correct or incorrect. Table 2 provides these rates across each item and condition.

Table 2. Rates across each item and condition

	Laptop	Cell Phone	Google Cardboard	Samsung Gear
ITEM 1				
Incorrect	2 (4%)	7 (15%)	12 (24%)	10 (24%)
Correct	45 (96%)	39 (85%)	39 (76%)	32 (76%)
ITEM 2				
Incorrect	4 (9%)	5 (11%)	9 (18%)	7 (17%)
Correct	43 (91%)	41 (89%)	42 (82%)	35 (83%)
ITEM 3				
Incorrect	14 (30%)	18 (39%)	18 (33%)	12 (29%)
Correct	33 (70%)	28 (61%)	33 (65%)	30 (71%)
ITEM TOTAL				
Incorrect	20 (14%)	30 (22%)	39 (25%)	29 (23%)
Correct	121 (86%)	108 (78%)	114 (75%)	97 (77%)

[13] Questions included: "How is [sleeping sickness] transmitted?;" "Most cases of [sleeping sickness] are found in which African country?;" and "What strategies are used to combat [sleeping sickness]?"

ATTITUDES

A single scale was created to measure participants' impressions of the experience using three questions. A single item that directly measured participants' impression of the 360º video on a seven-point ordinal scale (1 = disliked a great deal, 7 = liked a great deal) as well as two Likert-type measures (1 = strongly disagree, 7 = strongly agree) assessing whether participants liked the video they viewed.[14] Similarly, a single scale to measure immersion in the experience was created using 8 questions, scored on 7-point Likert scales (1 = strongly disagree, 7 = strongly agree).[15]

Table 3.

	Mean	SD
Positive Impressions		
What was your overall impression of the 360º video experience?	**5.62**	**1.48**
I enjoyed watching the video.	**5.59**	**1.25**
I liked the experience.	**5.55**	**1.42**
Immersion		
I could picture myself in the scene of the experience.	**4.99**	**1.47**
I was mentally involved in the experience.	**5.37**	**1.33**
While in the experience, I had a vivid image of being in each locations.	**5.25**	**1.52**
The objects in the experience gave me the feeling that I could do things with them.	**4.36**	**1.66**
I had the impression that I could be active in the environment.	**4.46**	**1.57**
I felt like I could move around among the objects in the experience.	**4.72**	**1.65**
It seemed to me that I could do whatever I wanted in the environment.	**3.77**	**1.71**
I felt like I was in two places at once, both in the virtual space and the real world at the same time.	**4.43**	**1.77**

BEHAVIOR

After viewing the 360º video, participants were asked a battery of seven behavioral intention items on seven-point likelihood scales (1 = extremely unlikely, 7 = extremely likely). Two of these items referenced the 360º video devices, while a third item asked about motivations to watch the other videos in this video series. Two items assessed information seeking tendencies regarding the content of the videos (i.e., neglected tropical diseases). Finally, two items measured intentions

[14] For the purposes of analysis, the three items were averaged into a reliable composite (α = .87, [.83, .90]).
[15] Averaging these items together formed a reliable composite of immersivity (α = .92), which was used for inferential testing.

to provide financial support to health organizations and projects, and one item assessed support for policies that increase funding for aid in countries affected by tropical diseases.

Table 4.

	Mean	SD
Purchase Intentions		
Buy a 360º video device in the next year or two.	**5.62**	**1.48**
Post-Experience Motivations		
Rewatch or watch the other two videos in this series?	**4.99**	**1.47**
Search for more information about neglected tropical diseases.	**5.37**	**1.33**
Talk to others about neglected tropical diseases.	**5.25**	**1.52**
Donation and Policy Support Intentions	**4.36**	**1.66**
Donate money to support health organizations.	**4.46**	**1.57**
Donate money to projects in developing countries that combat parasitic diseases.	**4.72**	**1.65**
Support policies to increase medical research and health aid to countries affected by these diseases.	**3.77**	**1.71**

ANALYSIS

The research team employed a method known as Bayesian analysis. Bayesian models are used by statisticians to predict the probability of something happening in the future based on the information provided. These models tease apart the degree to which the results seen in a data set are due to the variables measured and the portion of change that is most likely due to chance, rather than the use of significance testing. To examine how different viewing experiences influenced participants' attitudes of 360º video and behavioral intentions, three sets of regression models were fit using a Bayesian multilevel modeling framework. In each case, the effect of viewing condition and the model intercept were allowed to vary across each of the three types of videos to better account for variability introduced by the different videos. Additionally, each model included three individual difference predictor measures (Science Curiosity, General Attitudes toward Science, and Interest in Emerging Technologies).

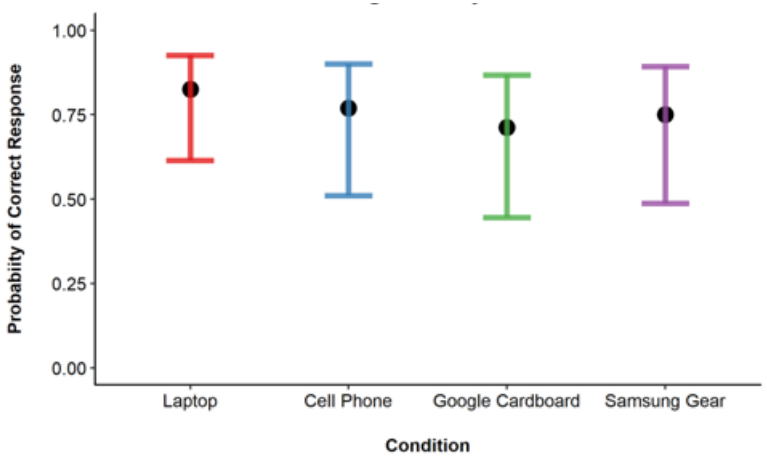
[14] For the purposes of analysis, the three items were averaged into a reliable composite (α = .87, [.83, .90]).
[15] Averaging these items together formed a reliable composite of immersivity (α = .92), which was used for inferential testing.

RESULTS

MODEL 1: KNOWLEDGE

The first model[16] was used to assess the accuracy of information recalled by participants and was split into two parts – a comparison of the viewing platform groups as whole, and a comparison of the viewing platform groups across each of the three identified knowledge areas (transmission, location, and treatment/prevention). The results indicated that the laptop condition was the most effective viewing device, while Google Cardboard appeared to be the least effective. This finding reflects feedback from participants that they had difficulty paying close attention to informational content while exploring the 360º video, particularly as few had seen a 360º video or used a 360º viewing device. However, this model did demonstrate a degree of uncertainty, which may indicate that these differences in effectiveness were due to an outside factor rather than a direct result of the viewing platform or research design.

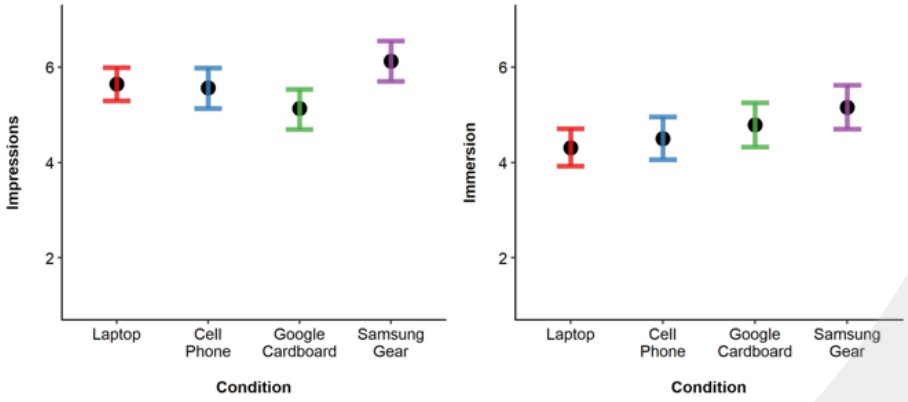
Figure 2. Figure regression intervals of model predicting accuracy of recall



MODEL 2: ATTITUDES

The second Bayesian model (Fig. 3) indicated that, overall, participants reported positive impressions and feelings of immersion after watching the Huffington Post's 360º video series. Specifically, participants reported greater positive impressions of the video content after using the Samsung Gear condition relative to the other conditions. Notably, participants in the Google Cardboard condition reported less positive impressions than those in the other conditions, which corresponds with the difficulties participants faced using the device. In terms of immersion, participants also reported feeling more immersed in the video content after using the Samsung Gear relative to the other conditions.

Figure 3. Figure regression intervals of model predicting immersion and impressions



[16] Please note for this figure and those that follow, the graph depicts posterior uncertainty intervals from the fitted regression model rather than confidence intervals. This means that the overlap of the intervals does not indicate 'insignificance,' but rather a representation of the uncertainty, meaning that values closer to the center point have greater probability than values at the tails.

Table 5.

	Laptop Mean (SD)	Cell Phone Mean (SD)	Google Cardboard Mean (SD)	Samsung Gear (Mean SD)
Impressions	5.58 (1.05)	5.55 (1.22)	5.11 (1.41)	6.21 (0.94)
Immersion	4.24 (1.22)	4.49 (1.35)	4.75 (1.22)	5.24 (1.10)

MODEL 3: BEHAVIOR

The final model considered the participants' intentions to purchase 360 technology, further engage with the 360° video content, and to donate and support research after watching the video. Results indicated that participants across all four platforms reported that they were not, on average, likely to purchase 360 technology; although, those in the Samsung Gear condition were somewhat more likely to purchase 360 technology. Participants also reported greater intentions to seek more information, donate, and support aid policies overall. However, breaking the results down by platform showed that the viewing platform did not produce a noticeable change in intentions to donate or in participant's other post-viewing-experience motivations.

Table 6.

	Laptop Mean (SD)	Cell Phone Mean (SD)	Google Cardboard Mean (SD)	Samsung Gear (Mean SD)
Purchase Intentions	3.00 (1.62)	3.00 (1.62)	3.23 (1.72)	3.95 (1.58)
Post-Experience Motivations	4.76 (1.26)	4.50 (1.21)	4.90 (1.51)	4.79 (1.11)
Donation & Policy Support Intentions	4.44 (1.39)	4.33 (1.21)	4.65 (1.47)	4.61 (1.36)

Figure 4. Figure regression intervals of model predicting purchase intentions

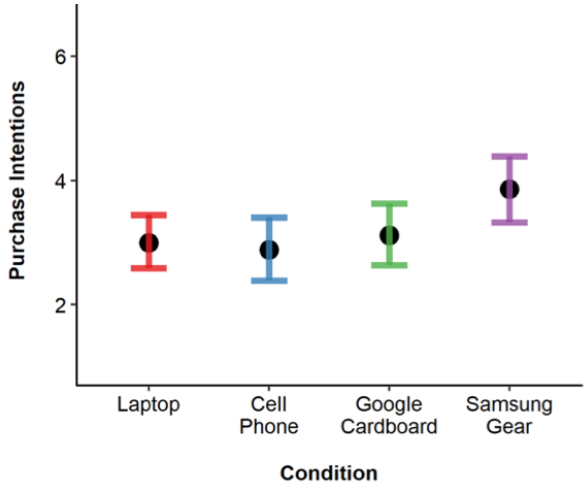
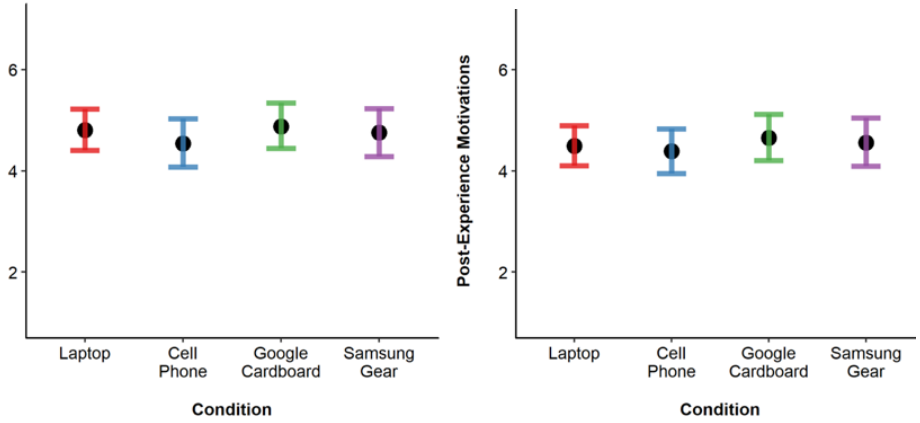


Figure 5. Figure regression intervals of model predicting donation intentions and other post-experience motivations



DISCUSSION

The results of this analysis found little to no evidence that the specific use of a 360º video device (Google Cardboard or Samsung Gear) to view educational materials will impact users' motivation to further research a humanitarian cause or intentions to donate.

However, results did suggest that the viewing platform did impact information recall, impressions, and immersion. Users tended to recall more correct information after using the laptop, matching previous findings.[17] Viewing platform also impacted degree to which the participant felt immersed, and this immersion likely positively influenced their attitudes. Participants perceived the Samsung Gear to be more immersive relative to the laptop, while the Google Cardboard was felt to be less immersive. The fact that most participants found the Samsung Gear to be more immersive is unsurprising, as this is a technology designed for this purpose. On the other hand, while the Google Cardboard was included as a "step up" in immersivity, many participants experienced difficulty using the device. Problems ranged from blurriness to technological difficulties with touch sensitivity, likely explaining the relatively low reported impressions by participants.

Although these results do not support the use of one platform over another to increase knowledge or donation actions, they do indicate that the Samsung Gear provided the strongest increase in immersion in the experience, while the difficulty of use associated with the Google Cardboard device significantly detracted from the users' impressions. This demonstrates that platform should be considered when accounting for user experience goals for 360º video, which has important implications for digital storytellers and journalists; however, a 'less optimal' viewing platform, like a laptop or cellphone, does not appear to render content ineffective.

Moving forward, it is important to note that the Samsung Gear and Google Cardboard viewing platforms are still relatively niche technologies. Few participants had ever used one of these devices. As such, one must still expect that the majority of viewers of 360º video are doing so through a laptop or cell phone. Given the strong link between immersion in material and empathic responses, perspective-taking, and pro-social behaviors demonstrated time and again in the body of literature, the current results support the continued exploration of user-friendly immersive technologies in humanitarian efforts.

[17] Karlin, B., Kim, H., Kelly, R., Blakley, J., Brenner, C., & Riley, P. (2018). *Does Medium Matter? Exploring the Role of Virtual Reality in Journalism*. USC. www.mediaimpactproject.org/uploads/5/1/2/7/5127770/frontlinevrreport_final.pdf