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Informing Immersed Citizens: The Impact of Interactivity on Comprehending News in Immersive Journalism

Hannah Greber [1], Loes Aaldering [2], and Sophie Lecheler [1]

[1] Department of Communication, University of Vienna, Austria
[2] Department of Political Science and Public Administration, Vrije Universiteit Amsterdam, The Netherlands

Correspondence: Hannah Greber (hannah.greber@univie.ac.at)

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Abstract

Immersive journalism has emerged as an innovative journalistic approach promising enhanced attention and understanding through interactive, virtual environments. Previously, this was mostly tested through factual knowledge. However, evaluating immersive audio-visual modalities solely along factual knowledge falls short of considering, firstly, what about and how an immersive experience is remembered and, secondly, the importance of considering the perceptions surrounding information acquisition. Therefore, this study examines how interactivity in immersive journalism affects traditional as well as novel ways of comprehending news, such as episodic memory. In addition, we consider perceptions related to knowledge. We draw on a laboratory experiment (N = 149) testing the effect of three levels of interactivity provided (no interactivity vs. looking around vs. looking around + control over pace and order of storyline). Results indicate that a higher range of interactivity does not influence factual memory, but leads to an increase in perceived knowledge, thus indicating an illusion of knowledge. Moreover, there is a tendency to formulate more subjective takeaways in the high-interactivity condition, while interactivity did not influence the credibility evaluations. This provides partial empirical support for the credibility paradox of immersive journalism.

Keywords

immersive journalism; information retention; interactivity; memory; virtual reality

1. Introduction

Journalism should inform citizens; this normative assumption of journalism vis-à-vis democracy is almost universally acknowledged (Peters & Witschge, 2015; Strömbäck, 2005). Informing citizens typically means that "the news should provide citizens with the basic information necessary to form and update opinions on all of the major issues of the day" (Zaller, 2003, p. 110). Consequently, empirical studies testing the extent to which journalism informs an audience often use factual recall to assess information retention (e.g., Grabe & Myrick, 2016). Immersive journalism (IJ), which was initially thought to improve attention and focus and ultimately inform citizens, was found to instead have a detrimental impact on information retention (e.g., Barreda-Ángeles et al., 2020).

Since 2015, media companies have embraced IJ to emotionally and experientially re-engage and inform audiences (Sánchez Laws, 2019). IJ employs audio-visually immersive technology, such as virtual reality (VR), to let the audience witness a news event or story as if they had been there (de Bruin et al., 2020). This immersion is believed to capture the audience's attention, render split-screening impossible, and invite a deeper and more focused understanding of a subject (Sánchez Laws, 2019, p. 2). Recently, IJ's potential for more extensive interactivity possibilities has received attention due to the assumed engagement potential (Vázquez-Herrero, 2021) and perceived benefit in guiding user attention (H. Wu et al., 2021). Despite the optimism surrounding this potential of interactivity in IJ to help journalism's core function of informing citizens, studies of IJ's effect on information intake surprisingly indicate that IJ has either no (Barnidge et al., 2022; Bujić et al., 2023) or a negative influence (Barreda-Ángeles et al., 2020; Greussing, 2020; Sundar et al., 2017) on factual information intake.

Evaluating immersive audio-visual modalities solely in terms of factual knowledge falls short of considering how an immersive experience is remembered and the perceptions surrounding information acquisition. This line of thinking reflects a trend in visual communication arguing that it is crucial to consider the informational qualities of these visuals (Grabe & Myrick, 2016). Similarly, scholars suggest that IJ is remembered as a prosthetic memory (Dowling, 2022, p. 918). Thus, when evaluating IJ's informational quality, it is crucial to account for its modally rich nature (Dowling, 2022). This becomes even more important when considering that interactivity in IJ seems to be remembered as if it had happened to oneself (Ruddle et al., 2011). In addition, users' perceptions, such as their evaluation of the information's accuracy (e.g., Aitamurto, 2019; Sundar, 2008) and their perception of how much they remember (e.g., Schäfer, 2020), play an important role when assessing whether receiving information prompts individuals to adopt attitudes and behaviors (Grabe & Myrick, 2016; Pilditch et al., 2020; Schäfer, 2020).

This study aims to identify how interactive IJ relates to the democratic function of journalism vis-à-vis its citizens—to inform them (Strömbäck, 2005). We adopt a broader view of how users can be informed through IJ and investigate the impact of interactive IJ on factual recall, episodic and autobiographic memory, and main takeaways. We also explore perceptions such as perceived knowledge gain, credibility, and the completeness of the information received. We test the effect of an IJ experience in which the range of interactivity possibilities is manipulated (no interactivity vs. medium interactivity vs. high interactivity) in a laboratory experiment (N = 149). The data collection was part of a more extensive project and was pre-registered for the larger study.

2. Contextualization of IJ

IJ, positioned at the intersection of the emotional turn (Wahl-Jorgensen, 2020), the audience turn (Costera Meijer, 2020), and narrative visualism (Baía Reis & Coelho, 2018), offers a multi-sensory, user-centric news experience that aims to foster both cognitive and emotional understanding (Bujić & Hamari, 2020; Sánchez Laws, 2019). IJ encompasses three dimensions (de Bruin et al., 2020). First, inclusive technologies refer to the extent to which physical reality is audio-visually shut out or overlaid by VR (de Bruin et al., 2020). Inclusiveness is a core characteristic of immersive technologies (Slater & Wilbur, 1997), and can be placed on a spectrum, from less inclusive technologies, such as augmented reality, to more inclusive technologies, such as VR (Milgram & Kishino, 1994). Second, immersive narratives are narrative structures that provide an active role for the user in the environment (de Bruin et al., 2020). Third, interaction possibilities refer to ways of navigating the inclusive environment. Specifically, interactivity refers to "the extent to which users can participate in modifying the form and content of a mediated environment in real-time" (Steuer, 1992, p. 84; see also de Bruin et al., 2020).

IJ peaked in 2017 when major news agencies such as *The New York Times* and *Euronews* partnered with tech giants like Samsung and Google to fund immersive storytelling (Sirkkunen et al., 2021). Other global news companies followed suit. However, enthusiasm decreased after IJ failed to gain traction on larger platforms like *The New York Times* (Wang et al., 2018). Still, Meta, Apple, and South Korea's investments in VR headsets and the metaverse indicate ongoing hardware and software development (Thompson, 2023). Anticipated improvements in head-mounted display (HMD) quality, affordability, and an expanded media environment through tech giant investment may lead to wider IJ adoption, as an HMD-enabled presence could make IJ more engaging (Greber et al., 2023). In this context, extending interactivity beyond simply looking around is proposed to further increase the impact (Vázquez-Herrero, 2021) and competitiveness of IJ in a highly engaging environment.

3. IJ and Traditional Ways of Informing Citizens

An informed citizenry often lies at the center of normative democratic theories: Citizens should develop an informed opinion, resulting in rational decisions when participating in elections or political discussions (Zaller, 2003). While the extent to which citizens ideally should be informed varies depending on the comprehension of democracy (e.g., thick vs thin), as well as the notion of decision-making processes (e.g., informed decision-making vs. heuristic decision-making), at its core lies the argument that citizens need sufficient information to connect their interests to their political choices (Delli Carpini, 2000). As citizens are primarily informed about politics through the media, this notion has provoked extensive research on how social media platforms influence their users' information acquisition (e.g., Schäfer, 2020). These studies often measure factual recall.

As IJ was initially assumed to inform its users, numerous studies investigated whether this was true. Somewhat surprisingly, studies indicate that IJ either has no effect (Barnidge et al., 2022) or negatively impacts factual recall compared to less immersive formats, particularly when delivered through audio in a 360° video (Barreda-Ángeles et al., 2020; Sundar et al., 2017). Journalists now also highlight the need to reduce the amount of information provided to not overwhelm the audience (Mabrook, 2021).

This negative trend for factual information retention in IJ can be attributed to the cognitive resources required for processing sensory-rich modalities, navigating virtual environments, and experiencing presence (Barreda-Ángeles et al., 2020; Pjesivac et al., 2022). Processing information from a multimodal environment requires more cognitive resources, as each modality adds perceptual information to be processed, limiting the capacity for systematic processing (Fisher et al., 2019). Furthermore, the visual immersion facilitated by one mode, such as a 360° view and interaction possibilities, might impede attention to information conveyed via a different mode, such as audio. However, most factual information in 360° news is presented via audio rather than visuals (Barreda-Ángeles et al., 2020). Incorporating interactivity in IJ likely increases the cognitive demand on users (Bowman, 2021), adding to the challenge of remembering factual information provided in a voiceover. Studies suggest that VR interactivity indeed negatively influences factual knowledge gain via embodied learning (Petersen et al., 2022). Thus, highly interactive IJ is likely not beneficial for learning facts:

H1: Interactivity in IJ decreases factual recall.

Interaction possibilities in journalistic storytelling reflect a power struggle for narrative control; journalists are wary of losing their role in contextualizing events (Peters & Witschge, 2015). Journalists report concerns related to interactivity in IJ, as it increases users' control over their information intake, which may lead users to focus on a story's specific viewpoints while disregarding others (Mabrook, 2021). The fear is that interactivity in IJ could result in a subjective understanding and takeaway from a news story, thus enhancing "user-induced subjectivity" (Aitamurto, 2019; Mabrook, 2021, p. 209). However, whether this tendency exists when consuming interactive IJ has, to the authors' knowledge, not yet been investigated empirically:

RQ1: How does more interactivity in IJ influence the main takeaways of the audience?

4. IJ and Its Novel Way of Informing Citizens

Arguably, evaluating whether citizens are better informed after experiencing IJ mainly based on understanding facts and their main takeaways falls short of considering that audio-visual immersive media are experienced and, consequently, remembered differently than, for instance, text (e.g., Sundar et al., 2017). The tendency to evaluate information intake based on facts relates to traditional ways of informing citizens, such as high-quality, text-based newspapers, as bringing about informed citizenship (Grabe & Myrick, 2016) as well as the aforementioned concept of the informed citizenry (Delli Carpini, 2000). However, as Grabe and Myrick (2016) argue, in a high-choice media environment where people increasingly consume often emotional (audio-)visual information (Newman et al., 2023), we should conduct research on the informational value of visuals. A similar debate evolves from the emotional turn within which IJ is set, where the informational value of emotions is highlighted (Bas & Grabe, 2015; Wahl-Jorgensen, 2020). In IJ, investigating how visuals are remembered is even more important when considering that factual information in IJ is often transmitted via audio, while users are visually and bodily immersed in the news experience (Barreda-Ángeles et al., 2020). However, previous research indicates that visuals are more likely to be remembered when visual and audio stimuli are presented simultaneously (Lang et al., 1999). Arguably, as IJ exemplifies an experiential, modal-rich account of the news that users experience much closer to how they perceive reality than a traditional news format (Sundar, 2008), it has *novel ways of informing citizens*. We need different measures and perspectives evaluating IJ's potential to be remembered.

This notion is also reflected in discussions surrounding IJ's additional information layer. For instance, remembering IJ can be understood as a form of prosthetic memory: Media "functions as a kind of stand-in for real experiences that nonetheless bears a lasting impact recalled as if the individual were physically present" (Dowling, 2022, p. 918). Schlembach and Clewer (2021) suggest that eliciting prosthetic memory is central to assumptions about VR's potential power: Factual knowledge seems insufficient as the aim for serious VR experiences, and individuals instead need to be "made to feel" potentially terrifying experiences to elicit societally beneficial outcomes. Kool (2016) broadly agrees with this in their analysis of the 360°, documentary-style production *Clouds Over Sidra*, highlighting that by remembering a VR experience as if it happened to oneself, the experience "becomes a personally relevant lived experience" (p. 6). Importantly, not all IJ experiences are produced with the aim of eliciting such a personally relevant experience. While some, such as character-led first-person experiences, are produced with the intention to let the audience witness a news event as if they were there, others are produced with the intention to lead a passive audience through a news story, such as reporter-led narratives (Jones, 2017; Nyre & Vindenes, 2021). Regardless of these differences in production, the inclusive and interactive nature of IJ might still be remembered by the audience as a form of prosthetic memory.

Relatedly, psychologists are interested in examining to which extent memory can be experimentally investigated in VR. These studies indicate that VR experiences can indeed be remembered in the form of episodic and autobiographic memory (Smith, 2019). Episodic memory was originally defined as remembering "information about temporally dated episodes or events, and temporal–spatial relations among these events" (Tulving, 1972, p. 385). More recently, episodic memory has also been found to encompass a "sense of self-awareness and a subjective conscious experience" (American Psychological Association, 2023b). Studies evaluating VR environments find visual fidelity (Wallet et al., 2011) and active navigation (Ruddle et al., 2011; Sauzéon et al., 2012) to be positively related to episodic memory. However, while certain forms of interactivity, such as active choice in navigation, might improve episodic memory, other forms, such as including highly complex motor control, might lead to worse episodic memory, likely due to the high cognitive burden placed on individuals in those conditions (Plancher et al., 2013). Moreover, much literature focusing on the impact of interactivity on episodic memory lacks the inclusion of a passive experimental condition, resulting in calls for studying this phenomenon with a non-interactive condition (Smith, 2019). Autobiographic memory is "a memory of a personally experienced event that comes with a sense of recollection or reliving" (Greenberg & Rubin, 2003, p. 688). It includes self-referential processing in remembering events (Cabeza et al., 2004), which often encompasses a reliving of emotions and recalling spatiotemporal contexts in contrast to episodically recalling laboratory contexts (Svoboda et al., 2006). Autobiographic memory can encompass information that is stored as both episodic and semantic memory (American Psychological Association, 2023a). While videos shown in laboratory settings are remembered as isolated episodic events, VR experiences tend to be recollected in an autobiographic manner (Kisker et al., 2021b; Schöne et al., 2019). As a consequence, such VR experiences seem to elicit real-life behavior, such as anxiety and physiobiological responses in a height exposure experiment (Kisker et al., 2021a).

Thus, while it seems likely that VR experiences aiming to recreate a realistic environment result in a form of visual episodic or autobiographic memory encoding, IJ may be different. IJ differs from psychological stimuli in that it typically entails clear signs of journalistic mediation, such as narrators and sources, and their interaction possibilities rarely change the outcome of an IJ story (S. Wu, 2023). In addition, the most common form of IJ encompasses 360° videos with high journalistic narrative control, therefore focusing on storytelling and

limiting realistic exploration (Rodríguez-Fidalgo & Paíno-Ambrosio, 2022). Therefore, this assumption has yet to be tested for journalism:

H2: Interactivity in IJ results in more episodic and autobiographic memory encoding.

5. IJ and Evaluation of Information

It is also crucial to assess users' perceptions of the information and their information intake in IJ to enhance the evaluation of IJ's potential impact and effectiveness in informing citizens, as they can substantially impact the formation of attitudes and behaviors (e.g., Grabe & Myrick, 2016; Pilditch et al., 2020; Schäfer, 2020). One crucial perception relates to credibility evaluation—that is, is the information presented perceived as accurate, plausible, and authentic? Following the MAIN theory (Sundar, 2008), the "realism heuristic" suggests that the more realistic and close-to-life a message is conveyed, the more users evaluate it as credible. Indeed, 360° videos are evaluated as more credible (Kang et al., 2019) and trustworthy (Sundar et al., 2017) than normal videos. Additionally, more interactive IJ is evaluated as more accurate than its non-interactive counterparts (H. Wu et al., 2021). Credibility evaluations are related to belief uptake, regardless of whether the information presented is factually correct or not (Pilditch et al., 2020). Paradoxically, interactivity might simultaneously create a perception of accuracy while potentially resulting in a more fragmented understanding, rendering interactive IJ de facto less accurate (Aitamurto, 2019).

Another approach to evaluating whether participants feel their experience was comprehensive—specifically relevant for IJ—is the fear of missing out (FOMO). For VR, FOMO refers to individuals feeling that they are missing important information at their virtual backside due to the omnidirectional view (Aitamurto et al., 2018). Indeed, participants seem to experience more FOMO after experiencing 360° videos than normal videos (Aitamurto et al., 2018), which could mean that the experience is perceived to be less comprehensive. Adding more interactivity could thus facilitate the FOMO experience.

Furthermore, IJ's immersive audio-visual nature might result in an increased perceived knowledge gain, which could indicate an illusion of knowledge (Schäfer, 2020). Brucks (1985) differentiates between objective and subjective knowledge, where objective knowledge refers to the extent to which individuals identify factually correct information, while subjective knowledge refers to the extent to which individuals assess how much they know about a given topic. As such, an illusion of knowledge can be defined as the difference between low factually correct knowledge about a topic and high perceived knowledge about a topic (Kim, 2019). The reason why a higher range of interactivity in IJ might elicit an illusion of knowledge is linked to the processing fluency theory, which shows that the more fluently information is processed, the more it tends to increase perceived knowledge but not actual knowledge (Frauhammer & Neubaum, 2023). The cognitive load of simultaneously encoding perceptual information from different modalities means that modal-rich formats might not undergo thorough processing (Fisher et al., 2019), which might be responsible for lower factual information retention. Rather, they tend to be processed automatically and more fluently, thereby facilitating perceived knowledge (Sundar et al., 2021). Processing fluency is increased when audio-visual modalities are used (Ryffel & Wirth, 2020). Indeed, interactivity in immersive environments has previously been found to increase perceived but not actual knowledge gain (Aitamurto et al., 2020). A higher range of interactivity might increase cognitive load and, thus, be processed more fluently, leading to perceived knowledge gain:

H3: Interactivity in IJ increases perceived credibility;

H4: Interactivity in IJ increases FOMO;

H5: Interactivity in IJ increases perceived knowledge gain.

6. Method

A laboratory experiment ($N = 149$) was conducted with one IJ experience varying along a range of interactivity (Steuer, 1992, p. 104). Interactivity can be differentiated along its range, which means that "the greater the number of parameters that can be modified, the greater the range of interactivity" (p. 104). The IJ experience (Figure 1) *Hanen's Story* about a Syrian family in a Greek refugee camp, produced by Wiener Zeitung and Junge Römer, was used as a stimulus. In the no-interactivity group ($n = 52$), participants viewed a video. In the medium-interactivity group ($n = 45$), participants experienced a 360° video, enabling omnidirectional view exploration. The high-interactivity group ($n = 52$) viewed the same 360° video but with a map of the refugee camp, which participants could use to navigate through the scenes. As such, each manipulation of interactivity adds new parameters that can be influenced by the users, thus corresponding to the range of interactivity as defined by Steuer (1992). The duration of the experience in the no- and medium-interactivity conditions was 5 minutes and 25 seconds; the high-interactivity experience took $M = 7$ minutes ($SD = 1.7$ minutes). All conditions were shown through a Meta Oculus Quest 2.

Participants completed a comprehensive health screening, provided informed consent, and were familiarized with the equipment. Then, they completed a questionnaire covering control variables and were randomly assigned to one of the three treatment conditions. After the IJ experience, participants answered an extensive questionnaire. At the end, participants received a reward of 15 EUR. Data were collected from 06.06.2022 to 30.09.2022 as part of an extensive data collection project on IJ, which was approved by the institutional review board of the University of Vienna (IRB 20220427_016). The power analysis, data analysis plan, survey questionnaire, hypothesis, and stimulus were pre-registered for the full project; the dataset, R-scripts, and Appendix are also made available on OSF (https://osf.io/x2wbz/?view_only=14daacf13d104f02abf010951913f23b); alterations from pre-registration are listed in Appendix E.

Figure 1. Screenshots of stimulus material: (a) no interactivity; (b) high interactivity; (c) beginning scene of the experience.

6.1. Measures

Cued recall was tested with seven multiple-choice questions, each presenting three incorrect and one correct choice (Bujić et al., 2023; Sundar et al., 2017). This is a common approach used within the LC4MP literature to test information storage (Fisher & Weber, 2020). All questions referred to information provided in a voiceover. The final measure is the overall correct score of the answers, ranging from 0 (*no answer correct*) to 7 (*all answers correct*; $M = 5.27$, $SD = 1.06$).

To assess the participants' main takeaways, open responses to the following question were collected: "What was the main takeaway from the production you just saw?" The lead author conducted inductive thematic analysis (Clarke & Braun, 2014) on the answers. Inductive coding was conducted until theoretical saturation was reached—i.e., when 10% ($n = 15$) of cases failed to generate a new code—at $n = 71$. Seven themes were identified. Appendix B (Table 14) presents a detailed description of each theme, including references to the stimulus text.

To test autobiographical memory, following Kisker et al. (2021a, 2021b), participants sorted 12 pictures—six correct and six incorrect (see Appendix C)—along the remember/know paradigm (Kisker et al., 2021c; Tulving, 1993), where remembering refers to a conscious recollection of knowledge, indicating autobiographic memory, and knowing refers to knowledge that is familiar, but not consciously retrieved (Tulving, 1993). Participants sorted visuals as being "definitely unknown," "rather unknown," "familiar," or "vividly remembered" (Kisker et al., 2021c). The six correct pictures were screenshots of the stimulus, while the six incorrect pictures were screenshots of another video shot on the same day in the same refugee camp, depicting similar scenes. The performance measures are calculated as a d' (prime) score (Haatveit et al., 2010). A participant's performance in a task improves when they maximize hits and minimize false alarms. A positive d′ suggests that performance is better than chance (Haatveit et al., 2010). A general retrieval score is calculated as d'-general retrieval score = z(vividly remember hits + familiar hits) − z(vividly remember false positives + familiar false positives). The recollection score indicates "recollection-based judgments," typically related to autobiographic memory retrieval (Kisker et al., 2021b), calculated as d'-recollection score = z(vividly remember hits) − z(vividly remember false positives). The familiarity score indicates judgments related to the know part of the remember/know paradigm (Tulving, 1993), calculated as d'-familiarity score = z(familiarity hits) − z(familiarity false positives).

As episodic memory includes the temporal encoding of information (Tulving, 1993), participants were asked to sort the six correct visuals from the previous task in the order they encountered them during the experience (Wallet et al., 2011). Following previous literature (e.g., Ruddle et al., 2011), the Levenshtein distance algorithm was calculated to indicate the minimum number of edits required to correct the sequence (Levenshtein, 1966). The score ranged from 0 (*no alignment with correct order*) to 6 (*perfect alignment with correct order*; $M = 2.36$, $SD = 1.50$).

Credibility was measured using six items based on Kang et al. (2019), measured on a scale from 1 (*do not agree*) to 7 (*strongly agree*; $CA = .745$; $M = 5.00$, $SD = 1.02$; Mcgrath & Gaziano, 1986). FOMO was tested with a three-item scale based on Aitamurto et al. (2018), from 1 (*do not agree*) to 7 (*strongly agree*; $CA = .694$; $M = 2.85$, $SD = 1.43$). Three items testing perceived knowledge gain were included (Aitamurto et al., 2020; Kim, 2019), measured on a scale from 1 (*do not agree*) to 7 (*strongly agree*; $CA = .795$; $M = 4.62$, $SD = 1.40$).

Extensive quality checks (a-priori pre-registered power analysis, attention checks, randomization checks) were conducted and are reported in detail in Appendix F. In line with Steuer (1992), who argues that "interactivity is a stimulus-driven variable, and is determined by the technological structure of the medium" (p. 104), the differentiation between the experimental groups is based on concrete technological functionalities, not on the subjective evaluation of interactivity by participants; thus, no manipulation check is conducted (also see O'Keefe, 2003). Nonetheless, see Appendix F for an analysis of the impact of interactivity in IJ on the sense of agency and sense of presence. The analysis included 149 participants; the average age was 26.76 (SD = 10.12), and 54.4% were female. The majority had completed their Matura (Austrian equivalent of A-Levels, 39.6%), followed by bachelor's (23.5%), master's (16.1%), practitioners' Matura (10.1%), other education (3.4%), and PhD (2.7%). Randomization checks were successful for all variables aside from familiarity with VR; thus, familiarity is added to all analyses as a control variable. Appendix D reports analyses without familiarity as a control; the results remain largely the same.

7. Results

Ordinary-Least-Squares regressions were conducted to test the pre-registered hypotheses. Groups were dummy-coded (0 = *less interactive*, 1 = *more interactive version*).

7.1. H1 and RQ1: Factual Information Retention and Main Theme

H1 assumes that the higher the interactivity range, the less factual information participants remember. The results show no significant effect of the three experimental conditions on recalling facts (Appendix A, Table 6). Thus, IJ interactivity does not negatively influence cued recall. H1 is rejected.

RQ1 examines the influence of interactivity in IJ on the main theme perceived by the audience. Overall, the order in which participants encountered information seems to influence what they assessed as the story's main theme. In the no-interactivity condition, individuals tended to derive their theme from the last third of the story. In the medium-interactivity condition, participants tended to show a less rigid connection to the narrative's chronological sequence, focusing on the story's early and late segments. Meanwhile, in the high-interactivity condition, main themes tended to be phrased generally, instead of reiterating specific story segments. Emerging themes in the high-interactivity condition tended to relate to refugee camp life and a sense of instability. Notably, participants in the high-interactivity condition seemed more inclined to include their own interpretation in defining the main theme, rather than reiterating or summarizing what the story directly addressed. This might suggest that the impressions individuals derive from highly interactive experiences are less organized, more abstract, and more influenced by their existing predisposed viewpoints.

7.2. H2: Episodic and Autobiographical Memory

H2 assumes that more interactivity in IJ means that participants are more likely to remember IJ as part of their episodic memory, as well as autobiographical memory. Recalling the experience in temporal order was measured as an indicator of episodic memory. Data analysis indicates no significant difference between the high-, medium-, and low-interactivity conditions (Table 1), suggesting no episodic memory retrieval when considering episodic memory's temporal aspect.

Table 1. Influence of IJ interactivity on episodic memory (sorting task), general visual retrieval, recollection score, and familiarity score.

	Episodic memory	General visual retrieval	Recollection score	Familiarity score
	B (*SE*)	B (*SE*)	B (*SE*)	B (*SE*)
High-interactivity (no-interactivity)	.341(.296)	.546^{+}(.314)	−.046(.252)	.592^{+}(.304)
High-interactivity (medium-interactivity)	.059(.339)	−.010(.318)	.057(.293)	−.066(.295)
Medium-interactivity (no-interactivity)	.263(.287)	.548^{+}(.289)	−.084(.281)	.632(.285)*
Num.Obs.	104/97/97	104/97/97	104/97/97	104/97/97
R2	.014/.001/.014	.056/.052/.066	.003/.003/.009	.052/.041/.057
R2 Adj.	−.005/−.020/−.007	.038/.032/.046	-.016/-.018/-.012	.034/.020/.037

Notes: $^{+}$ $p < .1$; * $p < .05$; ** $p < .01$; *** $p < .001$; control on familiarity with VR.

Moreover, there is no difference between the high-, medium-, and low-interactivity conditions in the general visual recognition performance task (Table 1). However, the marginally significant results suggest that the medium- and high-interactivity conditions might result in better overall visual retrieval than the no-interactivity condition. The Mahalanobis distance indicates two strong outliers (*M-distance* = 14.267, 11.128). When excluding these, the difference between medium- and no-interactivity approaches marginal significance ($b = .569$, $p = .053$), and the difference between high- and no-interactivity becomes significant ($b = .664$, $p = .031$).

Furthermore, when breaking down the visual recognition score into recollection (i.e., autobiographic) and familiarity components, the data indicate that the visuals in medium-interactivity ($b = .632$, $p = .029$) and, marginally, the high-interactivity ($b = .592$, $p = .054$) condition tend to more likely trigger familiarity responses than in no-interactivity. However, there is no difference between high-interactivity and medium-interactivity conditions. The conditions also do not significantly affect recollection-related retrieval (i.e., autobiographic memory). Overall, these findings suggest a tendency of visuals to be better recognized in the medium- and high-interactivity conditions, indicating a form of personal involvement (Schöne et al., 2019). However, the increased performance does not seem to rely on autobiographical memory encoding, as indicated by the non-significant recollection score, but rather on familiarity-based knowing. A similar pattern for the familiarity score can be found in Kisker et al. (2021b), even though in that study the pattern appears for the computer-condition in contrast to the VR-condition. Consequently, our results could indicate that more interactivity in IJ might be remembered in a superficial episodic manner similar to computer-based psychological treatments rather than VR-based psychological treatments. H2 is partially accepted.

7.3. H3, H4, H5: Credibility, FOMO, Perceived Knowledge Gain

Against theoretical expectations (Sundar, 2008), increased interactivity does not result in more credibility (Table 2). H3 is rejected.

H4 assumes that more interactivity increases FOMO. In the medium-interactivity condition (M = 3.26, SD = 1.44), participants experienced significantly more FOMO than for both no-interactivity (M = 2.51, SD = 1.39; b = .756, p = .012) and high-interactivity (M = 2.78, SD = 1.36; b = –.567, p = .048). There is no difference between the high- and no-interactivity conditions. In the 360° experience, participants might be more aware of options they cannot access compared to the no- and high-interactivity conditions, increasing their perception of not getting a comprehensive view. H4 is partially accepted.

H5 hypothesizes that participants with more interaction possibilities have higher perceived knowledge gain. Indeed, both high-interactivity (M = 4.94, SD = 1.42; b = .723, p = .016) and medium-interactivity (M = 4.74, SD = 1.13; b = .590, p = .037) result in more increased knowledge perception than no-interactivity (M = 4.18, SD = 1.50). There is no significant difference between the high- and medium-interactivity conditions. H5 is partially accepted.

Table 2. Influence of IJ interactivity on credibility, FOMO, and perceived knowledge.

	Credibility	FOMO	Perceived knowledge
	B (*SE*)	B (*SE*)	B (*SE*)
High-interactivity (no-interactivity)	.105(.205)	.191(.277)	.723(.295)*
High-interactivity (medium-interactivity)	.052(.215)	–.567(.284)*	.204(.265)
Medium-interactivity (no-interactivity)	.114(.207)	.756(.293)*	.590(.280)*
Num.Obs.	104/97/97	104/97/97	104/97/97
R2	.019/.007/.004	.023/.059/.89	.068/.008/.046
R2 Adj.	.000/–.014/–.017	.004/.039/.069	.050/–.013/.026

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$; control on familiarity with VR.

8. Conclusion

This study investigated how IJ might contribute to journalism's aim of informing citizens. Results indicate that, concerning traditional approaches, interactivity in IJ does not affect factual recall; however, qualitative data analysis suggests it is related to higher subjectivity in the main takeaways. Regarding novel ways of informing citizens, high interactivity in IJ tends to enhance performance in a visual recognition task and result in familiarity-based remembering, indicators for shallow episodic memory retrieval (Kisker et al., 2021b). The findings further suggest interactivity in IJ might result in an increased illusion of knowledge, i.e., a gap between factual and perceived knowledge gain (Kim, 2019). Together, this suggests that IJ might not be suited to informing citizens about facts but is suited for communicating experiences to individuals with the aim of being remembered as if one were there.

While participants in the medium- and high-interactivity conditions did not recall more information (see Barreda-Ángeles et al., 2020; Bujić et al., 2023), they thought they knew more than those who only saw a video (see Aitamurto et al., 2020), resulting in a gap between factual and perceived knowledge gain, which can be interpreted as indicating an illusion of knowledge (Brucks, 1985; Schäfer, 2020). An illusion of knowledge is often related to democracy-related negative consequences, such as not being better informed about a topic but showing an increased willingness to discuss an issue and taking on more extreme viewpoints (Schäfer, 2020). Rather than addressing superficial knowledge intake, IJ could exacerbate the illusion of knowledge trend also seen in other media environments (Schäfer, 2020). However, the perceived knowledge in IJ might relate to knowledge aspects that are not factual. For instance, the findings suggest that participants in the medium- and high-interactivity conditions tend to perform better on a visual recognition task. Consequently, future studies should aim to identify whether a perceived knowledge gain in this context indicates an illusion of knowledge or whether it could relate to other forms of understanding, such as visual comprehension or process-related knowledge.

Second, this study partially confirms the credibility paradox presented by Aitamurto (2019) from an effects perspective. The paradox outlines that while the audience might perceive them as more accurate (see Kang et al., 2019), interactive possibilities might result in more subjective takeaways, thereby making the experience de facto less accurate. Concerning its first premise, our results, in line with more recent findings (Greussing, 2020; Weikmann et al., 2024), indicate that medium- and high-interactivity IJ videos are not perceived as more credible than normal videos. These results question the assumption that more modally rich media are more credible (e.g., Sundar, 2008). Concerning the paradox's second premise (Aitamurto, 2019), the results indicate that individuals might have a more subjective takeaway when controlling their experience's linearity. Thus, journalists' concerns about providing the audience with too much narrative control (Mabrook, 2021) might be justified.

Third, the visual performance tasks indicate that participants, in contrast to psychology findings (Kisker et al., 2021c; Schöne et al., 2019), might not have encoded the IJ experience as autobiographical memory but more likely tended to encode it as a shallow form of episodic memory that is typically associated with computer-based laboratory experiences (Kisker et al., 2021b). IJ is different from psychological stimuli in that the most common formats of IJ typically carry markers of its journalistic mediation (e.g., S. Wu, 2023), thus differentiating it from psychological VR experiences, or IJ experiences with the aim of creating a witnessing experience (Nyre & Vindenes, 2021). However, a different immersive journalistic stimulus than used in the conducted experiment, which is aimed at re-creating an event as it happened, without strong journalistic mediation, and including high-fidelity audio, might be remembered as a form of autobiographic memory (Davis et al., 1999). Therefore, this finding requires future, iterative research focused on diverse formats of IJ, as the question of how IJ is remembered might be important to inform ethical debates (Schlembach & Clewer, 2021). Beyond ethical considerations, in the current foreshadowing of a potential metaverse, it is crucial to investigate further what consequences such an episodic form of memory encoding might have for democratic processes. For instance, episodic memory induction can facilitate risk-taking when making decisions (St-Amand et al., 2018). How might this be related to political decision-making?

This study comes with limitations. First, it is difficult to disentangle the effect of interactivity vs. inclusive technology between the no- and medium-interactivity experimental conditions, as an increase in navigational interactivity also requires an increase in inclusive technology. Second, the findings concerning

autobiographical and episodic tendencies to remember an IJ story should be tested with different stimuli and larger sets of visual sorting to ensure their robustness. Moreover, psychological studies often assess autobiographical recollection 24 to 48 hours post-experience (Kisker et al., 2021b), which was not feasible for this study. Third, the study represents a single-message design; thus, it cannot assess whether the effects remain robust beyond the particular topic (Thorson et al., 2012). Therefore, this study should be replicated with several topically diverse stimuli, and a more diverse sample concerning age and educational backgrounds. Future studies should also include a broader objective knowledge quiz that goes beyond measuring factual recall to assess an illusion of knowledge. In addition, a follow-up on this study could test whether the results on the illusion of knowledge are indeed related to cognitive demands, as suggested in prior literature (Barreda-Ángeles et al., 2020; Pjesivac et al., 2022).

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Conflict of Interests

The authors declare no conflict of interests.

Data Availability

The pre-registration, as well as the Appendix, questionnaire, datasets, and R-scripts can be found on OSF as part of the larger project on immersive journalism here: https://osf.io/x2wbz/?view_only=14daacf13d104f02abf010951913f23b

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About the Authors

Hannah Greber is a postdoctoral researcher at the University of Vienna and part of the Political Communication Research Group. Her research explores the implications of emerging technologies and novel forms of news reporting for political communication.

Loes Aaldering is an associate professor in comparative politics at the Department of Political Science and Public Administration of VU Amsterdam. Her research mainly focuses on issues related to gender and politics, political leadership, political representation, and electoral behavior.

Sophie Lecheler is a professor of political communication at the University of Vienna, Austria. Her research focuses on political journalism, digitalisation and politics, emotions, and experimental research methods.