Article

new media & society
1–24

DOI: 10.1177/1461444820986816
journals.sagepub.com/home/nms
SAGE

Effects of immersive storytelling on affective, cognitive, and associative empathy: The mediating role of presence

James J Cummings, Mina Tsay-Vogel, Tiernan J Cahill and Li Zhang
Boston University, USA

Abstract

Popular claims of virtual reality systems serving as 'empathy machines' often fail to consider (a) the cognitive mechanisms driving the effects of technological immersion on empathy and (b) the conceptualization of empathy as a multidimensional construct. More, recent research has yielded mixed empirical support. This study investigates how dimensions of psychological presence—perceived self-location, sense of copresence, and judgments of social realism—mediate the effect of immersion on cognitive, affective, and associative empathy. Findings indicate that experiencing a news story via 360° video on a head-mounted display led to stronger self-location and copresence than engaging with the same video via desktop or reading a text version. While only copresence increased cognitive empathy, both self-location and copresence facilitated affective empathy. Whereas self-location and copresence enhanced associative empathy, social realism decreased it. These results highlight the value of a multidimensional conceptualization of empathy in investigating the prosocial potential of immersive media.

Keywords

Empathy, immersion, perspective-taking, presence, virtual reality

In recent years, there has been a great deal of discussion regarding the capacity for newly consumer-facing virtual reality (VR) systems to serve as potential 'empathy machines' (Alsever, 2015). Underlying such claims about 'VR' is the conflation of virtual reality

Corresponding author:
James J Cummings, Boston University, Boston, MA 02215-1300, USA.
Email: cummingj@bu.edu

content—computer-generated environments, often similar to what can be found on video gaming consoles and personal computers—and virtual reality devices—systems like the Oculus Rift or HTC Vive. Notably, most evangelists do not mean to suggest that empathy is heightened by the ability to simulate alternate universes or fantasy worlds; rather, the empathy-enhancing power of these systems is attributed to their affordance of *immersion*—that is, their technological features that permit users to feel psychologically present *within* a media message (Slater and Wilbur, 1997). Immersive media devices such as head-mounted displays (HMDs)—which adjust the user's perspective on a scene naturally through head-tracking, all the while also occluding external real world stimuli—and formats such as 360° video—which allows viewers to adjust their perspective within a video recording, as if on-site within the environment—are thought to offer a greater capacity for vivid, real-time perspective-taking than any other media technologies to date.

However, popular discussion about how immersive media may enhance user empathy typically fails to consider (a) the underlying cognitive mechanisms that may drive this proposed effect and (b) the notion of empathy not as a monolith, but rather, a multidimensional construct. Moreover, recent empirical research has provided mixed results, suggesting that the relationship between immersion within a media message and empathy for individuals depicted within that message is not as straightforward as popularly assumed.

To account for the literature's mixed findings, the current study uniquely takes a multidimensional approach to empathy, as well as to presence—the psychological state thought to be especially afforded by immersive media and to underlie immersion's effect on various outcomes. We experimentally investigate how different components of a user's sense of presence—specifically, perceived self-location, sense of copresence, and judgments of social realism—may mediate the effect of immersion on cognitive, affective, and associative empathy, respectively. Together, these considerations—empathy as a multidimensional construct and the mediating role of different presence dimensions—provide a more nuanced account of how immersive media may elicit empathy in users.

Immersive media, psychological presence, and empathy

Technological immersion and users' sense of presence

The ability to induce empathetic responses through media has been previously considered in the context of social media (Konrath et al., 2011), video games (Anderson et al., 2010), literary fictions (Kidd and Castano, 2013), and video (Loggia et al., 2008). However, recent claims about the special empathy potential of new media technologies, such as HMD devices and 360° video, are based on the notion that immersive media permit users to experience stories as if witnessing the depicted events firsthand. Put otherwise, these claims make implicit assumptions about the antecedents and effects of *presence*, or the psychological sense of 'being there' (Heeter, 1992). In particular, these propositions assume that (a) immersive media increase the feeling of presence, and (b) this feeling of being within a story can enhance empathetic responses.

Presence is often an implicit assumption of immersive media designs, so much so that the terms 'immersion' and 'presence' have frequently been used interchangeably.

However, Slater and Wilbur (1997) provided an important and useful distinction between the two concepts. Immersion can be regarded as a quality of the technology, or an objective measure of the extent to which a system presents mediated stimuli while shutting out perceptions of physical reality. In contrast, presence relates to the user's psychological state: namely, the degree to which they perceive the mediated reality as the one they are physically occupying. Immersive technology begets psychological presence, with presence often presumed to then augment related media effects (Cummings and Bailenson, 2016)—that is, if immersion perceptually situates a user within a message, that user may then be more cognitively, emotionally, and behaviorally engaged within the narratives or events conveyed. This line of reasoning is supported by the notion of embodied cognition, which stipulates that the body and brain are intertwined, with cognition being influenced by the physical sensations and actions of the body (Varela et al., 1992). As a result, to the extent an individual feels physically located within a mediated environment, their mental processes—including empathetic response—will be influenced by the media stimuli.

Beyond offering an embodied experience, the empathy-inducing potential of immersive technologies may directly relate to their capacity to aid in perspective-taking (Herrera et al., 2018; Van Loon et al., 2018). Compared with print, auditory, or 2D video stories, 360° videos and computer-generated simulations—particularly when engaged through an HMD device—provide relatively immersive portrayals, reducing the effort required to imagine someone else's immediate circumstances and their resulting thoughts, feelings, or actions. In turn, they may be especially apt means by which to enhance cognitive empathy in particular.

Empirical investigations into immersion and empathy

Shin (2017) reports that presence and empathy are perceived affordances of immersive technologies such as VR. Examining this possibility, recent scholarship has demonstrated that increased levels of technological immersion—such as viewing a 360° video through an HMD as opposed to on a tablet (Fonseca and Kraus, 2016) or as a non-panoramic version of the same video (Schutte and Stilinović, 2017)—are associated with greater levels of presence, as well as empathy. In contrast, other studies have failed to detect a relationship between immersion and empathy. Several studies have found that relatively more immersive media experiences—whether watching a 360° video via HMD as opposed to on a desktop (Bang and Yildirim, 2018) or on a smartphone screen (Bindman et al., 2018), or viewing a 360° split-view video as opposed to a 180° video (Aitamurto et al., 2018)—did not lead to more empathetic response than did comparably less immersive experiences. In addition, some studies have independently provided mixed results. Sundar et al. (2017) found a 360° video news story did not elicit greater empathy when viewed on a cardboard headset compared with on a desktop, yet both conditions led to stronger empathetic responses compared with a textual version of the story. Conducting two separate studies, Herrera et al. (2018) initially found that a perspective-taking narrative experienced through a computer-generated virtual environment resulted in greater empathy than did a text version of the same narrative; however, this finding was not replicated in a follow-up experiment.

Empathy and presence as multidimensional constructs

It is plausible that the previously observed mixed findings may be due to the multidimensionality of the variables of interest. Empathy can be construed as both (a) the means by which an individual gains insight into what another person thinks or feels and (b) the mechanism that leads one to respond with sensitivity and care to another's suffering (Batson, 2009). While many have conceptualized empathy as a multidimensional construct consisting of both cognitive and affective components (Strayer, 1990), a confirmatory factor analysis by Shen (2010b) revealed three distinct components of state empathy. *Affective empathy* refers to one's personal affective reactions to others' experiences and expressions. *Cognitive empathy* encompasses the perspective-taking through which one comes to recognize, comprehend, and adopt the viewpoint of others. Finally, *associative empathy* relates to the sense of social bonding with another person that is at the functional base of empathetic response (Decety and Jackson, 2004) and entails the personal, vicarious experience of what others are experiencing (Davis, 1994). In media contexts, Shen (2010b) equates it to identification (Cohen, 2001), the process by which audiences experience events happening to onscreen persons of narrative characters as happening to themselves. Notably, this explication of state empathy does not rely on a conceptualization that is biased toward altruistic behaviors in the face of specifically negative situations (e.g., empathetic concern, empathetic distress), in turn permitting insights into variable relationships across a wider array of message types (Shen, 2010a, 2010b), thereby avoiding specifically valenced or context-dependent definitions of empathy. In addition, the value in examining these dimensions independently is highlighted by previous work finding they serve as unique pathways to particular downstream effects. For instance, Wei et al. (2019) found associative empathy to uniquely mediate the effect of public service announcements (PSAs) on advocated values and behavioral intention.

In a similar vein, presence is also a complex psychological construct with several potential dimensions. Despite its common reduction to 'being there,' presence has been defined and typologized repeatedly over the past three decades (Heeter, 1992; Lee, 2004; Lombard and Ditton, 1997; Slater, 2009; Slater and Wilbur, 1997). One of the most commonly accepted explications conceptualizes presence based on a three factor typology: *physical presence* (experiencing virtual physical objects as actual physical objects), *social presence* (experiencing virtual social actors as actual social actors), and *self-presence* (experiencing virtual selves or representations as one's actual self; Lee, 2004). However, these aspects of presence are themselves often further treated multidimensionally within the broader literature. For instance, physical presence (sometimes referred to as spatial presence) has been regarded as a two-dimensional construct consisting of self-location (perceiving oneself as inhabiting a spatial environment) and perceived action possibilities (the sense that one can interact with that environment; Wirth et al., 2007). Similarly, systematic literature reviews have found that overall social presence can be construed as the sense of 'being there with a real person' (Oh et al., 2018), yet consists of the separate feelings of copresence, psychological involvement, and a behavioral engagement factor (Biocca et al., 2003).

To the extent presence mediates the effect of immersion on empathy, it is plausible that different dimensions of presence uniquely influence distinct elements of empathetic

response. This is a prospect that has yet to be fully examined. Although Sundar et al. (2017) investigated the role of different presence-related factors (e.g., being there, interaction, and realism) in predicting empathy, they conceptualized empathy unidimensionally. Conversely, whereas Herrera et al. (2018) separately measured empathy-related concepts such as personal distress (Batson et al., 1997) and inclusion of the other in the self (Aron et al., 1992), as well as both spatial and social presence, their measures of the latter were limited such that spatial presence was captured only through the coding of a single open-ended question related to overall user experience, while social presence—a notably multidimensional construct (Biocca et al., 2003; Cummings and Wertz, 2018; Oh et al., 2018)—was evaluated unidimensionally. Studies that employ a single composite score for these larger presence constructs—spatial or social—may fail to observe the true impact of presence on empathy and, in turn, immersion's indirect effect on empathy. The same applies for studies that do not consider the multidimensionality of empathy.

Presence factors relevant to inducing cognitive, affective, and associative empathy

The current study examines how psychological presence within a media message may mediate effects of immersion on empathy. In doing so, it also approaches the concepts of empathy and presence each as multidimensional variables, in turn considering how three distinct presence factors may differentially influence each empathy dimension. Based on previous literature, the current study specifically examines the mediating roles of *self-location* (a subdimension of spatial presence), *copresence* (a subdimension of social presence), and *social realism*, as these presence factors are particularly relevant to perspective-taking (cognitive empathy), emotional response to others (affective empathy), and identification with others (associative empathy), respectively.

Self-location. Presence, at its core, relates to one's frame of spatial reference: a sense of being there, in which 'there' is somewhere other than one's actual location in physical reality. Wirth et al.'s (2007) established model suggests that immersion elicits a sense of presence when a user experiences a mediated environment as one's 'primary egocentric reference frame.' This two-step process requires users not only to perceive a mediated environment as spatial (which can occur with non-immersive film, video, or still images), but also to perceive it as the space in which they are self-located. In accordance with this two-step model, the more immersive a media experience (in terms of providing spatial cues as well as blocking perception of external reality, thereby focusing attention on the media representation), the more likely a user will feel self-located within the message.

H1. Immersion will be positively associated with perceived self-location.

Embodied cognition theory (Barsalou, 2010; Varela et al., 1992; Wilson, 2002) suggests that perceived self-location may be a key factor in the role of presence as a mediator of the effect of immersion on empathy. An affordance-based perspective (Gibson, 1977, 1979) to media suggests that the form and means by which media technologies provide

information can influence how a receiver makes use of, interacts with, and processes that information. Immersive technologies especially afford users the ability to actively engage an environment from within, which may influence cognitive processes such as perspective-taking (Herrera et al., 2018), as physical movement can influence cognitive performance (Oppezzo and Schwartz, 2014; Williams and Bargh, 2008) and enhance levels of perceptual information, leading to improved mental models of situations depicted (Blanke, 2012). Thus, to the extent immersive media place a user's bodily frame of reference within a mediated environment and permit perceptual information gathering from within a message, they may facilitate cognitive processing of message content, including cognitive empathetic response. Supporting this line of reasoning, recent research has found perspective-taking outcomes in an immersive virtual simulation to be dependent upon the degree of spatial presence reported by users (Van Loon et al., 2018).

H2. Perceived self-location will be positively associated with cognitive empathy.

Less apparent, however, is the potential for self-location within a media message to influence feelings of other dimensions of empathy. Given that the nature of the impact of self-location on empathy pertaining to the affective reactions to others (affective empathy) and the vicarious experience of what others undergo (associative empathy) remains unknown, this study also explores these potential relationships.

RQ1. Does level of self-location impact users' levels of affective empathy or associative empathy?

Copresence. One key component of social presence is copresence (Biocca et al., 2003; Oh et al., 2018), which refers to the psychological connection and proximity experienced with another person and the perception of potential interaction (Nowak, 2001). To the extent that immersion in a media message influences one's sense of self-location within the space depicted, it should consequently heighten one's sense of copresence with other social actors depicted within that space. Consistent with this reasoning, previous work has empirically demonstrated that higher levels of system immersion lead to a greater sense of co-location or 'being together' with mediated others (Ahn et al., 2014).

H3. Immersion will be positively associated with copresence.

Empathy, fundamentally, concerns one's relation to other people. The impact of immersion on empathy, therefore, may be based not only on the extent to which users feel spatially present within a mediated environment or narrative, but also on the degree to which they feel that they are socially present with the inhabitants or characters therein. Notably, possibly supporting this, Herrera et al. (2018) reported a significant correlation between overall social presence and overall empathy. More specifically, copresence may most directly relate to the affective dimension of empathy, as perceived co-location should increase users' ability to bear witness to the emotional state of others and respond accordingly. Notably, a review of the vast psychology literature on social facilitation and affiliation reveals that the presence of others heightens the activation of emotional arousal (Geen and Bushman, 1989).

H4. Copresence will be positively associated with affective empathy.

While previous research provides strong reason for predicting a positive relationship between copresence and affective empathy, the nature of the influence of copresence on the other dimensions of empathy remains unexplored. Therefore, the current study also inquires about the potential impact of copresence as it relates to empathy in the domains of perspective-taking and vicariously experiencing the events and expressions of others.

RQ2. Does level of copresence impact users' levels of cognitive empathy or associative empathy?

Social realism. Previous research suggests empathy is more strongly triggered by messages with portrayals that are perceived as realistic (Campbell and Babrow, 2004). One's sense of presence is thought to include not just estimates of fidelity to real-world objects (perceptual realism), but also similarity to real-world events and behaviors (social realism; Lombard and Ditton, 1997). Immersion, by triggering presence heuristics, can cause audiences to experience a message as more realistic (Sundar et al., 2017). In addition, immersion may shift a user toward an involved versus analytical mode of message consumption, leading to a less critical reflection on the presentation (Vorderer, 1993). As such, higher levels of immersion should lead individuals to construe the events depicted in a story as more realistic.

H5. Immersion will be positively associated with social realism.

Rather than cognitively taking on the vantage of others or affectively responding to their displays and experiences, associative empathy is the vicarious experience of another's circumstances and emotions as one's own. Notably, in the context of media portrayals, Shen (2010b) equated associative empathy to the identification with onscreen others (Cohen, 2001). Identification can be defined as 'an imaginative process through which an audience member assumes the identity, goals, and perspective of a character' (Cohen, 2001: 261). In turn, the process of identification includes individuals becoming less aware of their role as audience members and coming to instead imagine themselves as parties within the narrative, experiencing media messages as if the depicted events are happening to them (Cohen, 2001). Therefore, to the extent one judges the social scenarios and actions exhibited within a media message as relatively realistic rather than contrived or fantastical, they may more readily place themselves within the events depicted. That is, perceiving occurrences as plausible should increase the possibility to vicariously experience the circumstances as one's own, leading to intrinsic emotional responses characteristic of associative empathy rather than merely reactive responses to the experiences of others.

H6. Social realism will be positively associated with associative empathy.

Though increased plausibility of events depicted may heighten the possibility of users identifying with persons within a story, it is unclear how social realism influences perspective-taking—that is, cognitive empathy—or the likelihood or intensity of emotional

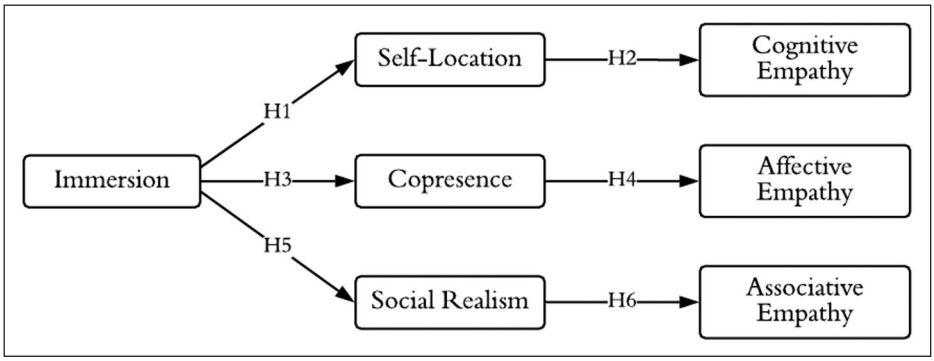

Figure 1. Hypothesized relationships among immersion, dimensions of presence, and dimensions of empathy.

responses underlying affective empathy. Hence, the current study also addresses these unexplored areas.

RQ3. Do estimates of social realism impact users' levels of cognitive empathy or affective empathy?

Indirect effects of immersion on empathy

Treating presence and empathy as multidimensional constructs, the current study also implies three indirect effects of immersion on empathy via presence (see Figure 1). Specifically, it proposes (a) immersion will lead to cognitive empathy through perceived self-location, (b) immersion will lead to affective empathy through copresence, and (c) immersion will lead to associative empathy through social realism.

Methods

Design

The study employed an experimental design in which immersion was manipulated between subjects. In line with previous research on immersion and empathy (Sundar et al., 2017), participants were randomly assigned to one of three immersion conditions that determined how they experienced a sequence of news stories—via 360° video in an HMD unit with head-tracking (high immersion; $n=30$), via 360° video on a desktop monitor with a mouse (medium immersion; $n=33$), or via text and photographs on a desktop monitor (low immersion; $n=32$). Within a given immersion condition, participants were exposed to two news stories.

Participants

Participants ($N=95$) were recruited from a research participation pool of undergraduate and graduate students enrolled in communication courses at a large private research

university in the northeastern United States (age: $M = 20.81$, $SD = 1.68$; gender: 84.2% female, 15.8% male).

Materials

A systematic review was completed of all videos ($N = 281$) published to *The New York Times'* official YouTube channel as part of the 'Daily 360' series between 3 January 2017 and 29 December 2017. Each video was coded according to five variables: country, age relevance, niche relevance, hedonic content, and eudaimonic content. *Country* was coded according to the country which was depicted in the video. *Age relevance* was a simple binary coding of whether the topic of the video was of particular relevance to the anticipated age group of the participant sample. Likewise, *niche relevance* was a binary coding of whether the topic of the video was of particular relevance to the anticipated common interests of the participant sample. *Hedonic content* was coded according to the affective valence of the content of the video, with codes for negative, positive, and mixed affect, as well as videos that were purely informational. *Eudaimonic content* was a binary coding of whether the content of the video could be considered uplifting or inspiring. The coded videos were then filtered based on the availability of corresponding article versions in *The New York Times* and the presence of an empathy target.

This process resulted in two stories which served as study stimuli—*Sleeping on Denver's Bitter Cold Streets*, which articulates the plight of Denver's homeless population, and *The Road to Nowhere*, which describes the movement of refugees along National Route 1 in Niger. The depicted characters in both stories had empathy-eliciting experiences associated with marginalization, homelessness, and the fight for survival. Although some story differences emerged, we combined the scores for the two stories in the analysis and treated the stories as two message instantiations given that the stories did not significantly differ across measures of the three empathy dimensions.[1] The stimuli serve as a strength of the study as having multiple message instantiations avoids a single stimulus effect, a limitation of many experimental studies in media psychology (see Reeves et al., 2016).

Participants in the HMD and desktop video conditions watched both of the 'Daily 360' stories, while participants in the text condition read the corresponding *New York Times* articles. The text and layout of the articles were edited to ensure structural consistency between the two stories, with the resulting stimuli each containing approximately 1,500 words and five photographs drawn from the original articles. The order in which the stories were displayed was randomized.

Apparatus

Participants in the HMD condition watched the 360° video using an Oculus Rift CV1, containing two 1080 2160 × 1200-pixel OLED displays and operating at 90 Hz. The HMD's built-in headset was used for audio. The software package *Skybox* was used to transform the 360° video from the native equi-angular cubemap used by YouTube for desktop viewing and then project the image as a sphere surrounding the participant, allowing them to look around the scene by turning their head without experiencing image distortion.

Participants in the desktop video condition watched the same videos using a 23-inch (58.42 cm) 1680 × 1050-pixel LED monitor operating at 59 Hz and positioned approximately 24 inches (60.96 cm) from their seat with audio delivered over a stereo speaker system. Participants were provided with a mouse that they could use to control the orientation of their viewport within the scene.

The desktop text condition used the same monitor setup to display the text stories as multi-page documents containing text and embedded images. Participants could use the mouse to scroll through each document.

Measures

All questionnaire items used in this study are provided in the Appendix.

Pretest measure. Prior to stimulus exposure, participants reported their trait empathy using the Interpersonal Reactivity Index (Davis, 1983), which consisted of 28 7-point items anchored by '*Does not describe me well*' and '*Describes me very well*.' The four subscales included perspective-taking ($\alpha = .80$, $M = 4.99$, $SD = 0.85$), fantasy ($\alpha = .86$, $M = 4.68$, $SD = 1.12$), empathic concern ($\alpha = .75$, $M = 5.29$, $SD = 0.80$), and personal distress ($\alpha = .80$, $M = 3.95$, $SD = 0.98$).

Posttest measures. Following exposure to each news story, participants were asked to complete a posttest questionnaire. All measures used a 7-point Likert-type scale ranging from '*Strongly disagree*' to '*Strongly agree.*'

Presence. Three dimensions of presence were measured—self-location, copresence, and social realism. Self-location represents one of two components in the process model of spatial presence proposed by Wirth et al. (2007), the other being *possible actions*. Participants' subjective experience of self-location in relation to each of the news stories was measured using the 10 self-location questionnaire items of Hartmann et al.'s (2015) Spatial Presence Experience Scale ($\alpha = .97$, $M = 4.01$, $SD = 1.42$). An example item was, '*I felt like I was actually there in the environment of the story*.'

Participants also rated their experience of copresence with the individuals in each of the news stories using a combination of four items drawn from the copresence scale developed by Nowak and Biocca (2003) and the social presence scale developed by Bailenson et al. (2004). As social presence and copresence scales commonly capture several different dimensions or even distinct conceptualizations (Biocca et al., 2003; Cummings and Wertz, 2018; Oh et al., 2018), these items were carefully selected as operationalizations of the particular underlying dimension of interest: user evaluations of their relative proximity or closeness with mediated others ($\alpha = .79$, $M = 4.06$, $SD = 0.99$). An example item was, '*I perceive that I am in the presence of the individuals in the story*.'

Finally, participants reported their perception of the social realism of each story using an adaptation of the Social Realism scale of the Temple Presence Inventory (Lombard et al., 2009), which included three items ($\alpha = .76$, $M = 6.31$, $SD = 0.60$). An example item was, '*The events in the story would occur in the real world*.'

Empathy. Posttest levels of state empathy were reported by participants following exposure to each story, using the scale developed by Shen (2010b). Three subscales of four items each assessed *cognitive* ($\alpha = .66$, $M = 5.57$, $SD = 0.67$), *affective* ($\alpha = .77$, $M = 4.63$, $SD = 0.90$), and *associative* empathy ($\alpha = .85$, $M = 4.07$, $SD = 1.21$), respectively. The wording of some items was adjusted to reflect the stimulus materials used (e.g., by substituting 'the story' for 'this message' and 'individual' for 'character'). Example items include, '*The reactions of the individuals in the news story to the situation are understandable*' (cognitive empathy), '*I experienced the same emotions as the individuals in the news story*' (affective empathy), and '*I can identify with the individuals in the news story*' (associative empathy).

Results

The findings in this section are presented in line with those that pertain to immersion as a predictor of presence, followed by presence as a predictor of empathy, and finally, presence as a mediator in the relationship between immersion and empathy.

Immersion as a predictor of presence

A set of hypotheses predicted effects of immersion on presence such that immersive experiences would facilitate higher levels of presence across the following dimensions: self-location (H1), copresence (H3), and social realism (H5). To test these hypotheses, three separate analyses of covariance (ANCOVAs) were conducted to examine differences in these presence dimensions among the immersion conditions, with trait empathy as a covariate.

Findings indicated an effect of immersion on self-location, $F(2, 88) = 16.16$, $p < .001$, $\eta_p^2 = 0.27$. Specifically, individuals in the HMD video condition ($M = 5.01$, $SE = 0.23$) experienced stronger self-location than those in the desktop video ($M = 3.89$, $SE = 0.21$; $p < .001$) and desktop text ($M = 3.19$, $SE = 0.22$; $p < .001$) conditions, with the latter two immersion conditions showing no significant differences in self-location ($p = .08$). Therefore, H1 was supported. The same pattern emerged for copresence, $F(2, 88) = 4.26$, $p < .05$, $\eta_p^2 = .09$, such that those experiencing the news story via HMD ($M = 4.47$, $SE = 0.17$) reported greater levels of copresence than those experiencing the same story via desktop video ($M = 3.85$, $SE = 0.16$; $p < .05$) and text ($M = 3.88$, $SE = 0.17$; $p < .05$)), with the latter two immersion conditions yielding no significant differences in copresence ($p = 1.00$). Thus, H3 was supported. In contrast, the analysis did not reveal an effect of immersion on social realism, $F(2, 88) = 0.22$, $p = .80$, $\eta_p^2 = .01$. Specifically, no differences emerged in social realism between HMD ($M = 6.32$, $SE = 0.11$) and desktop video ($M = 6.26$, $SE = 0.11$; $p = 1.00$) conditions, HMD and desktop text ($M = 6.36$, $SE = 0.11$; $p = 1.00$) conditions, or desktop video and desktop text conditions ($p = 1.00$). Therefore, findings do not support H5.

Presence as a predictor of empathy

Another set of hypotheses predicted that elements of presence—self-location, copresence, and social realism—would individually influence the experience of empathy across

cognitive (H2), affective (H4), and associative (H6) dimensions, respectively. In addition, a series of research questions inquired whether each of these presence dimensions would impact the other dimensions of empathy not included in the aforementioned hypotheses, specifically whether self-location influences affective or associative empathy (RQ1), whether copresence affects cognitive or associative empathy (RQ2), and whether social realism impacts cognitive or affective empathy (RQ3). To test the extent to which the dimensions of presence are predictors of each empathy component, a series of linear regressions with trait empathy as a covariate (Shin, 2018) were performed.

Findings revealed that instead of self-location, copresence increased cognitive empathy ($\beta = .44$, $p < .001$). Therefore, H2 was not supported. The analysis also identified copresence as a predictor of affective empathy ($\beta = .43$, $p < .001$), showing support for H4. Unanticipated, self-location likewise facilitated affective empathy ($\beta = .31$, $p < .01$). Finally, social realism surprisingly had a negative impact on associative empathy ($\beta = -.33$, $p < .001$), which was instead positively predicted by self-location ($\beta = .29$, $p < .05$) and copresence ($\beta = .29$, $p < .05$). Thus, H6 was not supported.

Presence mediating the relationship between immersion and empathy

To test the mediating role of presence on the relationship between immersion and empathy, controlling for levels of trait empathy, bootstrapping procedures using 5,000 bootstrap samples and 95% bias-corrected confidence intervals were employed (Preacher and Hayes, 2004, 2008) The analysis revealed a series of significant indirect effects of immersion on empathetic responses.

Specifically, there was a positive indirect effect of immersion on cognitive empathy through copresence ($B = 0.08$, $SE = 0.04$, $p < .05$). While immersion was positively associated with copresence ($B = 0.29$, $SE = 0.12$, $p < .05$), which in turn increased cognitive empathy ($B = 0.28$, $SE = 0.07$, $p < .001$), there was no direct effect of immersion on cognitive empathy ($B = 0.09$, $SE = 0.08$, $p = .29$).

The analysis also yielded a positive indirect path from immersion to affective empathy mediated by self-location ($B = 0.27$, $SE = 0.10$, $p < .05$) and copresence ($B = 0.10$, $SE = 0.05$, $p < .05$). In particular, immersion was positively associated with both self-location ($B = 0.91$, $SE = 0.16$, $p < .001$) and copresence ($B = 0.29$, $SE = 0.12$, $p < .05$). Self-location ($B = 0.30$, $SE = 0.08$, $p < .001$) and copresence ($B = 0.34$, $SE = 0.10$, $p < .01$) subsequently increased affective empathy. Moreover, immersion had a direct negative effect on affective empathy ($B = -0.28$, $SE = 0.10$, $p < .01$).

Finally, a positive indirect effect of immersion on associative empathy via self-location ($B = 0.35$, $SE = 0.13$, $p < .05$) emerged. Whereas immersion was positively related to self-location ($B = 0.91$, $SE = 0.16$, $p < .001$), in turn increasing associative empathy ($B = 0.39$, $SE = 0.13$, $p < .01$), there was no direct effect of immersion on associative empathy ($B = -0.15$, $SE = 0.17$, $p = .36$).

Discussion

To better understand the psychological mechanisms by which immersion may enhance empathetic responses, this study took a multidimensional approach to both user

presence—a key affordance of immersion—and empathy. As expected, different elements of presence—self-location, copresence, and social realism—were found to independently and differentially contribute to cognitive, affective, and associative dimensions of empathy.

Regarding the influence of presence on empathy, some unanticipated associations emerged beyond the hypothesized mediating pathways. First, self-location positively contributed to the affective and associative dimensions of empathy (RQ1). That is, the more users perceived themselves as occupying the story environment, the greater their response to a character's emotional state and their vicarious experience of those same emotions. Upon reflection, these findings are in line with the perspectives on embodied cognition (Varela et al., 1992) and identification (Cohen, 2001), reviewed earlier, respectively. Per embodied cognition, individuals are expected to affectively respond more strongly to any emotional environmental stimuli experienced as physically proximate. Furthermore, it stands to reason that users more readily experience another's situation as happening to themselves (i.e. are more likely to self-identify with an onscreen other) when perceiving themselves as occupying that same environment in which the depicted scenarios occur.

In addition, copresence (RQ2), and not self-location (H2), was found to facilitate cognitive empathy. This is particularly surprising as past research has found cognitive empathy to be directly related to one's experience of spatial presence (Van Loon et al., 2018). The disparity suggests there is a substantive difference between 360° video and computer-generated virtual simulations in regard to perspective-taking even when both are navigated by HMD. Most notably, the levels of interactivity afforded by each experience (the relative passivity of watching stories about individuals versus actively interacting with onscreen characters and objects) may determine the degree of spatial presence experienced and in turn influence the level of empathetic response. Established models of presence formation suggest that 'perceived action possibilities'—one's sense of possible actions with the persons or spaces depicted within a mediated environment—directly contribute to spatial presence (Wirth et al., 2007), and previous research suggests the relative level of interactivity afforded by control interfaces can influence presence experiences, particularly when users' hands are empty as was the case in the current HMD condition (Shafer et al., 2014). As the current study only included unidirectional story consumption, user response questionnaires did not include measures of users' perceived interactivity; however, future research designs may systematically vary the level of interactivity afforded by user interfaces in empathy contexts—ideally by directly manipulating the range of interactions permitted in different versions of a mediated environment, thereby controlling for other potential differences between navigating such spaces and 360° video viewing—to elucidate the relationships between immersion, perceived interactivity, particular elements of spatial presence and, in turn, different dimensions of empathy (including perspective-taking). In addition, though validated (Shen, 2010b) and found reliable in previous research (e.g., Cooke et al., 2018; Liu and Wei, 2018; Wei et al., 2019), the cognitive empathy scale used in the current study yielded relatively low internal consistency. It is possible that the context of the news stories used in this study (i.e., homelessness and displacement), which focused on macro-level social issues, may have influenced the efficacy of the cognitive empathy scale as prior studies have applied the same scale to more micro-level health and interpersonal contexts (e.g.,

anti-smoking and sexual abuse behaviors, online support through social media, and conflict resolution between friends). Therefore, in light of the interplay between the stimuli context and measurement instrument, the current study's findings pertaining to cognitive empathy should be interpreted with caution.

The observed relationships regarding social realism also ran contrary to our expectations. However, upon reflection, the non-significant relationship between immersion and social realism (H5) is quite reasonable. Narratives can be judged as perfectly plausible even when depicted in non-immersive formats, particularly video. Indeed, immersive media may influence sense of place independent of a sense of plausibility (Slater, 2009) in that users' construction of a spatial situational model of a mediated environment and perception of their relative position within that space (Wirth et al., 2007) may be completely orthogonal from their estimates of reality judgments (Baños et al., 2004). More surprising, however, is the negative relationship observed between social realism and associative empathy (H6). Though this finding is counter-intuitive, recent work has suggested that increased sense of transportation into a narrative may suppress the relative influence of perceived social realism on users' identification with a mediated other (Cohen et al., 2018). Thus, to the extent that other presence dimensions such as self-location perceptually transported participants into the narratives presented, the less critical social realism of the story may have elicited associative empathy.

Finally, regarding the indirect effects of immersion on empathy, we found support for the prosocial potential of immersive media in promoting affective empathy through multiple paths by boosting the perception of self-location and feeling of copresence among users. Moreover, these two presence dimensions also serve as unique mediators in other indirect effects. Specifically, the positive association between immersion and cognitive empathy was facilitated through one's psychological connection with others in that space (copresence), while the positive relationship between immersion and associative empathy was facilitated through one's sense of self-location.

Limitations

The current study manipulated overall levels of immersion to examine its influence on different dimensions of psychological presence and, in turn, impact on empathetic response. However, immersion, too, is a construct that can consist of different dimensions. As pointed out by Slater and Wilbur (1997), level of occlusion, richness and breadth of stimuli, and naturalness and magnitude of user input mappings all contribute to presence. Therefore, while the current findings provide insight into the effects of immersion holistically, this study does not isolate the relative effects of different elements of immersive media. Indeed, as distinct immersive features have been found to differentially contribute to the experience of spatial presence (Cummings and Bailenson, 2016), a multifactorial study design could provide insight into the indirect effects of each feature on different dimensions of empathy, beyond the single-vector manipulation of immersion in the current study. Identifying the relative contribution of various immersive system elements (e.g., screen size of different devices used to view 360° video, inclusion of spatialized sound, stereoscopy of rendered content) may in turn also help further explain the mixed findings in the literature reviewed earlier. Therefore, future research could examine how manipulations of field of view,

image quality, number of sensory channels, and number of degrees of freedom in a tracking system each independently impact empathetic responses, rather than holistically comparing platforms that confound levels of each factor. Such an approach can also provide insight into which specific features of the high immersion (HMD) condition not also included in the medium immersion (desktop video) condition—for instance, full occlusion of the external environment, natural tracking of visual orientation, or both—lead to only the former, eliciting significantly different levels of self-location and copresence compared with the low immersion (desktop text) condition.

Conversely, to the extent that this study relied on particular modalities holistically to implement low, medium, and high levels of immersion, it did not include certain alternative platforms. For instance, a phone-based "magic window" display (Bindman et al., 2018) could have been employed as an alternative medium level of immersion. Though not inherently required for comparing different overall levels of immersion, including such a condition alongside the three conditions in the current study would have permitted a more exhaustive modality comparison and in turn, offer additional practical insight into the relative effects of currently existing immersive media formats.

Practically speaking, different media formats provide different levels of visual information. Even though this study relied on existing news stories with corresponding sets of video versions and traditional text-and-image versions consisting of identical narratives and scope, the different conditions may have inherently included unique information (e.g., nonverbals only conveyed through video, contextual information only expressly provided through text). Thus, though the media formats and messages employed may heighten ecological validity, experimenter-produced stimuli would allow for greater control over the exact information delivered to participants across conditions. Relatedly, in attending to ecological validity, this study employed three common media formats for operationalizing distinct levels of immersion yet did not conduct a formal check of this manipulation. Though these formats include objectively different levels of the medium's properties that contribute to technological immersion per Slater and Wilbur's (1997) original conceptualization (e.g., field of view, number of user inputs tracked), the lack of a formal manipulation check may present a limitation.

Finally, this study relied on a convenience sample of college student participants. In turn, the generalizability of findings may be limited given previous work observing particular demographic differences with respect to immersive technology, user presence, and empathy (Felnhofer et al., 2014; Siriaraya and Siang Ang, 2012). In addition, while the participant sample size was adequate for examining the influence of technological immersion on psychological presence given established effect sizes (Cummings and Bailenson, 2016), it is difficult to evaluate the power required for testing each of the finer dimension-specific relationships examined here. Further research on immersion and distinct dimensions of both presence and empathy, along with subsequent meta-analytic review, will help address this potential limitation.

Theoretical implications and future directions

This study highlights the value of conceptualizing empathy as a multidimensional user state. Notably, if the current study treated empathy as a unidimensional concept, it would

have resulted in the misleading conclusion that immersion has a null effect on overall empathy, $F(2, 88) = 1.31$, $p = .27$. Moreover, this research demonstrates the importance of considering the multidimensionality of presence, as different dimensions were found to uniquely mediate immersion's impact on distinct components of empathy.

Although our hypotheses focused on presence dimensions that were related to each of Shen's (2010b) empathy dimensions based on prior literature, future research should examine the roles of other dimensions of presence, including self-presence (using stimuli that permit users to embody in-story representations, unlike the news stories used in the current study), affective valence, or mental absorption, as these components may differentially impact users' empathetic responses. Relatedly, other dimensions of social presence, beyond copresence, may be of particular interest for follow-up research, including perceived levels of intimacy and behavioral engagement with onscreen persons. On the other hand, perhaps of more practical importance, future work may directly examine the association between empathetic response and particular behavioral outcomes. This could include investigating how head rotation or eye gaze varies throughout video exposure, so as to identify whether state empathy is related to attention allocation. Alternatively, future studies may examine how different presence dimensions mediate immersion's influence on altruistic behavioral outcomes including charitable donations (Herrera et al., 2018).

Beyond attending to other presence dimensions as possible mediators of immersion's indirect effect on empathetic responses, future work may also consider alternate dimensions of empathy. While Shen (2010b) equated the associative dimension of empathy with identification in media contexts, identification itself may be a multidimensional construct in particular media environments. For instance, Van Looy et al. (2012) found that in the context of online video games, players' identification with their avatars consists of perceived similarity, wishful identification, and embodied presence. Future research could examine how these identification factors may be differentially influenced by system immersion.

In addition, differences in media richness and associated differences in cognitive load may impact one's sense of self-location, copresence, or social realism, as well as dimensions of presence beyond those directly investigated in the present study. To the extent that richness of stimuli may influence presence with respect to mental absorption (Baños et al., 2004) and estimates of plausibility (Slater, 2009), they may in turn influence empathetic responses. Future work should directly examine how message richness, cognitive load, and different presence dimensions together impact empathy in users. In a similar vein, one's heightened sense of being in a distant environment could potentially reduce the psychological distance between users and the story events and characters (Trope and Liberman, 2010). Hence, scholars may also consider investigating the impact of different dimensions of presence on the psychological distance users experience with story elements as such effects may subsequently influence empathetic responses.

The potential impact of media richness highlights another major consideration for future work on immersion and empathy: the role of content. Enthusiasm about the empathy potential of HMD devices and 360° video formats tends to focus on their immersive capacity, and the present study finds that in affording a sense of self-location and copresence, immersive media can indeed enhance levels of empathetic responses in users. However, our findings also demonstrate that immersion isn't everything. Certain elements

of presence—such as social realism—can impact empathy while not being associated with technological immersion. The extent to which a user construes a story's plot and events as plausible is inherently a matter of content, not immersion. In turn, additional content features—including plausibility, but also valence—should be considered in future research. For instance, the two news stories used for the stimulus of this study were negatively valenced, centering on themes of tragedy and suffering. However, the emotional tone of a story could make a difference such that more uplifting and inspirational content might lead to different effects of immersion on empathy as compared with more somber and depressing media fare, either directly or indirectly through presence. Future research on the empathy-eliciting potential of immersive media should investigate how different message features such as these may interact with relative levels of platform immersion to impact different empathy dimensions.

Finally, the current study expressly employed a multidimensional approach to empathy so as to gain potential insights into the mixed findings collectively provided by past research on immersion and empathy. With the value of a multidimensional explication of empathy evidenced in the current context, and given the previous findings of Wei et al. (2019) in the context of PSAs, future work may move beyond empathy as the outcome variable of interest and examine how different dimensions of empathetic responses to immersive news stories may impact downstream effects, including persuasion or memory of story content. That is, future research can consider the distinct mediation pathways leading to various affective and cognitive affordances for which the direct affordances of immersive media examined here (e.g., presence, empathy) are antecedents (Shin, 2017). In addition, such work can incorporate user goals and relevant personality differences such as immersive tendencies (Shin and Biocca, 2018; Witmer and Singer, 1998) to understand how technological affordances of immersion and individual differences interact in influencing the ultimate outcomes desired by the message producer.

Practical implications for immersive media message producers

The current study provides empirical evidence that—to the extent they make users feel located within a message and co-present with media characters—immersive media can provide prosocial benefits in the form of heightened empathetic responses in users. Practically speaking, this suggests that 360° news stories meant to elicit cognitive, affective, or associative empathy in a viewer may be more efficacious when engaged via HMD rather than less immersive means, such as desktop video displays or text-based delivery. Notably, the current study found immersion to enhance self-location and copresence, but not evaluations of the realism of the depicted events. Journalists believe omnidirectional 360° video can offer greater transparency to users and, in turn, more accurate representations of topics (Aitamurto, 2019); however, the current findings suggest that, although immersion had indirect effects on different empathy outcomes, it had no significant impact on users' perceptions of the depicted events themselves. Extending these findings beyond the context of immersive journalism and news stories, they suggest immersive platforms may serve as effective tools for psychotherapy related to perspective-taking or emotional response (Glantz et al., 1996; Riva, 2005) or empathetic response training for healthcare (Dyer et al., 2018) and education (Stavroulia et al., 2018) professionals.

Furthermore, these results highlight how adopting a multidimensional view of both presence and empathy may permit journalists and other content creators to more effectively produce stories meant to garner such responses. For instance, a given production may seek to stir emotional resonance in a user—that is, to elicit affective empathy. To do so, a producer may want to (a) orient onscreen persons toward the user (as direct address and eye gaze have been found to influence copresence; Freeth et al., 2013), while (b) shooting a video recording or rendering the perspective within a computer-generated virtual environment so as to position the user "on the ground" with a first-person perspective of the scene (as such a perspective has been found to heighten one's sense of self-location within the space; Havranek et al., 2012). Alternatively, only the first of these considerations may be important if the goal is to assist the user in comprehending the situational context of the onscreen character (cognitive empathy). In this way, understanding that unique presence dimensions distinctly and differentially impact the extent to which users understand, emotionally respond to, or identify with media persons can inform the production and design of immersive media stories. However, our findings also demonstrate that immersion isn't everything. Certain elements of presence—such as social realism—can impact empathy while not being associated with technological immersion. This highlights that message features—just as with more traditional media formats—matter. In turn, fully tapping into the empathy-producing potential of immersive technologies will also require content considerations.

Acknowledgements

The authors extend their gratitude and appreciation to Brittany Andersen, Saniya Farooqi, and Lee Hair for their assistance with data collection, as well as the Editor and anonymous reviewers for their helpful feedback pertaining to the issues addressed in this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

James J Cummings https://orcid.org/0000-0001-6239-2634

Note

1. A series of paired sample *t*-tests were conducted to examine story differences. Although findings yielded story differences in copresence, Denver: $M=3.95$, $SD=1.07$; Niger: $M=4.16$, $SD=1.12$, $t(94)=2.24$, $p<.05$, there were no story differences in self-location, Denver: $M=3.92$, $SD=1.43$; Niger: $M=4.09$, $SD=1.55$, $t(94)=1.75$, $p=.08$, social realism, Denver: $M=6.25$, $SD=0.73$; Niger: $M=6.37$, $SD=0.66$, $t(94)=1.68$, $p=.10$, and the three empathy dimensions—cognitive empathy, Denver: $M=5.59$, $SD=0.79$; Niger: $M=5.55$, $SD=0.88$, $t(94)=0.40$, $p=.69$, affective empathy, Denver: $M=4.58$, $SD=1.01$; Niger: $M=4.68$, $SD=1.10$, $t(94)=0.93$, $p=.36$, and associative empathy, Denver: $M=4.06$, $SD=1.31$; Niger: $M=4.09$, $SD=1.34$, $t(94)=0.26$, $p=.80$.

References

Ahn D, Seo Y, Kim M, et al. (2014) The effects of actual human size display and stereoscopic presentation on users' sense of being together with and of psychological immersion in a virtual character. *Cyberpsychology, Behavior, and Social Networking* 17(7): 483–487.

Aitamurto T (2019) Normative paradoxes in 360 journalism: contested accuracy and objectivity. *New Media & Society* 21(1): 3–19.

Aitamurto T, Zhou S, Sakshuwong S, et al. (2018) Sense of presence, attitude change, perspective-taking and usability in first-person split-sphere 360 video. In: *Proceedings of the 2018 CHI conference on human factors in computing systems*, Montreal, QC, Canada, 21–26 April, pp. 545. New York: ACM.

Alsever J (2015) Is virtual reality the ultimate empathy machine? *WIRED*. Available at: https://www.wired.com/brandlab/2015/11/is-virtual-reality-the-ultimate-empathy-machine/ (accessed 1 April 2017).

Anderson CA, Shibuya A, Ihori N, et al. (2010) Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: a meta-analytic review. *Psychological Bulletin* 136(2): 151–173.

Aron A, Aron EN and Smollan D (1992) Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology* 63(4): 596–612.

Bailenson JN, Aharoni E, Beall AC, et al. (2004) Comparing behavioral and self-report measures of embodied agents' social presence in immersive virtual environments. In: *PRESENCE 2004: the 7th annual international workshop on presence*, Valencia, 13–15 October, pp. 1105–1864. Valencia: Technical University of Valencia

Bang E and Yildirim C (2018) Virtually empathetic? Examining the effects of virtual reality storytelling on empathy. In: *International conference on virtual, augmented and mixed reality*, Las Vegas, FL, 15–20 July, pp. 290–298. Cham: Springer.

Baños RM, Botella C, Garcia-Palacios A, et al. (2004) Psychological variables and reality judgment in virtual environments: the roles of absorption and dissociation. *Cyberpsychology & Behavior* 2(2): 143–148.

Barsalou LW (2010) Grounded cognition: past, present, and future. *Topics in Cognitive Science* 2(4): 716–724.

Batson CD (2009) These things called empathy: eight related but distinct phenomena. In: Decety J and Ickes WJ (eds) *The Social Neuroscience of Empathy*. Cambridge, MA: MIT Press, pp. 3–15.

Batson CD, Early S and Salvarani G (1997) Perspective taking: imagining how another feels versus imaging how you would feel. *Personality and Social Psychology Bulletin* 23(7): 751–758.

Bindman SW, Castaneda LM, Scanlon M, et al. (2018) Am I a bunny? The impact of high and low immersion platforms and viewers' perceptions of role on presence, narrative engagement, and empathy during an animated 360 video. In: *Proceedings of the 2018 CHI conference on human factors in computing systems*, Montreal, QC, Canada, 21–26 April, pp. 457. New York: ACM.

Biocca F, Harms C and Burgoon JK (2003) Toward a more robust theory and measure of social presence: review and suggested criteria. *Presence: Teleoperators & Virtual Environments* 12(5): 456–480.

Blanke O (2012) Multisensory brain mechanisms of bodily self-consciousness. *Nature Reviews Neuroscience* 13(8): 556–571.

Campbell R and Babrow A (2004) The role of empathy in responses to persuasive risk communication: overcoming resistance to HIV prevention messages. *Health Communication* 16: 159–182.

Cohen J (2001) Defining identification: a theoretical look at the identification of audiences with media characters. *Mass Communication & Society* 4(3): 245–264.

Cohen J, Weimann-Saks D and Mazor-Tregerman M (2018) Does character similarity increase identification and persuasion? *Media Psychology* 21(3): 506–528.

Cooke AN, Bazzini DG, Curtin LA, et al. (2018) Empathic understanding: benefits of perspective-taking and facial mimicry instructions are mediated by self-other overlap. *Motivation and Emotion* 42: 446–457.

Cummings JJ and Bailenson JN (2016) How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. *Media Psychology* 19(2): 272–309.

Cummings JJ and Wertz B (2018) Technological predictors of social presence: a foundation for a meta-analytic review and empirical concept explication. In: *Proceedings of the 17th conference of the International Society for Presence Researchers*, Prague, 21–22 May, pp. 1–32. ISBN: 978-0-9792217-6-7.

Davis D (1994) *Empathy: A Social Psychological Approach*. Madison, WI: Brown & Benchmark Publishers.

Davis MH (1983) Measuring individual differences in empathy: evidence for a multidimensional approach. *Journal of Personality and Social Psychology* 44: 113–126.

Decety J and Jackson PL (2004) The functional architecture of human empathy. *Behavioral and Cognitive Neuroscience Reviews* 3(2): 71–100.

Dyer E, Swartzlander BJ and Gugliucci MR (2018) Using virtual reality in medical education to teach empathy. *Journal of the Medical Library Association: JMLA* 106(4): 498–500.

Felnhofer A, Kothgassner OD, Hauk N, et al. (2014) Physical and social presence in collaborative virtual environments: exploring age and gender differences with respect to empathy. *Computers in Human Behavior* 31: 272–279.

Fonseca D and Kraus M (2016) 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*, Tampere, 17–18 October, pp. 287–296. New York: ACM.

Freeth M, Foulsham T and Kingstone A (2013) What affects social attention? Social presence, eye contact and autistic traits. *PLoS ONE* 8(1): e53286.

Geen RG and Bushman BJ (1989) The arousing effects of social presence. In: Wagner H and Manstead A (eds) *Handbook of Social Psychophysiology*. London: John Wiley & Sons, pp. 261–281.

Gibson JJ (1977) The theory of affordances. In: Shaw R and Bransford J (eds) *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*. Hillsdale, NJ: Erlbaum, pp. 67–82.

Gibson JJ (1979) *The Ecological Approach to Visual Perception*. Hillsdale, NJ: Erlbaum.

Glantz K, Durlach NI, Barnett RC, et al. (1996) Virtual reality (VR) for psychotherapy: from the physical to the social environment. *Psychotherapy: Theory, Research, Practice, Training* 33(3): 464–473.

Hartmann T, Wirth W, Schramm H, et al. (2015) The spatial presence experience scale (SPES): a short self-report measure for diverse media settings. *Journal of Media Psychology* 28: 1–15.

Havranek M, Langer N, Cheetham M, et al. (2012) Perspective and agency during video gaming influences spatial presence experience and brain activation patterns. *Behavioral and Brain Functions* 8(1): 34.

Heeter C (1992) Being there: the subjective experience of presence. *Presence: Teleoperators and Virtual Environments* 1: 262–271.

Herrera F, Bailenson J, Weisz E, et al. (2018) Building long-term empathy: a large-scale comparison of traditional and virtual reality perspective-taking. *PLoS ONE* 13(10): e0204494.

Kidd DC and Castano E (2013) Reading literary fiction improves theory of mind. *Science* 342(6156): 377–380.

Konrath SH, O'Brien EH and Hsing C (2011) Changes in dispositional empathy in American college students over time: a meta-analysis. *Personality and Social Psychology Review* 15(2): 180–198.

Lee KM (2004) Presence, explicated. *Communication Theory* 14: 27–50.

Liu B and Wei L (2018) Modeling social support on social media: effect of publicness and the underlying mechanisms. *Computers in Human Behavior* 87: 263–275.

Loggia ML, Mogil JS and Bushnell MC (2008) Empathy hurts: compassion for another increases both sensory and affective components of pain perception. *Pain* 136(1–2): 168–176.

Lombard M and Ditton TB (1997) At the heart of it all: the concept of presence. *Journal of Computer-Mediated Communication* 3(2): 1–39.

Lombard M, Ditton TB and Weinstein L (2009) Measuring presence: the Temple Presence Inventory. In: *Proceedings of the international society for presence research annual conference*, Los Angeles, CA, 11–13 November.

Nowak KL (2001) Defining and differentiating copresence, social presence and presence as transportation. In: *Presence 2001 conference*, May 21–23, Philadelphia, PA.

Nowak KL and Biocca F (2003) The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators & Virtual Environments* 12(5): 481–494.

Oh CS, Bailenson JN and Welch GF (2018) A systematic review of social presence: definition, antecedents, and implications. *Frontiers in Robotics and AI* 5: 114.

Oppezzo M and Schwartz DL (2014) Give your ideas some legs: the positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 4: 1142–1152.

Preacher KJ and Hayes AF (2004) SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers* 36(4): 717–731.

Preacher KJ and Hayes AF (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods* 40(3): 879–891.

Reeves B, Yeykelis L and Cummings JJ (2016) The use of media in media psychology. *Media Psychology* 19(1): 49–71.

Riva G (2005) Virtual reality in psychotherapy. *Cyberpsychology & Behavior* 8(3): 220–230.

Schutte NS and Stilinović EJ (2017) Facilitating empathy through virtual reality. *Motivation and Emotion* 41(6): 708–712.

Shafer DM, Carbonara CP and Popova L (2014) Controller required? The impact of natural mapping on interactivity, realism, presence, and enjoyment in motion-based video games. *Presence: Teleoperators and Virtual Environments* 23(3): 267–286.

Shen L (2010a) Mitigating psychological reactance: the role of message-induced empathy in persuasion. *Human Communication Research* 36(3): 397–422.

Shen L (2010b) On a scale of state empathy during message processing. *Western Journal of Communication* 74(5): 504–524.

Shin D (2018) Empathy and embodied experience in virtual environment: to what extent can virtual reality stimulate empathy and embodied experience? *Computers in Human Behavior* 78: 64–73.

Shin D and Biocca F (2018) Exploring immersive experience in journalism. *New Media & Society* 20(8): 2800–2823.

Shin DH (2017) The role of affordance in the experience of virtual reality learning: technological and affective affordances in virtual reality. *Telematics and Informatics* 34(8): 1826–1836.

Siriaraya P and Siang Ang C (2012) Age differences in the perception of social presence in the use of 3D virtual world for social interaction. *Interacting with Computers* 24(4): 280–291.
Slater M (2009) Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. *Philosophical Transactions of the Royal Society B* 364(1535): 3549–3557.
Slater M and Wilbur S (1997) A framework for immersive virtual environments (FIVE): speculations on the role of presence in virtual environments. *Presence: Teleoperators and Virtual Environments* 6: 603–616.
Stavroulia KE, Baka E, Lanitis A, et al. (2018) Designing a virtual environment for teacher training: enhancing presence and empathy. In: *Proceedings of Computer Graphics International 2018*, Bintan Island, 11–14 June, pp. 273–282. New York: ACM Press.
Strayer J (1990) Affective and cognitive perspectives on empathy. In: Eisenberg N and Strayer J (eds) *Empathy and Its Development*. New York: Cambridge University Press, pp. 218–244.
Sundar SS, Kang J and Oprean D (2017) Being there in the midst of the story: how immersive journalism affects our perceptions and cognitions. *Cyberpsychology, Behavior, and Social Networking* 20(11): 672–682.
Trope Y and Liberman N (2010) Construal-level theory of psychological distance. *Psychological Review* 117(2), 440–463.
Van Loon A, Bailenson J, Zaki J, et al. (2018) Virtual reality perspective-taking increases cognitive empathy for specific others. *PLoS ONE* 13(8): e0202442.
Van Looy J, Courtois C, De Vocht M, et al. (2012) Player identification in online games: validation of a scale for measuring identification in MMOGs. *Media Psychology* 15(2): 197–221.
Varela FJ, Thompson ET and Rosch E (1992) *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: The MIT Press.
Vorderer P (1993) Audience involvement and program loyalty. *Poetics* 22(1–2): 89–98.
Wei L, Ferchaud A and Liu B (2019) Endorser and bodily addressing in public service announcements: effects and underlying mechanisms. *Communication Research Reports* 36(1): 1–13.
Williams LE and Bargh JA (2008) Experiencing physical warmth promotes interpersonal warmth. *Science* 322(5901): 606–607.
Wilson M (2002) Six views of embodied cognition. *Psychonomic Bulletin & Review* 9(4): 625–636.
Wirth W, Hartmann T, Böcking S, et al. (2007) A process model of the formation of spatial presence experiences. *Media Psychology* 9: 493–525.
Witmer B and Singer M (1998) Measuring presence in virtual environments: a presence questionnaire. *Presence* 7(3): 225–240.

Author biographies

James J. Cummings is an assistant professor in the Division of Emerging Media Studies at Boston University. His research focuses on issues related to human-computer interaction and the psychological processing and effects of new and emerging media.

Mina Tsay-Vogel is an associate professor in the Department of Mass Communication, Advertising & Public Relations at Boston University. Her research focuses on the psychological and social effects of media with an emphasis on entertainment and new media.

Tiernan J Cahill is a PhD student in the Division of Emerging Media Studies at Boston University. His research focuses on the psychological processing and adaptive use of immersive virtual environments and interactive narratives.

Li Zhang is a PhD student in the Division of Emering Media Studies at Boston University. His research areas of interest include computational social science and media psychology.

Appendix

The following is a comprehensive listing of the self-reported measures in this study.

Presence: Self-Location
I felt like I was actually there in the environment of the story.
It seemed as though I actually took part in the action of the story.
It was as though my true location had shifted into the environment of the story.
I felt as though I was physically present in the environment of the story.
I experienced the environment in the story as though I had stepped into a different place.
I was convinced that things were actually happening around me.
I had the feeling that I was in the middle of the action rather than merely observing/reading it.
I felt like the objects in the story surrounded me.
I experienced both the confined and open spaces in the story as though I was really there.
I was convinced that the objects in the story were located on the various sides of my body.

Presence: Copresence
I perceive that I am in the presence of the individuals in the story.
I feel a sense of closeness with the individuals in the story.
I want a deeper relationship with the individuals in the story.
I feel a sense of distance between myself and the individuals in the story. (RC)

Presence: Social Realism
The events in the story would occur in the real world.
The events in the story could occur in the real world.
The way in which the events occurred in the story is a lot like the way they occur in the real world.

Empathy: Cognitive
The reactions of the individuals in the story to the situation are understandable.
I can understand what the individuals in the story are going through.
I recognize the situation of the individuals in the story.
I can see the point of view of the individuals in the story.

Empathy: Affective
I experienced the same emotions as the individuals in the story.
The emotions of the individuals in the story are genuine.
I was in a similar emotional state as the individuals in the story when watching/reading the message.
I can feel the emotions of the individuals in the story.

Empathy: Associative
I can identify with the individuals in the story.
I can identify with the situation described in the story.
I can relate to what the individuals in the story are going through.
When watching/reading the story, I was fully absorbed.

Interpersonal Reactivity: Perspective-Taking
I sometimes find it difficult to see things from the "other guy's" point of view. (RC)
I try to look at everybody's side of a disagreement before I make a decision.
I sometimes try to understand my friends better by imagining how things look from their perspective.
If I'm sure I'm right about something, I don't waste much time listening to other people's arguments. (RC)
I believe that there are two sides to every question and try to look at them both.
When I'm upset at someone, I usually try to "put myself in his shoes" for a while.
Before criticizing somebody, I try to imagine how I would feel if I were in their place.

Interpersonal Reactivity: Fantasy
I daydream and fantasize, with some regularity, about things that might happen to me.
I really get involved with the feelings of the characters in a novel.
I am usually objective when I watch a movie or play, and I don't often get completely caught up in it. (RC)
Becoming extremely involved in a good book or movie is somewhat rare for me. (RC)
After seeing a play or movie, I have felt as though I were one of the characters.
When I watch a good movie, I can very easily put myself in the place of a leading character.
When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me.

Interpersonal Reactivity: Empathic Concern
I often have tender, concerned feelings for people less fortunate than me.
Sometimes I don't feel very sorry for other people when they are having problems. (RC)
When I see someone being taken advantage of, I feel kind of protective toward them.
Other people's misfortunes do not usually disturb me a great deal. (RC)
When I see someone being treated unfairly, I sometimes don't feel very much pity for them. (RC)
I am often quite touched by things that I see happen.
I would describe myself as a pretty soft-hearted person.

Interpersonal Reactivity: Personal Distress
In emergency situations, I feel apprehensive and ill-at-ease.
I sometimes feel helpless when I am in the middle of a very emotional situation.
When I see someone get hurt, I tend to remain calm. (RC)
Being in a tense emotional situation scares me.
I am usually pretty effective in dealing with emergencies. (RC)
I tend to lose control during emergencies.
When I see someone who badly needs help in an emergency, I go to pieces.

Note: (RC) = reverse-coded item.