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Virtual Reality, 360⁰ Video, and Journalism Studies: Conceptual Approaches to Immersive Technologies

A growing number of newsrooms are experimenting with Virtual Reality (VR) and other immersive storytelling techniques, typically supported by technology companies that see journalism as a potential vehicle for taking VR mainstream. The resulting pieces have been wide-ranging in topic, style, and scope, but all introduce new complexities to journalistic norms and practices. To date, however, journalism studies scholars have conducted relatively little research into these immersive technologies. This essay proposes three conceptual approaches to examining VR journalism: Actor-Network Theory, normative theory, and a sociological perspective on journalistic work.

Driven in part by curiosity and in part by a desire to explore new opportunities for audience engagement and revenue generation, a growing number of major news organisations are experimenting with Virtual Reality (VR) and other immersive technologies such as 360⁰ video (Watson 2017). These experiments have been wide-ranging, from sophisticated data visualisation, as in the *Wall Street Journal*'s "roller coaster" VR about the Nasdaq index[1], to the provision of emotionally compelling user experiences, such as the *Guardian*'s "6x9" piece on prison life in solitary confinement[2]. Some have relied on actual footage, such as a BBC 360⁰ video placing users inside an Iraqi helicopter firing on ground targets in Mosul.[3] Others have created fictionalised narratives based on news events; another *Guardian* piece used an imaginary monologue written by novelist Khaled Hosseini to construct a story around the Kurdish boy who drowned as his parents fled to freedom.[4]

As technological developments have propelled journalistic VR out of university labs and research institutes, experimentation has blossomed. Today, 360⁰ videos can be produced with little technical expertise, using relatively inexpensive cameras, and posted on Facebook or YouTube, allowing pieces to go viral as well as dramatically cutting their delivery cost. The more technically complex VR is becoming widely available via Google Cardboard, which news organisations such as the *Guardian* and *The New York Times* have provided free to their members or subscribers. Meanwhile, the cost of headsets that deliver an even more realistic experience continues to fall.

The time is ripe, then, for journalism studies scholars to engage with the implications of this immersive, multi-faceted, and emotionally compelling innovation for the product and practice of journalism. Many conceptual approaches likely will prove fruitful, but this essay focuses on three, each enabling researchers to explore particular aspects of VR and associated

technologies. Actor-Network Theory offers a way to interrogate the nature of this technology as a journalistic device, as well as the agency of diverse actors involved in its production and consumption. Normative theory addresses the challenges posed by immersive video to journalistic understandings of how news work *should* be done. And sociological approaches, which explore how such work actually *is* done, facilitate examination of how VR meshes with broader trends toward experimentation and collaboration.

We start with a brief overview of two prominent forms of immersive video technology, focusing on their application to journalism. We then consider each of our three approaches in turn, outlining its connection to VR journalism before suggesting questions that may help guide future research. Our purpose in this essay is to generate thought and discussion about opportunities that can lead to a deeper and more nuanced collective understanding of this powerful and rapidly developing form of journalistic storytelling.

Journalism, Virtual Reality, and 360⁰ Video

Virtual Reality immerses its users within a three-dimensional narrative environment characterised by vividness and interactivity, eliciting a sense of presence or concrete existence within the constructed world (Bryson 2013; Lelyveld 2015; Steuer 1992). This sense of presence is both subjective and objective: Users *feel* themselves to be inside the virtual environment and *behave* as if they were really there (Sirkkunen et al. 2016). For example, users of an early experiment with journalistic VR, about hunger in Los Angeles, responded physically when a virtual character collapsed whilst in line for a food bank, kneeling on the ground and "trying to comfort the seizure victim, trying to whisper something into his ear or in some way help him" (de la Peña 2015, 04:01).

However, the technological expertise required to create true VR is considerable, and the necessary hardware and software are complex, costly, and continually evolving. Few news organisations today are able to produce high-end VR journalism solely in-house; instead, they are partnering with technology companies such as Google and Samsung, as well as obtaining post-production help from specialised studios (Watson 2017). To take just one example: VR video must be shot using multiple cameras, with the results then digitally stitched together to create a seamless user experience. This time-consuming process requires collaboration amongst cross-disciplinary teams that include journalists, programmers, other technical specialists, artists, and motion graphic designers (Owen et al. 2015).

In fact, most of what has been labelled VR journalism really is something else: 360⁰ video. This technology is less responsive, less interactive (Conroy 2016), and especially if viewed on a smartphone, far less immersive (Watson 2017) – but also a lot easier to create and consume. The 360⁰ format enables users to look in every direction, thus placing them "inside" an environment. Some say that although it can be cool and even emotionally impactful, it is essentially just a new form of filmmaking: "Just like hoverboards that don't actually hover, everything you view in … VR headsets is not necessarily 'virtual reality'" (Goldman and Falcone 2016, para.1). But others say the creation of spatial presence means 360⁰ should be considered a form of VR (Bryson 2013), especially because of its ability to elicit powerful emotions in the user, who feels surrounded by the content.

Such definitional disputes aside, journalists across a growing number of news organisations are learning to produce 360⁰ footage, typically with a central, multidisciplinary team taking things from there (Watson 2017). Enterprising news organisations therefore tend to see it as a gateway to full VR production (ibid.), and consumers often will have their initial "VR" news experiences via this format (Goldman and Falcone 2016). For our purposes in this essay, we found it useful to incorporate both formats in our consideration.

At a theoretical or conceptual level, perhaps the most distinctive feature of immersive video formats, particularly true virtual reality, is their affordance of agency to the user. Since the advent of the Web browser in the 1990s, journalists have been steadily losing control as erstwhile gatekeepers over the creation and dissemination of news content. Virtual reality takes this ongoing evolution a big step forward. User agency is a defining characteristic of VR, which gives users both real and perceived control over, and responsibility for, actions to which the system then responds. This agency can take various forms, from influence over a sequence of pre-scripted occurrences to the creation of wholly new events (Kim 2016). In other words, users can affect how the story is told, what happens within it, and how it ends. A news story has a beginning, middle, and end, all determined by journalists; VR is instead an experience described as "storyliving," in which users embody virtual characters, explore virtual space, and make sense of their own experience within that space (Maschio 2017).

Nonetheless, news organisations have been excited by the potential of VR to "transport viewers to places and events – to understand the world in new ways" (Watson 2017, 7). Building on the enthusiasm of such pioneers as Nonny de la Peña, who described how VR journalism can enable audiences to explore the "sights and sounds and possibly the feelings and emotions that accompany the news" (de la Peña et al. 2010, 292), journalists have tackled a wide range of visually and emotionally compelling topics. A number of these experiments are highlighted in the discussion below. Some are animations, such as the BBC's exploration of human trafficking[5]; the Associated Press' journey inside the brain of an Alzheimer's patient[6]; or Al Jazeera's look at long-term effects of an oil spill on a Nigerian community, produced in collaboration with Contrast VR[7]. Others use video, for instance to explore human interactions with the natural environment, as in the *Economist*'s piece on the coral reefs of Palau[8] or *The New York Times*' VR documentaries of some of the hottest and coldest places on Earth.[9] Others have sought to put users inside another person's skin, exemplified by two quite different *Guardian* pieces, one in which we experience solitary confinement in a tiny prison cell[2] and another in which we relive the first year of life through an infant's eyes.[10]

Even this small sample indicates the capabilities, challenges, and complexities inherent in immersive storytelling. The rest of this essay expands on these ideas to explore some of the ways we as journalism scholars might begin to build our conceptual understanding of these new forms of journalism.

Actor-Network Theory

Actor-Network Theory (ANT), which originated in poststructuralist French debates around the sociology of science and technology, offers insights into how things occur and, in particular, the nature of agency (Muniesa 2015). ANT examines a phenomenon of interest by tracing its components and uncovering their interrelations (Latour 2005). It foregrounds the study of social groups as actor-networks, a net of relationships in which each entity has a contingent position subject to change depending on what others do (Weiss and Domingo 2010). In line with a broader call for a consideration of the objects of news-making (Boczkowski 2015), ANT has been highlighted as a useful way to incorporate the role of technology in considerations of changing newsroom culture and practice without falling into the trap of technological determinism. It emphasises relationships rather than giving primacy to either people or their tools (Plesner 2009).

Indeed, ANT is perhaps best known for its eradication of theoretical distinctions between humans and non-humans, as well as between far/near, inside/outside, and large/small components of a given phenomenon (Latour 1996). ANT views all relevant components as actors, each exercising a level of agency (Latour 2005) and each holding comparable power

(Law 2008). Whether or not they possess behavioural intentionality, all actors have the ability to promote, permit, or restrict outcomes (Sayes 2004).

ANT thus offers the flexibility to devote attention to every actor involved in the generation of VR journalism – including the technology itself, as scholars advocating a turn toward a socio-technical emphasis in the study of news production have urged (Anderson and Kreiss 2013; Lewis and Westlund 2015). To take just one example, different forms of immersive video require different viewing apparatuses, which vary dramatically in cost, degree of interactivity afforded, and richness of the experience delivered to the user. A 360° video can be viewed from a computer screen or a smart phone, while high-end interactive VR requires a sophisticated (and expensive) headset (Lelyveld 2015). The technology thus is an agent that directly affects the product created and consumed by other agents, such as journalists or users.

Moreover, while journalism studies approaches typically foreground journalists' agency, VR intrinsically foregrounds the actions taken by users. Similar to the worlds of gaming – where a form of VR was widely used by the early1990s (Heisel and Roth 1991) – the experience of each user immersed in a journalistic VR narrative is contingent on what he or she does within the virtual space, affording agency far beyond that of reading or viewing a traditional journalistic piece. Users not only can manipulate the sequence of events but even, in higher-end forms of VR, inject themselves into the story, affecting subsequent options and actions (Kim 2016).

This ability for user agency to contradict journalistic authorship creates what Aylett and Louchart call a "narrative paradox" (2007, 117), with user engagement more important than the completeness or cohesion of a story (Maschio 2017):

> A significant formal shift from traditional storytelling mediums to VR is that "telling" is less central to a VR experience. The audience learns through engagement and embodiment, by entering into a scene, inhabiting a digital entity, and experiencing what it knows. Viewers experience the story as though they lived it (ibid., 9).

ANT, then, gives journalism studies scholars the flexibility to pay close attention to the agency of technology as well as users of that technology, and thus their impact on the content, structure, affordances, and experience of a "journalistic" VR narrative. The theory also opens opportunities for a fresh look at content producers, who must be broadly defined when the content being produced involves immersive technology. As already indicated and discussed further below, the technical complexity of VR all but necessitates the involvement of actors with backgrounds outside a newsroom, from developers to programmers to project managers. ANT fully engages consideration of a wide-ranging news network (Domingo, Masip, and Meijer 2015), inviting application of such theory-based dichotomies as near/far and inside/outside (Latour 1996).

Google funding, for example, has been integral to the development of VR and 360° video pieces at *El País* (Liñán, Alameda, and Galán 2017), the *Guardian*, and *The New York Times* (Southern 2017), as well as to academic experiments in immersive journalistic storytelling (E. Anderson 2017). ANT enables consideration of Google's role as an instigator and its influence – including technological and economic – on creation of a journalistic story.

One more point about ANT is worth a mention before offering some questions that this approach might profitably guide. ANT theorists view culture in a performative way: Culture is seen as a constructed product, an outcome of socialisation among multiple actors in the phenomenon of interest, and a guide for those actors' interrelationships (Entwistle and Slater 2014). ANT thus can provide a framework for studying the norms and practices that inform VR journalism without resorting to external explanation (Latour 2005). Research

guided by ANT will permit actors the freedom to demonstrate and explain how they perceive their work, their social or professional roles, and the standards by which they abide. In other words, seen through this prism, VR journalism culture is holistic, a composite informed by the experiences and understandings of journalists, technologists, marketers, project managers, and any other actors identified through practice or research.

What sorts of questions, then, might the application of Actor-Network Theory suggest for journalism studies scholars interested in the use of immersive technologies to create journalistic narratives? We offer three suggestions:

The role of technology: The application of ANT to VR journalism can usefully guide ongoing exploration of the ways in which technological change intersects with news work (Domingo, Masip, and Meijer 2015; Plesner 2009; Weiss and Domingo 2010). What role does the nature of immersive video technology play in decisions about story topics, content, production, and dissemination? To what extent do human producers and consumers shape their decisions to align with technological affordances? Are particular skills or areas of expertise being foregrounded because of these affordances; if so, how are the various human actors responding? At a more conceptual level, how might the nature of VR and associated technologies – including their extensive application in fields external to journalism, from gaming (Zyda 2005) to medical science (Satava and Jones 1998) – further our understanding of the interplay among actors in an complex media universe?

User agency: The immersive nature of these narrative forms represents a continuation in the shift of control over journalistic narratives to users and others outside the traditional newsroom. VR and 360⁰ video give users power not just to respond to journalistic content, as has been the case with earlier forms of "user-generated content," but also to actively shape the story and therefore their own experience of it. ANT thus offers a valuable way to explore changes to journalistic authority through a focus on the shifting power balance among networked actors. It also facilitates examination of the tension among these actors, including the ways in which journalists respond to the increased agency of those outside the newsroom. How do journalists perceive external actors, and how do those actors affect editorial decisions? In what ways is the narrative paradox (Aylett and Louchart 2007), described above, incorporated or otherwise accommodated in VR story construction? What levels of user agency or control over the story line will be most prevalent in journalistic VR, and to what extent will each user have the ability to craft a personal narrative? Indeed, a whole host of audience studies also open up under this approach, exploring user responses to and interactions with VR journalism and investigating how audience members make use of the agency afforded them.

The role of other human actors: As discussed further below, the production of immersive video involves many other actors outside the newsroom, including but not limited to technologists, creative industry workers, and marketers. ANT facilitates careful consideration of their roles and the ways in which they interact with and affect journalistic actors as well as users. Topical exploration might encompass effects on editorial decisions, the power dynamics among near/far human actors, and more broadly, their impact on the culture and consumption of journalism. Questions related to these issues can be explored from the perspective of journalists and non-journalists: How do various actors see themselves, and how do they see the other actors within the VR production network?

The application of ANT thus raises questions closely related to both normative and sociological understandings of journalism and the ways in which those understandings also may be affected by VR journalism. We next consider both of these approaches in turn.

Normative Theory: How Journalists Think about News Work

Journalism in democratic society has been characterized as an occupation whose practitioners gather, verify, and process factual information so that citizens can use it to make sound civic decisions (Kovach and Rosenstiel 2014). Throughout the 20th century and into the 21st, this occupational role has taken on some characteristics of a profession (Aldridge and Evetts 2003; Deuze 2005; Tumber and Prentoulis 2005), informed by normative ideals that point to responsible journalistic use of the freedom to publish. These include providing complete, honest, truthful, and fair information; acting freely and independently; being straightforward and transparent; avoiding harm; behaving with justness and honour; and respecting privacy (Hanitzsch 2007). American journalists, for example, are advised to seek and report truth, minimise harm, act independently, and be accountable and transparent (SPJ Code 2014). Press codes elsewhere offer variations on these themes. Truth-telling is often prominent, along with fairness and the safeguarding of free expression (Hafez 2002).

As journalism continually evolves, however, these normative understandings come under pressure. In the 21st century, steadily expanding capacities for interactivity, hypertextuality, and immediacy have changed the nature of journalism and challenged core principles embedded in ethics codes (Díaz-Campo and Segado-Boj 2015). Such norms as objectivity, accuracy, and independence have been described as "relaxing or expanding" in a digital age (Robinson 2007, 213), and immersive video journalism adds to the challenges.

Let's start with independence or autonomy. As already noted, the production of VR demands collaboration with a range of actors outside the newsroom, including not only external production houses but also the commercial side of the news organisation itself. Many experiments with VR have involved native advertising or other forms of branded content, which employ journalistic narrative conventions for commercial purposes (Carlson 2015). Leading news organisations such as *The New York Times*[11], the *Guardian*[12], and CNN[13], among others, have created whole divisions dedicated to producing such content with immersive video and other cutting-edge technologies (Watson 2017). These collaborations have the potential to breach the vaunted wall between editorial and commercial content. Although publishers are adamant that they take care to do nothing that might jeopardize their journalistic integrity, they also typically "employ the rhetoric of survival" in describing what they see as a need to create compelling content that appeals to advertisers and sponsors (Coddington 2015, 77).

The degree of user agency within the VR experience described above also impinges on journalistic autonomy and, potentially, on the accurate representation of real events. The surrender of narrative control affects not only the ability to structure a particular story in a particular way but also the ability to oversee the fidelity of the content underlying users' experience. The ability of high-end VR users to intervene with the narrative means they can shape the ensuing storyline in ways that may or may not correspond to external reality.

What, then, becomes of the journalist's paramount commitment to truthfulness? Some propose that VR and live-action 360° video amplify facticity because users can freely explore a scene, unconstrained by the frame of a narrator – or a journalist. Migielicz and Zacharia (2016) further argue that the formats enable users to discover or rediscover additional truths each time they engage with a VR piece. And some creators say that fictionalised versions of real people and situations are truthful at a deeper level than everyday journalism and can offer a story "that you can remember with your entire body, not just your mind" (de la Peña 2015, 00:12).

Such sentiments echo those of writers of narrative or "literary journalism." These practitioners have long relied on fictionalised accounts to connect facts with feelings (Greenberg 2011), with reporters piecing together past events through documents, eyewitness

accounts, and similar reconstructive devices (Frank 1999; Lorenz 2005). Such journalists typically have relied on transparent disclosure of their sourcing to try to address audience concerns about just why all those details should be trusted (Lorenz 2005). In VR, the use of text or graphic cues to remind users of the edited nature of the experience can be seen as an application of this approach, though it comes at the cost of destroying the illusion of an unmediated environment (Elmezeny, Edenhofer, and Wimmer 2018).

Although transparency and, more broadly, the careful management of user expectations (Greenberg and Wheelwright 2014) may prevent reconstructions from being deceptive, critics still maintain that stories drawing on emotion and personal experience are antithetical to quality journalism and its commitment to truth grounded in real-world facts (Kormelink and Meijer 2015). In this view, reporters are truth-tellers rather than storytellers who might not "shy away from intervening with reality" to create compelling tales (Boesman and Meijer 2018, 1004). Indeed, as early as the 1990s, researchers were exploring the use of virtual elements to supplement users' experience of a real environment (Hollerer, Feiner, and Pavlik 1999); contemporary VR iterations range from music, used to convey mood in a way similar to documentary films, to the incorporation of composite characters or imagined scenes. An example is the *Guardian*'s "Sea Prayer" 360º video, referenced at the start, in which a novelist created an illustrated narrative inspired by the plight of refugees.

Proponents, however, see such literary techniques as affective and effective ways of telling a larger truth by evoking emotions and deepening understanding. The now-iconic multimedia story "Snow Fall," published by *The New York Times* in 2012, provides an example. Identified as the vanguard of "a new wave of literary journalism" for a digital era (Jacobson, Marino, and Gutsche 2016), Snow Fall was pioneering in its use of narrative techniques to create a fact-based immersive experience online (van Krieken, 2018). Reconstructed scenes revealed the thoughts and feelings of characters caught in an avalanche; these reconstructions were supported by audio and video clips of sources reflecting on what happened in the real world.

This foregrounding of artistic creativity and the expression of personality (Christopherson 2008) challenges journalistic norms not just of truth-telling but also of objectivity (Mindich 2000; Schudson 2001), which emerged along with journalists' self-perception as members of a profession rather than individuals communicating their personal take on a day's events. VR content is inherently subjective: Virtually all of it is designed to pack some sort of emotional punch. One response to the immersive experience is empathy, as users can feel as if every occurrence is happening to them personally (Milk 2015). But because many VR experiments immerse users in distressing, even fear-inducing, situations – as prisoners in solitary confinement, women trafficked as sex slave, refugees from war-torn homes, asylum seekers alone in an unfamiliar city[14] – the journalistic norm of minimising or at least not deliberately causing harm to audiences can be tested. Research also suggests that users perceive VR as more credible than traditional news formats (Sundar, Kang, and Oprean 2017), perhaps because of this sense of personal experience. The combination of immersion, empathy, and perceived credibility has the potential to be manipulative (Maschio 2017) and to cause emotional distress as well as to inject particular points of view into users' perceptions of the world (Owen et al. 2015).

Of course, this emotional power also can be used in ways widely seen as socially desirable. VR offers a potent new tool for interventionist or advocacy journalism, in which journalists actively promote positive change (Hanitzsch 2007) – though advocacy journalism has itself been subject to criticism over its direct challenge to norms of objectivity (Waisbord 2009). De la Peña (2013) describes the VR journalist as a "civic partner" who encourages users to take action (para.4). VR production partners also can be non-profit as well as for-profit organisations. For example, promotion of the preservation of cultural heritage was a goal of *The Economist*'s "RecoVR Mosul"[15], a piece created in partnership with non-profit

company Rekrei that digitally reconstructed the artefacts of an Iraqi museum destroyed by Daesh/ISIS (Prospero 2016). At a minimum, VR narratives force journalists to break open the "black box" surrounding professional norms such as objectivity (Craft 2017), asking themselves both how and why it might be abrogated.

VR journalism, then, calls into question a range of interconnected professional norms, including autonomy, truth-telling, objectivity, and the minimisation of harm. What sorts of questions might journalism studies scholars ask to systematically explore normative issues as immersive technologies become more widely used as news vehicles?

* *The value of objectivity*: Despite its position as perhaps the key professional norm of the 20th century, objectivity has come under a barrage of criticism from journalism studies scholars in a digital age (see Agarwal and Barthel 2015; Broersma 2010; Craft 2017). With VR and related forms of immersive journalism, this norm is essentially abandoned in favour of highly subjective storytelling explicitly designed to elicit an emotional response. Research might explore the rationale for this move away from facticity and its effects on users as well as producers of VR content. Does it encourage new considerations of what constitutes journalistic truth-telling, and if so, what factors are relevant to those considerations? In the absence of objectivity, how do audiences assess the credibility or trustworthiness of VR journalism, or are other normative markers more important in this context? How might we distinguish between immersive journalism that is impactful as opposed to manipulative or even potentially deceptive? More broadly, if objectivity is set aside, what replaces it as a paramount norm for journalists? For users? For others who produce and disseminate VR news content?

* *The effect on autonomy*: Issues directly related to the ways in which agency is shared among actors involved in the production and consumption of VR journalism were considered in the previous section, but a normative approach suggests a focus on the interplay between commercial and editorial team members. Critics have highlighted the role of increasingly severe economic pressures in driving news selection and calling attention to advertiser interests, in both traditional and digital news environments (Cohen 2002; Küng 2015; McManus 2009). Within in-house VR development labs, journalists and marketers are literally working side by side. What do those working relationships look like in practice, and how are potentially conflicting normative expectations negotiated? To what extent do editorial and commercial interests overlap and intersect, and what tensions arise and demand resolution? Is the notion of editorial autonomy seen as desirable or even appropriate in the development of VR journalism – which is expensive and so far difficult to monetise, as discussed further below – or does the format invite a conscious decision to consider editorial and marketing goals in tandem? If the latter, how does that shift in thinking connect with the challenges to objectivity posited above?

* *The consideration of harm*: Understanding of harm in relation to virtual reality historically revolved around physical harm, notably mild nausea caused by a disconnection between real and simulated motion (see Hettinger and Riccio 1992). But the issues for journalists are primarily normative ones. The effects of emotionally distressing experiences within an immersive environment specifically designed to elicit feelings of empathy and engagement are ripe for exploration, and there has been very little to date. How lasting are such effects, and who bears responsibility for them? Given the high degree of user agency already described, should journalists build into VR environments ways of offsetting the harm or addressing the problems raised, an approach evocative of "solutions journalism" (Curry, Stroud, and McGregor 2016)? Are other ways of mitigating the potential for harm appropriate, such as issuing warnings or recommending age restrictions for use? In general, what are the implications of a format that elevates emotional engagement to levels not possible with traditional formats? As VR technology continues to evolve, making fully

immersive VR increasingly accessible and affordable, answers to such questions will become increasingly important for VR creators, users, and scholars.

Taken together, these and other normative issues raised by immersive video formats present a final general question that journalism studies scholars might profitably debate: Should ethics guidelines tailored to VR production be formulated, and if so – given the range of actors with different normative sensibilities involved in the process – by whom? If guidelines are desirable, what might they cover and how might they be framed? Should oversight be formalised, for instance under the auspices of an agency such as UK broadcast regulator Ofcom, or should it take on a more informal or even voluntary structure, such as various proposed ethics guidelines for bloggers in the 2000s (Kuhn 2007; Perlmutter and Schoen 2007)? As VR and related formats move out of the experimentation stage described more fully in the next section, concerns over whether and how to safeguard ethical use of the technology are likely to become more pressing for practitioners – and scholars.

Sociology of News: How Journalists Engage in News Work

In the previous section, we considered how VR and other immersive video technologies challenge the ways journalists think about news work, particularly in relation to occupational norms. An additional focus for journalism scholars is journalistic practice, distinct from normative biases and professional aspirations (Zelizer 2017). Such an approach can be especially useful in considering the impact of technological developments: Looking at practice foregrounds the dynamic nature of situationally based conventions and routines, in the process embracing "relativity, subjectivity, reflexivity, engagement, and construction" (Plesner 2009, 168). It facilitates examination of performative aspects of news work, thus avoiding normative debates about what counts as proper journalism (Domingo, Masip, and Meijer 2015). And it opens the door to considering people outside the newsroom as a part of journalistic culture (Zelizer 2017) – all relevant to considerations of VR journalism as a form of news work.

We might start with those people outside the newsroom who are integral to the production of virtual reality journalism. Although many journalists have been socialised to compete with other news organisations over sources and stories (Berkowitz 2009), the production of VR is necessarily a collaborative enterprise. We discussed in a normative context some of the issues surrounding cooperation between commercial and editorial teams. But as previously highlighted, collaboration also typically involves people who work outside the news organisation altogether (Owen et al. 2015). Look through the credits for VR journalism and you'll likely find an eclectic mix of in-house R&D units plus production company staff; technical, artistic and sometimes academic advisers; and writers, designers, sound engineers, and musicians. Projects emerging from the *Economist*'s Media Lab[16], to take one example, include 360° videos produced in conjunction with at least three different production houses.

Collaborative enterprises are an emerging trend in journalism generally (Owen 2017; Stonbely 2017). In the area of immersive journalism, collaboration is all but essential because the diverse, multifaceted, and often highly specialised skills needed to produce VR are not ones journalists typically possess. Yet team members with such dissimilar backgrounds are likely to see themselves and their role in society differently, potentially affecting how they understand the rationale for the content they are creating. Is the goal to entertain? To interpret? To inform? All three? The answer may affect how various partners in the enterprise view the normative precepts discussed above – as outdated boundaries or as a crucial assurance of good practice, for instance – and therefore shape their actions.

Many technologists, in particular, have been socialised within a "hacker" culture, which values sharing and is quite different from the overtly competitive nature of traditional news work. Usher (2016) describes hacker culture as imbued with a spirit of community, openness, participation, and experimentation. In this light, full transparency about production processes is seen as a public good, and it incorporates not only user feedback but also user input into software development (Lewis and Usher 2013). Some news organisations partially adopted this culture in earlier explorations with Open APIs (Aitamurto and Lewis 2013) and have brought it into current experiments with VR. The BBC, for instance, offers a VR blog documenting lessons learned from its constant experimentation[17] plus a "Taster" platform inviting user contributions to new ideas the organisation is developing.[18] At the *Financial Times*, a GitHub account provides the coding behind apps and tools; publishers and developers are invited to contribute, as well as to share any challenges they face.[19]

The BBC explicitly identifies Taster as a place for trial and error, offering access to incomplete products and asking users to rate them, share them, and provide feedback. Such offerings highlight another hallmark of changing journalistic practice as news organisations explore VR: experimentation and the embrace of uncertainty (Lowrey and Gade 2013). The "news labs" responsible for VR content at many news organisations typically also engage in experiments with data or computational journalism (Gynnild 2014); such ventures in turn draw on previous trials of everything from citizen-produced video (Kperogi 2011) to mobile journalism (Westlund 2013). This fluid and fast-moving experimentation represents a dramatic departure from the immeasurably slower pace of redesign and other changes in traditional print or broadcast environments.

Helping drive these shifts toward collaboration and experimentation are the economic pressures that loom over contemporary news work. Ownership, policies, bureaucratic structures, and economic viability and stability all significantly affect journalistic practice (Shoemaker and Reese 2014), including the exploration of immersive video. A pressing issue for commercial media organisations experimenting with VR is the elusiveness of a sustainable business model to support it. Immersive video content is costly to produce; monetising it is a significant concern and a generally unfulfilled goal (Doyle, Gelman, and Gill 2016). Some initiatives have been supported by grants from organisations such as Google, but these arrangements may not be financially sustainable in the long term (Watson 2017). VR has yet to generate reliable advertising revenue, given the still-small number of users; moreover, advertisers pursuing VR have the option to publish their material independently rather than via a media outlet (Southern 2017).

Influences on journalistic practice operate at other levels, too (Shoemaker and Reese 2014). Practice is connected to newsroom routines, encompassing practitioner roles as well as many of the normative guidelines considered earlier. Looking at earlier iterations of online journalism, Deuze (2008, 205) observed that the fluid nature of the medium challenges "the specific notions of what a 'story' is, how a 'deadline' functions, or when the news is actually a 'finished' product" – three aspects of news work highly relevant to immersive journalism yet to date unexplored in this context.

Individual-level influences, including journalists' attributes and their role in news production (Shoemaker and Reese 2014), also merit attention. Not everyone in a news organisation has equal access to emerging technology and thus the ability to understand, use, and shape it (Deuze 2008). As pressures mount to produce stories for digital, mobile, and social platforms, desk-bound journalists are less and less likely to have time for the long-term, complex, and labour-intensive work needed to create immersive video narratives (see Witschge and Nygren 2009). Adding to the challenge is that VR experimentation typically occurs in innovation "labs" and other physical spaces apart from the main newsroom, and through interactions with employees of external partner organisations. The likelihood thus is

that only a very small minority of news workers will be engaged in VR journalism, raising a host of personal development and associated issues.

So here again, journalism studies scholars are presented with a wide variety of intriguing questions that might be asked about the practice of VR journalism. As before, we offer a few suggestions among the many possibilities:

* *The nature of collaborative culture*: Collaboration with outsiders, once rather an odd concept in relation to journalistic work, is gaining momentum in various iterations. News organisations around the world are discovering the power of the collective: from the massive Panama Papers project,[20] with 100-plus media organisations analysing millions of leaked documents about offshore financial holdings; to collaborative fact-checking enterprises around recent French[21] and German[22] elections; to data journalism projects that enable community news outlets to share, investigate, and localise public information.[23] However, those initiatives primarily linked journalists at disparate news organisations. VR journalism offers opportunities to explore collaboration amongst people with different backgrounds and mind sets, extending preliminary investigations of the intersections of programmers and journalists (Lewis and Usher 2013; Parasie and Dagiral 2013; Usher 2016). Does VR push journalism further in the direction of a collaborative enterprise, or does it spur journalists to more explicitly delineate their own areas of occupational expertise? What is the nature of the cultural exchanges among diverse actors? How are potentially conflicting goals and perspectives negotiated, tasks allocated and addressed, and immersive narratives ultimately created? What are the challenges of collaboration, and how do journalists (and their VR partners) negotiate those challenges? Which sorts of compromises, if any, are acceptable, and which are not? What aspects of the experience can be brought back to a more traditional news environment, and how might that importation process best be accomplished?

* *The nature of an experimentation culture*: VR and 360⁰ video are experimental forms, with uncertainty surrounding not just how to create them but also how to use them effectively in a journalistic context, how to market them, and how to monetise them. Moreover, the integration with "hacker" culture might be expected to result in greater transparency about the trials and errors inherent in experimentation, an openness about unsuccessful efforts that may make some journalists uncomfortable. How amenable are they to the process of sharing iterations of partially completed work or even partially formed ideas? What value do they place on experimentation in general, including experimentation with traditional formats and in the development of something new, such as immersive journalism? Which aspects of the process do they feel are viable back in the newsroom, and which do they see as specific to the creation of virtual reality? In general, does experience with an experimental – and collaborative – culture translate to a fresh way of thinking about journalism more broadly? How so … or why not?

* *The nature of individual experience*: Finally, virtual reality initiatives beg a host of questions about the journalists involved with it, and about influences at the individual level that either facilitate or discourage that involvement. We might start by looking at the skills, experiences, and personalities of journalists involved in creating immersive video. From there, we might move on to questions of how they think about audiences, journalistic goals, and social roles such as gatekeeping, as well as their views about virtual reality as a format for news. What do they believe they can achieve with VR journalism that is different from what might be achieved with more traditional approaches? What new doors does immersive video open, what new ideas or ways of thinking does it engender, and how do journalists see themselves capitalising on those opportunities? In short, where might VR journalism take them – and us?

Conclusion

Virtual reality, 360° video, and other rapidly developing forms of immersive storytelling offer enormous scope for investigation by journalism studies scholars. In this essay, we have highlighted just three of the many possibilities for thematic exploration, and with a few exceptions, the questions we suggest as starting points have been descriptive in nature. This seems to us appropriate for a topic about which we currently know so little. But opportunities abound for more theoretically driven research, and those opportunities will expand in tandem with our baseline of knowledge. From media effects theories to diffusion studies to approaches encompassing political economy and cultural appropriation, VR journalism promises to be richly informative.

For now, however, we believe that Actor-Network Theory, normative theory, and concepts drawn from media sociology offer productive places to start. They enable consideration of aspects of the creation and use of immersive technologies that seem to us most clearly definitive, including agency, subjectivity, and ongoing experimentation.

That said, the technologies themselves are not new. They have been studied by scholars in other fields – from game design to medical technology to psychology – for a quarter-century and more. The insights gained can and should inform work within our own purview, journalism studies. And of course, VR journalism offers fresh opportunities for interdisciplinary research, too. Journalism is an increasingly collaborative enterprise, and our understanding of it will surely benefit from scholarly collaboration, as well.

Finally, as we have highlighted throughout, users are integral to every aspect of these emerging forms of immersive journalism. Virtual reality and its kin thus represent the continuation of a narrative thread that has run through every iteration of digital journalism: the strengthening of relationships between those who work inside a newsroom and those who do not. At a London conference in 2017, *New York Times* executive Patrick Falconer described VR as "one giant leap forward in a never-ending march of technological advances that all point in the same direction: the consumer and the creator, together at the centre of the story itself." Creators, consumers, and content are inextricably intertwined in the study as well as the practice of contemporary journalism, and perhaps nowhere are these interconnections more apparent than in its immersive iterations.

NOTES: Media websites referenced in the text

1   http://graphics.wsj.com/3d-nasdaq/

2   https://www.theguardian.com/world/ng-interactive/2016/apr/27/6x9-a-virtual-experience-of-solitary-confinement

3   http://www.bbc.co.uk/news/resources/idt-sh/mosul_from_above_360

4   https://www.theguardian.com/world/2017/sep/01/sea-prayer-a-360-story-inspired-by-refugee-alan-kurdi-khaled-hosseini

5   http://www.bbc.co.uk/news/world-38093431

6   https://insights.ap.org/whats-new/behind-the-scenes-on-our-first-animated-vr-experience

7   http://contrastvr.com/oilinourcreeks/

8   https://www.economist.com/blogs/prospero/2017/03/virtual-reality;
        https://www.youtube.com/watch?v=jvtvFHPRcsY

9   https://www.nytimes.com/interactive/2017/06/30/magazine/ethiopia-hottest-place-on-earth-vr.html; https://www.nytimes.com/interactive/2017/climate/antarctica-virtual-reality.html

10   https://www.theguardian.com/lifeandstyle/video/2017/apr/11/first-impressions-a-virtual-experience-of-the-first-year-of-life-video-trailer

11   http://www.tbrandstudio.com/

12   https://guardianlabs.theguardian.com/

13   https://courageousstudio.com/

14   https://www.theguardian.com/technology/2017/jul/05/limbo-a-virtual-experience-of-waiting-for-asylum-360-video

15   https://www.youtube.com/watch?v=0EazGA673fk

16   http://labs.economist.com/

17   http://www.bbc.co.uk/rd/projects/360-video-virtual-reality

18   http://www.bbc.co.uk/taster/; http://www.bbc.co.uk/taster/about

19   https://github.com/Financial-Times

20   https://panamapapers.icij.org/

21   https://firstdraftnews.com/project/crosscheck/

22   https://correctiv.org/en/correctiv/

23   https://www.thebureauinvestigates.com/local

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