FULL PAPER

Restarting virtual reality in journalism? A quantitative analysis of problems and potentials of selected immersive apps as perceived by their users

Neustart für Virtual Reality im Journalismus? Eine quantitative Analyse der Probleme und Potenziale ausgewählter immersiver Apps aus der Sicht ihrer Nutzenden

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Abstract: Since its emergence in the 1960s, virtual reality (VR) has generated significant enthusiasm among researchers and practitioners, as well as technology and media companies. In journalistic practice, however, VR has so far only been able to compete to a limited extent. This paper first establishes the status quo of VR apps in the journalistic field as found in the Oculus Store, and then analyses the user comments (N = 770) of 15 VR apps produced by journalistic media outlets to evaluate their perceptions in terms of the constructs of immersion, emotion, usability, and utility. Results show that users positively highlight VR's capacities to elicit immersion and emotion, while technological aspects of usability and utility are often assessed negatively. Additionally, positive emotional and immersive reactions in VR are possible despite flaws in technology, and a positive immersion is also associated with a positive emotional VR experience. Derivations for a potential restart of VR apps in journalism are drawn.

Keywords: Virtual reality, journalism, immersive technology, user experience, VR journalism.

Zusammenfassung: Seit ihrem Aufkommen in den 1960er Jahren hat Virtual Reality (VR) in Forschung und Praxis sowie bei Technologie- und Medienunternehmen großes Interesse ausgelöst. In der journalistischen Praxis konnte sich VR jedoch bisher nur bedingt etablieren. In diesem Artikel wird zunächst der Status Quo von VR-Apps im journalistischen Bereich im Oculus Store ermittelt. Anschließend werden die Kommentare von Nutzenden (N = 770) von 15 VR-Apps journalistischer Medienunternehmen analysiert, um deren Wahrnehmung im Hinblick auf die Konstrukte Immersion, Emotion, Benutzerfreundlichkeit und Nützlichkeit zu bewerten. Die Ergebnisse zeigen, dass die Nutzenden die Fähigkeiten von VR, Immersion und Emotionen hervorzurufen, positiv hervorheben, während die technischen Aspekte der Benutzerfreundlichkeit und des Nutzens oft negativ bewertet werden. Darüber hinaus sind positive emotionale und immersive Reaktionen bezüglich der VR-Apps trotz technischer Mängel möglich und eine positive Immersion ist auch mit einer positiven emotionalen VR-Erfahrung verbunden. Es werden Schlussfolgerungen für einen möglichen Neustart von VR-Apps im Journalismus gezogen.

Schlagwörter: Virtual Reality, Journalismus, immersive Technologien, Nutzererfahrung, VR-Journalismus.

1. Introduction: Assessing VR in journalism

Since the advent of virtual reality (VR) in the early 1960s, scholars and practitioners of journalism have been fascinated by the technology's potential for the field, and still suggest it has a promising future (Frausto-Robledo, 2018). VR has been defined as an "immersive, multi-faceted, and emotionally compelling innovation for the product and practice of journalism" (Mabrook & Singer, 2019, p. 2). Using computer technology, VR applications "create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence" (Bryson, 2013, p. 1). It "immerses users into another reality (the news story), takes over their attention and makes them feel part of it" (Ambrosio & Fidalgo, 2019, p. 6), thereby creating an "illusion of an accessible place that provides a visceral experience and opportunity for exploration" (Kukkakorpi & Pantti, 2021, p. 1).

This positive outlook has been further nurtured by big tech and media companies investing in VR, such as *Google Glass* or the *BBC VR Hub* that was launched in 2017 (see BBC, 2019a; Google Glass, n.d.). The presumptions of making VR marketable, however, have not yet proven true and several companies have withdrawn from the market again (BBC, 2019b).

However, a study showed that 17 percent of the German population use VR at times, and 18 percent said they are going to use VR glasses in the future (BIT-KOM, 2021). While the reasons for usage are diverse, such as video games (77%), travel (71%), movies (56%) or sports activities (37%), 16 percent also use VR for educational reasons (BITKOM, 2021). Furthermore, new rumours about inventions and investments in the VR market spread time and again: Apple might launch high-definition VR glasses soon (Bezmalinovic, 2021), while rumours about Microsoft entering the VR market are seemingly rebutted, with VR allegedly not at the centre of the company's focus for reasons of rentability (Bastian, 2021).

On the basis of these unstable, highly interesting developments, this paper aims to serve two purposes: First, a look at the strengths and weaknesses of VR as identified by journalism scholars in recent years gives an overview and orientation regarding the current state of the technology and its application in the journalistic field (1). Secondly, users' evaluations of current VR applications produced by journalistic media outlets are analysed in order to assess their standpoints as well (2). Taken together, these insights aim to create a summary of the lessons learned so far as well as practical conclusions for a possible restart of VR in journalism. In this regard, the focus mainly lies at VR as a technology and software application, while deductions are drawn for VR as a branch of the journalistic industry.

## 2.	A make-believe feeling of being there: Immersion, presence, and user agency

Considering the existing body of research about VR in journalism, most of the identified characteristics and strengths of VR are directly connected to the user experience (as opposed to, for example, the displayed content or the producing journalists). This focus is connected to the view that VR in journalism is "defined in its very essence by the relationship between journalism and its audience" (Baía Reis & Coelho, 2018, p. 1098) and that "this type of innovation is about what audiences (allegedly) need and want" (Lecheler, 2020, p. 289).

First and foremost, VR in journalism cannot be considered without mentioning the concept of *immersion* (Baía Reis & Coelho, 2018; Hassan, 2020; Kukkakorpi & Pantti, 2021; Marini et al., 2012; Nielsen & Sheets, 2021; Steinfeld, 2020; Van Damme et al., 2019). Immersion, or immersivity, is defined as "the degree to which a VR system stimulates the sensory system without interference from external environment" (Marini et al., 2012, p. 234). Through VR devices, which occupy the user's view (Marini et al., 2012), the users can become fully absorbed in a story and thereby experience a "state of altered consciousness" (Baía Reis & Coelho, 2018, p. 1090). When news organizations utilise the concept of immersion, they can generate an "attention capture of users" (Hassan, 2020, p. 196): *Immersive journalism,* for example in terms of immersive storytelling, "is aimed at capturing the audience with a news story and triggering an immersive response of the reader or viewer" (Van Damme et al., 2019, p. 2055), so that it elicits "a connection between the audience and the news story" (De la Peña et al., 2010, p. 291). Hence, it "does not aim solely to present the facts, but rather the opportunity to experience the facts" (De la Peña et al., 2010, p. 299); this experience is different for every user (Hassan, 2020, p. 207). Consequently, in immersive journalism, the audience becomes part of the content (Baía Reis & Coelho, 2018, p. 1098).

Thereby, it is assumed "that greater system immersion results in higher levels of immersive response of the viewer" (Van Damme et al., 2019, p. 2056), which scholars have also highlighted as the (illusory) feeling of *presence* (Baía Reis & Coelho, 2018; Kukkakorpi & Pantti, 2021; Mabrook, 2021; Marini et al., 2012; Nielsen & Sheets, 2021; Van Damme et al., 2019, p. 2056; Wimmer, 2017): Users of journalistic VR experiences and applications have the feeling of "being there" (Cummings & Bailenson, 2016), and tend to have a realistic response to a virtual situation, despite knowing it is not real (De la Peña et al., 2010, p. 293). Since "journalists have always attempted to present audiences with the most intimate sense of being part of the news event" (Van Damme et al., 2019, p. 2055), VR journalism can help them achieve this goal. Thereby, the notion of place and spatial narrative in VR play a relevant role since it "allows the user to extend their interpretation of a place to the character's story" (Kukkakorpi & Pantti, 2020, p. 14) and "reinforces a contextual and emotional understanding of the characters' situation" (Kukkakorpi & Pantti, 2020, p. 16).

With users feeling present in a news story and responding realistically to its displayed content, scholars have furthermore highlighted the degree of *user agency* in this context as the "most distinctive feature of immersive video formats"

(Mabrook & Singer, 2019, p. 3). Arguing that journalists have steadily lost their gatekeeping control over the distribution of news ever since journalism moved to the digital sphere, VR can be seen as the next step of this development, in which users themselves determine how they engage with the displayed content (Mabrook & Singer, 2019). Thereby, user agency has been identified as one of three main gratifications gained from VR (alongside affect and experience), which divides again into information and control (Nielsen & Sheets, 2021, p. 9). On the other hand, however, VR stories are still defined in their narratives by the reporting protagonist and related framing (Baía Reis & Coelho, 2018, p. 1097). Hence, while users can engage with and experience the content according to their individual preferences, the VR content creator still determines the limits and narratives of this experience. In 2019, user agency was said to be "a defining characteristic of VR" (Mabrook & Singer, 2019, p. 3), while three years later VR journalism is considered to confine it "to low levels of agency to maintain a degree of authorship" (Mabrook, 2021, p. 211).

3.   The double-edged sword of VR: Emotion and empathy

Next to the characteristics of immersion, with its related aspects of presence and user agency, a frequently discussed attribute of VR is its potential to elicit *emotions* (Baía Reis & Coelho, 2018, p. 1097; Kukkakorpi & Pantti, 2021; Lecheler, 2020; Nielsen & Sheets, 2021; Sánchez Laws, 2020), with a specific focus on empathy. This stands in line with a general "emotional turn in journalism" (Wahl-Jorgensen, 2021). Scholars hypothesize that "some strands of immersive journalism are beginning to meet the requirements which enable us to witness the emotions of others and to thereby feel empathy for them" (Sánchez Laws, 2020, p. 223). This is only made possible by the underlying technology, so "new forms of emotion-driven journalism seem to be motivated by technological innovation" (Lecheler, 2020, p. 288).

Not only does the perception of emotions in journalism depend on the underlying technology, but also on "how humans will in principle process emotional journalistic content" (Lecheler, 2020, p. 290). Here, the responsibility again rests with the journalists creating VR content and demarcating the framework and boundaries in which users can explore, experience and potentially also feel the displayed content. At times, an ethical conflict arises whereby journalists have to find a balance between journalistic ideals and empathic reactions (Mabrook, 2021, p. 220). As well as this ethical conflict, the notion of using emotions to engage with content "must be at odds with traditional positions on journalism where this appeal to emotion is unwelcome" (Sánchez Laws, 2020, p. 222).

These two areas of conflict become even more obvious when considering the specific emotion of *empathy* (Hassan, 2020; Herrera et al., 2018; Mabrook, 2021, p. 210; Nielsen & Sheets, 2021; Sánchez Laws, 2020; Steinfeld, 2020; Sundar et al., 2017), which is seen as "the mechanism through which we gather information to cooperate with others" (Sánchez Laws, 2020, p. 218). In psychology, empathy is defined according to the three levels of "the sharing of another's emotional state; the explicit understanding of another's emotional state; and the prosocial be-

haviours that follow" (Dadds et al., 2008, p. 112). In journalism research, empathy is also "related to the perception of other people's emotions" (Steinfeld, 2020, p. 244), hence, the first two mentioned aspects of sharing and understanding the emotions of others constitute the definition of empathy as it is underlying this study. Furthermore, empathy in journalism "fulfils multiple crucial roles in news production" (Steinfeld, 2020). While some scholars are positive that VR journalism has the potential to generate empathy in its users (Mabrook & Singer, 2019; Sánchez Laws, 2020; Shin & Biocca, 2017), some studies could not prove this assumption, or at least not as an outstanding characteristic (Hassan, 2020; Steinfeld, 2020; Van Damme et al., 2019).

In Steinfeld's (2020) controlled experiment exposing participants to content either displayed as text, video or immersive 360° video, the immersive format did not result in higher levels of empathetic reaction than other content formats, hence, "use of VR by itself may not be enough" (p. 252). To address this challenge, Marini et al. (2012) suggest analysing "the syntactic, semantic, and pragmatic character of a VR application … to determine the technical solutions that better implement the desired communication" (p. 240). Van Damme et al. (2019) conducted a comparable experiment in which participants either watched a 360° video on a laptop, an interactive 360° video on a laptop, or the same video through Cardboard VR glasses or Oculus glasses, presuming an increasing level of immersion. Their conclusion echoes Steinfeld (2020) by stating that "360° video journalism does not lead to being emotionally more moved … or increased empathy" (Van Damme et al., 2019, p. 2069). Stretching these findings and their implications even further, Hassan (2020) doubts that a virtual technology can generate real-world emotions and states that "360° immersion generates a hyperreal spectacle" (p. 208). Nevertheless, potentials of VR journalism are seen in *news enjoyment* and *topic engagement*: News organizations using VR provide their users "with an enjoyable experience while presenting a news story" and furthermore strengthen their feelings of engagement (Van Damme et al., 2019, p. 2057, 2058).

4. VR content creators: Implications for journalistic practice and ethical considerations

These twofold reflections and findings about emotion and empathy in VR journalism are also found in the discussion around its *displayed content*. On the one hand, immersive journalism provides "the means for strengthening the fourth estate's civic role in informing and enlightening the public through absorbing informational stimuli on political events, conflicts, natural disasters, and the like" (Hassan, 2020, p. 196). On the other hand, the displayed content in VR journalism can have its limits and it seems up to the journalists to carefully handle these: There are limits as to how much information a VR story can embody (Mabrook, 2021, p. 217), as well as limits concerning the suitability of VR technology for presenting specific story content (Mabrook, 2021). Regarding the latter, interviews with VR content creators show that they "avoid complicated stories with too many nuances because they may overwhelm users" (Mabrook, 2021, p. 220);

furthermore, immersive journalism seems "less suitable for presenting facts and statistics" (Nielsen & Sheets, 2021, p. 9). This has, of course, implications for journalistic production in the digital realms, in which the so-called media-content match (Planer & Godulla, 2021, p. 12) has to be considered. VR provides the opportunity to portray certain topics, while others may be displayed better using other forms and formats of presentation, such as, for example, data stories, long-form stories (Planer et al., 2022), or video storytelling. Additionally, content creators need to keep in mind potential cyber sickness (McCauley & Sharkey, 1992, p. 311), as a part of motion sickness, which might exclude certain users from experiencing a VR story.

If the displayed VR content fails to immerse or is not carefully chosen and edited, it can easily become too much and too stressful for daily use (Nielsen & Sheets, 2021, p. 12), hence usability plays a crucial role. It is not only the demanding VR content, but also the underlying technology, which is expensive and not (yet) easily affordable (Steinfeld, 2020, p. 243) as well as "relatively inconvenient in its current form" (Nielsen & Sheets, 2021, p. 12), that contribute to everyday use of VR in journalism being so far out of sight – its usability and utility for the user do not seem convincing enough yet. Beyond this, even if the immersion functions well, there is the danger of immersing the audience into "a world of fake news, their bodies learning to respond automatically and unconsciously with hatred and anger toward the world within and outside virtual reality" (Sánchez Laws, 2020, p. 223).

This point emphasises the journalists' responsibility when creating VR content, which can have a "powerful psychological impact" and "manipulate users" (Mabrook, 2021, p. 211), and ties in with the question of objectivity and truth in VR journalism. While it might offer journalists the previously mentioned potentials of informing the audience profoundly and fulfilling the journalistic watchdog function, "[…] objectivity in VR is not problematic any less than in traditional journalism" (Mabrook, 2021, p. 220). Hence, it is crucial for VR content creators to be aware of both the advantages and disadvantages of VR (Mabrook, 2021, p. 217). Although users can be immersed in real footage, they still engage in a virtual (as opposed to real) world. This opens up a scholarly discourse on VR's questionable ethical and deontological framework (Baía Reis & Coelho, 2018, p. 1097; Nielsen & Sheets, 2021, p. 12; Sánchez Laws, 2020, p. 223). Although content is shaped, framed, edited, and hence manipulated to an extent in more traditional forms of content creation too, this might be even more the case in VR journalism.

Yet perhaps the stronger involvement of the full body in a virtual reality experience, and the degree to which this embodiment will affect our emotional response, our memory, and our decision-making, should make journalists even more aware of the need to address ethical concerns with the utmost care (Sánchez Laws, 2020, p. 224).

Last but not least, VR technology "comprises traditional journalism" (Baía Reis & Coelho, 2018, p. 1097), and therefore brings further structural changes to journalistic practices. These lie, for example, in the necessary support by "technology companies that see journalism as a vehicle for taking VR mainstream"

(Mabrook & Singer, 2019, p. 1). News outlets often partner with technology companies like Google and receive support from specialized companies (Mabrook & Singer, 2019, p. 2), because the "technological expertise … and the necessary hardware and software are complex, costly, and continually evolving" (Mabrook & Singer, 2019, p. 2). This is confirmed by a 2019 BBC summary of their experiences with VR: Under the headline "Things you need to know about running a VR production", the company states that it is costly and takes time, involves lawyers due to the lack so far of standard licensing agreements, and involves a lot of material that needs to be archived (BBC, 2019a, p. 25). Furthermore, the ethical and deontological concerns need to be considered here, too, in order for VR to become successfully implemented into journalistic work processes.

Considering all the mentioned aspects – and thereby highlighting the degree to which "creators, consumers, and content are inextricably intertwined" in immersive journalism (Mabrook & Singer, 2019, p. 13) – this type of content can be highly innovative for media organizations and is considered "one of the future pathways to experience contents" (Baía Reis & Coelho, 2018, p. 1096). The discussed areas of scholarly discourse about VR journalism as displayed in Table 1 can be seen as a summary of the characteristics and strengths identified thus far, but also the concerns and weaknesses regarding VR in journalism. They represent its current state as well as the learnings from past experiments both in research and practice.

Table 1. Strengths, characteristics, concerns, and weaknesses of VR as identified by journalism scholars (own representation)

Strengths and characteristics of VR	Concerns and weaknesses of VR
related to the user	
Immersion	Costly technology
User agency	Limited user agencyw
Feeling of presence	Psychological impacts
Emotions and empathy	No real empathy
Objectivity	Limited objectivity
Topic engagement and news enjoyment	Limited content
related to the journalistic field	
Profit and prestige	Structural changes
New form of journalism	New expertise required
VR journalism seems promising	Ethical and deontological concerns

5. Evaluating journalistic VR apps: A previous study

For some time now, a huge market has been predicted for VR (Frausto-Robledo, 2018). In 2014, Facebook joined the VR market and bought the company Oculus VR for USD 2 billion. With the help of continuous research and an aggressive

pricing policy, Facebook has since successfully made Oculus headsets the market leaders among VR glasses on the platform Steam (Machkowech, 2020). As a result, Oculus can be seen as the most promising approach to further establish VR on the mass market (Pavlik, 2015).

The present study builds up on an earlier qualitative-deductive content analysis of VR apps available in the Oculus Store and is described in the following. The Oculus Rift S was the flagship product of Oculus until the Oculus Quest 2 was launched, but since the Rift was used early on as a display platform for journalism and the Quest 2 had not been released at the time of the previous study, the focus was put on the Rift S. Therefore, on April 24, 2020, all VR apps available for Oculus Rift S were assessed from the Oculus Store ($N = 1{,}757$). In a next step, the selected VR apps were filtered according to whether they were published by a journalistic media company. Journalistic media outlets were understood here, following Voci et al. (2019, p. 45), as "media companies in a narrow sense" that include the three core elements "(1) content sourcing, (2) content aggregation, and (3) content dissemination". The term "content" here means journalistic information, entertainment, and their hybrid forms (Voci et al., 2019). The outlined definition of media organizations also includes digital-only media organizations, which today compete with traditional journalistic media organizations. Apps from those organizations ostensibly involving video game companies or film studios were excluded from the sample as they display fictional content and games serving the purpose of pure entertainment and are therefore not subject to the underlying research interest. Thus, this work understands journalistic VR apps as virtual reality applications that are published by journalistic media outlets or transmit journalistic information; in our study, this specifically concerns VR applications that can be accessed through the Oculus Store and hence can be used with the Oculus Rift. Apps which only display 360° videos are thus not considered.

Since the sampled VR apps ($n = 15$) were not only produced by journalistic organizations, but also all related to socially, technologically, culturally, historically, politically, or otherwise relevant topics, they were considered to be comparable. Finally, the sample consists not only of news journalism applications, but applications in general in which background reporting takes place and content is prepared in such a way that users can experience it immersively and interactively (see Table 2).

While the majority of the VR apps were published in 2017, the most recent was published in 2019. The selected VR apps are still available and can be accessed through the Oculus Store. Their existence on the market for at least a few years justifies their consideration in this project. Despite their partly earlier release dates, several of these apps (e.g., BBC Two & BBC Three) still generate a lot of user comments. Additionally, almost all of these apps not only display 360° videos but also create interactive and immersive user experiences.

Table 2. Sample of VR apps produced by journalistic media outlets*

Publisher	Nr.	Title	Content	Publication Date	Comments
ARTE	1	Notes on Blindness	Society: A journey through the world of a blind person.	07.12.2017	19
BBC	2	1943 Berlin Blitz	History: World War II: Inside a Lancaster bomber flying over Berlin in 1943.	04.10.2018	215
	3	BBC Home – A VR Space-walk	Technology: A spacewalk in-spired by NASA's training pro-gram.	30.11.2017	159
	4	Bear Island	Environment: A black bear searching for a fishing spot.	29.03.2017	62
	5	Cat Flight	Environment: A mother caracal trying to find food in a desert.	23.02.2017	21
	6	Easter Rising	History: Memories from 1916 Easter Rising in Irish History.	05.07.2017	15
	7	Is Anna OK?	Society: An accident that oc-curred to 20-year-old twins.	18.10.2018	18
	8	Oogie	Environment: The journey of a small beetle through the South African desert.	05.04.2017	26
	9	We wait	Politics: Experiences of mi-grants during refugee crisis.	13.12.2016	49
CNN	10	CNN VR	Technology: Inside a newsroom of the future.	15.03.2018	46
LIVE	11	Buzz Aldrin: Cycling Pathways to Mars	Technology: American astro-naut Aldrin's ideas about in-habiting planet Mars	16.06.2017	30
Sky Ltd.	12	Sky VR: Hold the World	Culture: A journey through London's Natural History Mu-seum with Sir David Attenbor-ough.	01.11.2018	39
	13	Sky VR	Miscellaneous: Latest Sky VR content.	03.10.2016	22
NYT	14	Apollo 11: As They Shot It	History: A journey to the moon in the footsteps of Neil Arm-strong and Buzz Aldrin.	30.12.2019	43
VICE	15	Cut-Off	History: Prime Minister Justin Trudeau's historic visit to an Indigenous reserve in Canada.	26.10.2016	6
Total					770

Note. *According to Godulla, Planer, et al. (2021).

Due to the qualitative-deductive content analysis, all user comments (N = 770) on these 15 VR apps that were available at the time of the project were analysed through a qualitative coding scheme and with the help of four main categories deducted from the considered body of research (Godulla, Planer, et al., 2021). Patterns within the comments were identified and resulted in inductive categories (see Table 3).

Table 3. Overview of deductive and inductive categories*

Deductive	Inductive
I Immersion	(1) Immersive character of the app/story
	(2) Perception of audio-visual effects/sensory experience
	(3) Storytelling or script that causes immersion
	(4) Background information that causes immersion
	(5) Technical implementation that causes immersion
II Emotion	(6) Emotional character of the app/story
	(7) Perception of audio-visual effects/sensory experience
	(8) Storytelling or script that causes emotion
	(9) Background information that causes emotion
III Usability	(10) Perception of audio-visual effects/sensory experience
	(11) Motion sickness
	(12) Navigation/controller/mode
	(13) Interactivity
	(14) Language
IV Utility	(15) (Technological) requirements for installation
	(16) Technical factors
	(17) Technical implementation of audio-visual effects (sensory experience)

Note. *According to Godulla, Planer, et al. (2021).

The results of the qualitative analysis of user comments already gave hints as to which aspects the majority of users referred to in a positive tone (immersion & emotion) and which aspects of their VR experience they criticised (usability & utility) and resulted in four hypotheses (Godulla, Planer, et al., 2021) which were further elaborated for this study. The respective study qualitatively showed that users usually commented on aspects of immersion and emotion positively, while they commented on aspects of usability and utility in a more negative manner (Godulla, Planer, et al., 2021). Thus, hypothesis 1 and 2 were formed:

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> *H1: The majority of users' comments on aspects of immersion and emoti-on on VR apps produced by journalistic media outlets are in a positive tone.*

> *H2: The majority of users' comments on aspects of usability and utility on VR apps produced by journalistic media outlets are in a negative tone.*

Furthermore, since the study showed that immersion and emotion are referred to in a positive manner (H1), their concrete association or relation became of interest as well. A positive relation was thus hypothesized in H3:

> *H3: Positive perceptions of immersion in VR apps produced by journalistic media outlets are also associated with positive perceptions of emotion.*

Similarly, and combining the findings, the question whether positive perceptions of emotion/immersion can exist simultaneously to negative perceptions of utility arose (Godulla, Planer, et al., 2021). It might be that if the technological flaws are too heavy, emotion and immersion cannot be experienced, or users might be too annoyed. If it worked out, however, this would have implications for journalistic outlets and their aspirations in VR. Hence, H4 was formed as a result of the qualitative pre-study:

> *H4: Negative perceptions of usability in VR apps produced by journalistic media outlets exist simultaneously with positive perceptions of immersion and emotion.*

6. Methodology

This paper builds on the mentioned pre-existing qualitative analysis of user comments (N = 770) of VR apps produced by journalistic media outlets and published in the Oculus Store (N = 15, see Table 2). As defined in the previous chapter, the sample was selected according to the following criteria: (1) the VR application was produced by a journalistic media outlet or (2) the content of the applications transmits journalistic information. VR apps that focus solely on entertainment, such as applications published by video game companies or film studios, were excluded. The sample is analysed according to the users' comments on the theoretical constructs of *immersion, emotion*[1], *usability* and *utility* (Godulla, Planer, et al., 2021), and the results aim to answer the proposed hypotheses (*H1-H4*).

Therefore, with the help of the established category system (see Table 3), user comments were then coded manually in the period from January 4 to January 31, 2021, thus preparing for their quantitative content analysis. Thereby, a total of 15 people coded the data after extensive training. A two-stage pretest was completed

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1   Although empathy appears to be the most prominent and frequently discussed emotion in the context of VR applications, the range of emotions generated through VR goes far beyond this. Therefore, a focus on emotions in general seems relevant and is being pursued in this paper.

together in advance. This involved repeatedly randomly assigning coders to each other and calculating the corresponding Holsti values. In the coding process, only categories that achieved an *H*-value above 0.8 were considered.

During the analysis of the comments, each comment was also examined for its positive, neutral, or negative tone regarding the respective category and coded accordingly. In the codebook, definitions and coding instructions[2] were given as to when something was to be coded as negative, positive or neutral. Positive reactions referred to comments that expressed excitement over the content, the elicited emotions, or the technology (i.e., "Great VR experience and emotional storytelling in VR" [1943 Berlin Blitz]), while comments were coded as negative when they referred to these aspects in a critical, underwhelmed or deceived tone (i.e., "Interface controls are poor, and quality of the pieces is actually embarrassing" [Sky VR]). Neutral comments highlighted specific aspects of the experience and the app without hinting as to whether they liked it or not (i.e., "Just saying, you need an internet connection, check your settings" [SKY VR]).

In order to assess the importance of immersion in the user comments regarding the VR apps, a variable was created that counts how often users commented on the respective categories of immersion (without considering a positive or negative tone). Based on the frequency of comments referring to the aspects of immersion, it is possible to evaluate immersion in relation to the other research constructs (emotion, usability, utility). In parallel, an additional variable was created that counts how often comments with a positive or negative tone regarding the categories of immersion were made. The same approach was adopted to evaluate the constructs of emotion, usability and utility and their respective categories. In a next step, in order to answer the research hypotheses, the relationship of the individual constructs was analysed by calculating Chi-Square independence tests and correlation coefficients using the statistical software SPSS Statistics 2021 (version 28.0.1.0 [142]).

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2   To give some insights, for example, the coding instructions of the emotional/immersive character of the app include general statements about the sensation of emotions or the full immersion in the virtual reality, which, however, do not explain why the user feels this way. Based on this, it was further differentiated to what extent other factors such as storytelling or audiovisual effects cause the perception of emotions and immersion. Accordingly, the corresponding coding instructions refer to the narration of a story to convey information, knowledge, values, etc. and/or the thematic context of interactions and the control of attention/flow, which cause emotion/immersion or the audible (e.g., tones, sounds, noises) and/or visible perception (e.g., images, videos) which cause emotion/immersion. Coding instructions of usability refer, for example, to navigation/controller/mode and the investigation to what extent the navigation or movement in the game, e.g., by the controllers, contributes to the user-friendliness. This also includes the synchronization of controller and app as well as the modes (e.g., standing or sitting) in which the app should be played. Finally, utility includes statements on technical implementation, for example, regarding audiovisual effects (sensuality), which examines whether the technical implementation of acoustic and visual effects works. This also includes whether the 3D animation typical for VR functions.

7. Results: When VR works despite technological flaws

Descriptive data analysis

The large number of comments that refer to immersion, emotion, usability, and utility will be presented considering the respective research hypotheses.

> H1: *The majority of users' comments on aspects of immersion and emotion on VR apps produced by journalistic media outlets are in a positive tone.*

A total of 208 comments (27%) refer to immersion, with the majority describing a positive immersion (142, see Table 4). A closer look reveals that in particularly the immersive character (119) of the VR app as well as the perception of the audio-visual effects (37) are mentioned as facilitators of immersion. Likewise, numerous comments (47) refer to the relationship between storytelling and immersion. The evaluation of immersive perception due to storytelling, however, is divided. While 26 comments mention storytelling as a cause of positive immersion, 18 comments identify a negative relationship. Similar results can also be identified for both technical implementation and the user's background information causing immersion. Comments on these categories are almost equally divided into positive and negative immersion, although it should be noted that fewer comments were made that could be assigned to the categories of technical implementation and the user's background information. In addition, the confidence intervals of the proportion of positive comments on all comments of the respective variables were calculated. Thus, for each variable, the results show a range of values containing the proportion of the underlying population (user comments on the respective variable) with a 95 percent confidence level.

As Table 4 shows, the proportions of positive comments and the confidence intervals of the variables *overall perception, immersive character, perception of audio-visual effects and storytelling* are each above 0.5 minimum, indicating that in each case more than half of all comments on these aspects of immersion are positive; the confidence intervals have a 95 percent likelihood of representing the actual proportions of all comments on these aspects of immersion. In contrast, the results of the variables *background information* and *technical implementation* show that the minimum of these confidence intervals are below 0.5 and therefore it cannot be assumed with a 95 percent probability that more than half of the comments on these aspects of immersion are positive.

Table 4. Aspects of immersion

Variable		Frequencies	Percent	Proportion positive comments (p)	Confidence intervals (95%)
Comments on immersion	yes	**208**	**27.0**	-	
	no	562	73.0		
Overall perception of immersion	positive	142	18.4		
	negative	57	7.4	0.71	[0.708, 0.712]
	n. a.	571	74.2		
Immersive character of the app/story	positive	**119**	**15.5**		
	neutral	12	1.6	**0.76**	[0.757, 0.763]
	negative	25	3.2		
	n. a.	614	79.7		
Perception of audio-visual effects/sensory experience	positive	**37**	**4.8**		
	neutral	2	.3	**0.79**	[0.782, 0.798]
	negative	8	1.0		
	n. a.	723	93.9		
Storytelling or script that causes immersion	positive	**26**	**3.4**		
	neutral	3	.4	**0.55**	[0.536, 0.564]
	negative	18	2.3		
	n. a.	723	93.9		
Background information that causes immersion	positive	7	.9		
	neutral	-	-	0.54	[0.489, 0.591]
	negative	6	.9		
	n. a.	757	98.3		
Technical implementation that causes immersion	positive	14	1.8		
	neutral	-	-	0.5	[0.475, 0.525]
	negative	14	1.8		
	n. a.	742	96.4		
Total		**770**	**100**		

Note. Source: Data set of user comments (N = 770) on VR apps produced by journalistic media outlets (N = 15); neutral = number of comments that address this aspect without positive or negative valence; n.a. = number of comments that do not address this aspect at all.

When examining the construct of emotion, a total of 152 comments (19.7%) refer to emotional aspects of the respective VR apps (see Table 5). The majority of the comments refer to a positive emotional experience, i.e., emotions were generated according to the intention of the respective VR app. In terms of the identified inductive categories, it appears that in particular the emotional character of the app and the storytelling are mentioned as causes of positive emotions (96 comments; 37 comments). Nevertheless, it should be noted that there are also a number of cases in which the emotional character of the app and the

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storytelling were mentioned as causes for negative emotions (24 comments; ten comments), i.e., emotions not intended to be generated by the app. In addition, the perception of the audio-visual effects as well as the user's background factors were mentioned less frequently as reasons for a positive emotional involvement in the VR app (23 comments; nine comments). Similarly, fewer comments on audio-visual effects and the user's background factors are associated with negative emotional involvement in the VR app (six comments; two comments). In addition, as Table 5 shows, the proportions of positive comments on aspects of emotions as well as the confidence intervals of all the variables are each above 0.5 minimum, indicating that in each case more than half of all comments on these aspects are positive; the confidence intervals have a 95 percent likelihood of representing the actual proportions of all comments on these aspects of emotion.

Table 5. Aspects of emotion

Variable		Frequencies	Percent	Proportion positive comments (p)	Confidence intervals (95%)
Comments on emotion	yes	**152**	**19.7**	-	-
	no	618	80.3		
Overall perception of emotion	positive	**107**	**13.9**		
	negative	30	3.9	**0.78**	[0.777, 0.783]
	n. a.	633	82.2		
Emotional character of the app/story	positive	96	12.5		
	neutral	16	2.1		
	negative	**24**	**3.1**	**0.71**	[0.706, 0.714]
	n. a.	634	82.3		
Perception of audio-visual effects/sensory experience	positive	23	3.0		
	neutral	-	-		
	negative	6	.8	**0.79**	[0.777, 0.803]
	n. a.	741	96.2		
Storytelling or script that causes emotion	positive	**37**	**4.8**		
	neutral	-	-		
	negative	10	1.3	**0.79**	[0.782, 0.798]
	n. a.	723	93.9		
Background information that causes emotion	positive	9	1.2		
	neutral	2	.3		
	negative	2	.3	**0.69**	[0.651, 0.729]
	n. a.	757	98.3		
Total		770	100		

Note. Source: Data set of user comments (*N* = 770) on VR apps produced by journalistic media outlets (*N* = 15); neutral = number of comments that address this aspect without positive or negative valence; n.a. = number of comments that do not address this aspect at all.

H2: The majority of users' comments on aspects of usability and utility on VR apps produced by journalistic media outlets are in a negative tone.

The analysis of the usability of the VR apps reveals that a total of 292 comments (37.9%) refer to this construct (see Table 6). While the majority of comments that refer to immersion and emotion report a positive experience, usability is dominated by a negative perception (176 comments). The perception of audio-visual effects is mentioned most frequently as an aspect of usability, however, the results show users' perceptions vary widely: While 78 comments state a positive perception of audio-visual effects, 75 comments express a negative perception. Additionally, the majority of comments referring to motion sickness (37 comments), navigation/controller/mode (76 comments) as well as interactivity (20 comments) and language (twelve comments) describe negative experiences and thus a negative usability. Further, not all aspects of usability proved to result in predominantly negative comments. As results of Table 6 demonstrate, the proportions of negative comments and the confidence intervals of the variables *overall perception, motion sickness, navigation and language* are each above 0.5 minimum, indicating that in each case more than half of all comments on these aspects of usability are negative; the confidence intervals have a 95 percent likelihood of representing the actual proportions of all comments on these aspects of usability. In contrast, the results of the variables *perception of audio-visual effects and interactivity* show that the minimum of these confidence intervals are below 0.5 and therefore it cannot be assumed with a 95 percent probability that more than half of the comments on these aspects of usability are negative.

Table 6. Aspects of usability

Variable		Frequencies	Percent	Proportion negative comments (*p*)	Confidence intervals (95%)
Comments on usability	yes	**292**	**37.9**	-	-
	no	478	62.1		
Overall perception of usability	positive	89	11.6	**0.66**	[0.658, 0.662]
	negative	176	22.9		
	n. a.	505	65.6		
Perception of audio-visual effects/sensory experience	positive	**78**	**10.1**	0.44	[0.436, 0.444]
	neutral	17	2.2		
	negative	75	9.7		
	n. a.	600	77.9		
Motion sickness	positive	3	.4	**0.76**	[0.752, 0.768]
	neutral	9	1.2		
	negative	37	4.8		
	n. a.	721	93.6		

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Navigation/controller/ mode	positive	10	1.3		
	neutral	9	1.2	**0.80**	[0.796, 0.804]
	negative	76	9.9		
	n. a.	675	87.7		
Interactivity	positive	11	1.4		
	neutral	15	1.9	0.43	[0.414, 0.446]
	negative	20	2.6		
	n. a.	724	94.0		
Language	positive	4	.5		
	neutral	2	.3	**0.67**	[0.641, 0.699]
	negative	12	1.6		
	n. a.	752	97.7		
Total		**770**	**100**		

Note. Source: Data set of user comments (*N* = 770) on VR apps produced by journalistic media outlets (*n* = 15); neutral = number of comments that address this aspect without positive or negative valence; n.a. = number of comments that do not address this aspect at all.

Additionally, the number of comments referring to utility is similar to that for usability (218 comments, 28.3%), with the majority of comments on aspects of utility referring to a negative experience (see Table 7). A negative perception of the technical factors during use is mentioned in particular by the users (76 comments), while only a few comments refer to this category in a positive tone (ten comments). In addition, as the results of Table 5 show, the proportions of negative comments as well as the confidence intervals of all the variables are each above 0.5 minimum, indicating that in each case more than half of all comments on these aspects of utility are negative; the confidence intervals have a 95 percent likelihood of representing the actual proportions of all comments on these aspects of utility.

Table 7. Aspects of utility

Variable		Frequencies	Percent	Proportion negative comments (p)	Confidence intervals (95%)
Comments on utility	yes	**218**	**28.3**	-	-
	no	552	71.7		
Overall perception of utility	positive	40	5.2		
	negative	146	19.0	**0.78**	[0.778, 0.782]
	n. a.	584	75.8		
(Technological) requirements for installation	positive	4	.5		
	neutral	14	1.8	**0.59**	[0.576, 0.604]
	negative	26	3.4		
	n. a.	726	94.3		
Technical factors	positive	10	1.3		
	neutral	13	1.7	**0.77**	[0.766, 0.774]
	negative	76	9.9		
	n. a.	671	87.1		
Technical implementation of audio-visual effects (sensory experience)	positive	**32**	**4.2**		
	neutral	16	2.1	**0.56**	[0.554, 0.566]
	negative	60	7.8		
	n. a.	662	86.0		
Total		770	100		

Note. Source: Data set of user comments (N = 770) on VR apps produced by journalistic media outlets (N = 15); neutral = number of comments that address this aspect without positive or negative valence; n.a. = number of comments that do not address this aspect at all.

Further, there are numerous comments referring to the implementation of audio-visual effects. While the majority of these comments refer to this aspect negatively (60 comments), there are also many comments in which the implementation of these effects is considered positively (32 comments). Relatively fewer comments were made regarding the technological requirements for installation (44 comments), with most of them being negative (26 comments). Only four positive comments were made on the technological requirements for the installation of the respective VR apps.

Statistical data analysis

In the following, the results of the relationship between immersion and emotion as well as the relationship between immersion/emotion and usability will be presented considering the research hypotheses.

> *H3: Positive perceptions of immersion in VR apps produced by journalistic media outlets are also associated with positive perceptions of emotion.*

When analysing the relationship between perceived immersion and perceived emotion, the results show a strong effect with the statistical value being highly significant ($p < .001$, see Table 8). When considering comments containing positive statements on perceived immersion, it appears that aspects of emotion are only perceived positively (100%), with no comments that mention positive perceived immersion and negative perceived emotions at the same time. Additionally, the majority of negative comments on perceived immersion also mention negative perceived emotion (85.7%), with only a few comments that report positive perceived emotion despite mentioning negative perceived immersion (14.3%). Therefore, a positive emotional VR experience seems likely to be associated with a positive immersion and vice versa.

Table 8. Immersion and emotion

Variable		positive immersion	negative immersion	Chi^2	*p*	Phi
Emotion	positive	**42 / 100%**	2 / 14.3%	45.81	.000	.905
	negative	0 / 0%	**12 / 85.7%**			
		42 / 100%	14 / 100%			

Note. Source: User comments concerning immersion and emotion (*n* = 56) on VR apps produced by journalistic media outlets (*N* = 15).

> *H4: Negative perceptions of usability of VR apps produced by journalistic media outlets exist simultaneously with positive perceptions of immersion and emotion.*

As the results in Table 9 show, a strong significant relationship exists between usability and perceived immersion with the respective VR apps (Chi^2(1) = 29.03, $p < .001$, Phi = 0.63). Regarding comments in which a positive usability was expressed, immersion was also predominantly perceived positively (91.9%), with only 8.1 percent of such comments expressing negative perceived immersion. In contrast, comments that expressed a negative usability were slightly more ambivalent in regard to perceived immersion. Although the majority of these comments (69.4%) express negative immersion, there are several comments that report positive perceived immersion despite mentioning negative usability (30.6%). Hence, users seem especially likely to have a positive immersive VR experience if the technological aspects function well.

Table 9. Perceived immersion and usability

Variable		positive usability	negative usability	Chi^2	p	df	Phi
Immersion	positive	**34 / 91.9%**	11 / 30.6%	29.03	.000	1	.63
	negative	3 / 8.1%	**25 / 69.4%**				
		37 / 100%	36 / 100%				

Note. Source: User comments concerning immersion and usability (*n* = 73) on VR apps produced by journalistic media outlets (*N* = 15).

Similarly, the results in Table 10 show that there is a strong significant relationship between usability and the perceived emotions of journalistic VR apps (Chi^2(1) = 17.57, *p* < .001, Phi = 0.58). Regarding comments in which a positive usability was expressed, emotion was only perceived in a positive way (100%), with no comments that mention positive usability and negative perceived emotions at the same time. Conversely, the comments on perceived emotions in the context of negative usability are distinctly divided. While slightly more than half of the comments that mention negative usability also mention negative perceived emotions (53.3%), almost as many express positive perceived emotions (46.7%). Thus, it can be summarised that users primarily have a positive emotional VR experience if the technological aspects function well, but some of them can also have a positive emotional experience when the technological aspects are perceived as negative.

Table 10. Perceived emotion and usability

Variable		positive usability	negative usability	Chi^2	p	df	Phi
Emotion	positive	**23 / 100%**	14 / 46.7%	17.57	.000	1	.58
	negative	0 / 0%	**16 / 53.3%**				
		23 / 100%	30 / 100%				

Note. Source: User comments concerning emotion and usability (*n* = 53) on VR apps produced by journalistic media outlets (*N* = 15).

8. Discussion: A necessary trio of technology, immersion, and storytelling

The goal of this paper was to create a summary of the lessons learned so far about VR apps produced by journalistic media outlets and published in the Oculus Store, as well as to generate practical conclusions for a possible re-start of VR in journalism. First, the strengths, characteristics, weaknesses and concerns as identified by journalism scholars (Table 1) seem mirrored in the quantitative content analysis of this study and thus by the users' comments on 15 journalistic VR apps: The majority of users' comments on aspects of emotion on VR apps produced by journalistic media outlets are in a positive tone, which confirms the statements by Sánchez Laws (2020) that immersive journalism enables witnessing

emotions (p. 223) and furthermore confirms the close relation between VR and emotion in general (e.g., Baía Reis & Coelho, 2018, p. 1097; Kukkakorpi & Pantti, 2021; Nielsen & Sheets, 2021). It can be assumed that the same holds true for the specific emotion of empathy (e.g., Hassan, 2020; Steinfeld, 2020); however, empathy itself has not been assessed and can therefore not be judged at this point.

Concerning the aspect of immersion, it is important to note that not all related aspects were considered in a positive tone in the majority of users' comments (e.g., background information that causes immersion; technical implementation that causes immersion). Hence, in this case, the enthusiasm existing in the scholarly debate around immersive journalism (e.g., Baía Reis & Coelho, 2018; Marini et al., 2012) is only partly reflected in the results. Since "greater system immersion results in higher levels of immersive response of the viewer" (Van Damm et al., 2019, p. 2056), it might be argued that the system immersion of the analysed VR apps was not established enough for the immersion to function well. Thus, *H1* can only partly be accepted.

This assumption would be supported by the fact that technological aspects of usability and utility are more often accompanied by concerns and criticism in the users' comments: The majority of users' comments on aspects of utility on VR apps produced by journalistic media outlets are in a negative tone. Considering the aspects of usability, however, a distinction needs to be made as not all aspects were considered in a negative tone in the majority of users' comments (e.g., perception of audio-visual effects/sensory experience; interactivity). Thus, also *H2* can only partly be accepted.

Considering these results, both the continuing availability of the apps in the Oculus Store and the number of comments referring to a positive experience during use (emotion, immersion) indicate that "this type of innovation is about what audiences (allegedly) need and want" (Lecheler, 2020, p. 289), even though the technology sometimes lacks in terms of usability. The positive comments related to the immersive character of the app and its audio-visual effects also suggest that these journalistic VR apps have proven to successfully transmit the feeling of being there to the users (Cummings & Bailenson, 2016). Additionally, the results of this study also follow up on studies that consider VR journalism to have the potential to generate emotions such as empathy among its users (Mabrook & Singer, 2019; Sánchez Laws, 2020; Shin & Biocca, 2017). In contrast, the predominantly negative comments on usability and utility follow the argument that the technology seems to be "relatively inconvenient in its current form" (Nielsen & Sheets, 2021, p. 12) and indicate that journalistic media organizations wanting to advance in VR production should focus on technological aspects and the VR apps' functionality. Referring to Lecheler's (2020) statement that emotion-driven journalism seems motivated by technological innovation, it also seems *facilitated* or *advanced* by technological innovation, and this seems particularly the case when the innovation functions well.

Additionally, it appears that the narratives, storylines, and character of the journalistic VR apps seem to be in place as users mostly referred to these aspects in a positive tone. This applies specifically to storytelling that enabled emotion (as

perceived by the users). In comparison, the storytelling that enabled immersion received more negative comments than the storytelling that enabled emotion. If the table of strengths and weaknesses of VR were to be expanded by insights from the users' comments, one might add the particular aspect of "storytelling" to VR's strengths. It seems to be functioning as an intervening variable, since it also had the power to split users' opinions on both emotion and immersion. Hence, good storytelling or script is highly relevant to the immersive VR experience and overall emotion which in turn can also enable users to feel empathy for others (Sánchez Laws, 2020).

How the emotional and immersive VR experiences correlate has been tested with *H3*. The results show that positive perceived immersion is also related to positive perceived emotions, therefore *H3* can be accepted. If users seem more likely to have a positive emotional VR experience if immersion works well, this again points to the importance of functioning technological aspects and usability, which underlie the immersion. Hence, these findings indicate once again that VR journalism should place a strong focus on increasing the level of usability, which may ultimately benefit both the level of immersion and the level of emotion. It is important to understand, however, that the very best VR technology will most likely not succeed if the content and storytelling of the journalistic VR app are not coherent.

Lastly, we examined to what extent negative perceptions of the usability of journalistic VR apps can be perceived simultaneously with positive perceptions of immersion and emotion *(H4)*. It turns out that usability has a strong effect, especially in regard to the construct of immersion. Users who perceive the usability of a VR app negatively are more likely to perceive less immersion, although in some cases positive perceptions of immersion were possible despite negatively perceived usability. Thus, our hypothesis *H4* can be accepted for the construct of immersion. These findings are consistent with those from previous research indicating that usability plays a critical role, especially when it negatively affects perceived immersion, so that users may find it "too stressful and attention demanding for everyday use" (Nielsen & Sheets, 2021, p. 12). In terms of perceived emotions, the effect of the usability of the journalistic VR apps is more sharply divided. As the relationship analysis shows, users primarily have a positive emotional VR experience if the technological aspects function well, but some may also have a positive emotional experience even though the technological aspects are perceived negatively. These findings might relate to the research indicating that each person perceives an immersive VR experience differently (Hassan, 2020), and that technology is not the only decisive factor (Lecheler, 2020; Marini et al., 2012).

The fact that positive emotional and immersive reactions in VR are possible despite flaws in technology might be one explanation for why VR continued to live on after leading media and technology companies withdrew from the market. Although it might not have had the best start and might not initially have found a market, users did have positive experiences playing with VR – maybe due to good storytelling. What was not promising in terms of revenues, might nonetheless have been promising in terms of users' experiences. This also gives hope to journalistic productions that operate in the low-budget sector. They can still im-

merse users emotionally into their content without necessarily being competitive with the latest VR technology which is costly and unaffordable to many (Steinfeld, 2020).

This finding is generally interesting for both VR journalists and developers of technology, since an improvement in technology would logically result in even greater user experiences, and hence might lead to VR becoming more marketable in journalism. Picking up on the identified weaknesses and concerns faced by VR in the past (Table 1), however, this technology would have to be cheaper for both journalism and its users, and journalists would have to be trained in its application. If VR is to become a successful tool in the future of journalistic reporting – and not merely a fancy add-on that only big media companies can afford – journalism education has to pick up on it, too, by teaching how to create VR content.

At this point, journalism research might contribute to the discussion around ethical conflicts and the seeming contradiction with traditional journalism, where emotion is rather unwelcome (Sánchez Laws, 2020, p. 222) and seen as an opponent of objectivity, while in VR journalism, emotion is one of the outstanding strengths. Only if journalists and journalism students know how to handle VR as both a technology and a journalistic format – knowing how to marry objectivity to the emotional and immersive character, knowing what content to choose for a VR experience, gaining experiences in making decisions in terms of user agency, learning how to treat ethical conflicts and balance different perspectives, et cetera – only then will users understand how to approach VR journalism and what to expect of it. Therefore, journalism research and education have to find a consensus on these rather critical or debatable aspects, and clear ethical and practical guidelines need to be developed alongside an ongoing practice of trial and error in VR.

9. Outlook: A restart of VR journalism with certain terms and conditions

This paper aims to fill gaps in research on VR journalism by (1) examining the strengths and weaknesses of VR as identified by journalism scholars in recent years and thus providing insights of the state of the art of VR applications in the journalistic field and (2) focusing on the user's perception of VR apps produced by journalistic media outlets in the context of immersion, emotion, usability, and utility.

As pointed out, there seems to be a contradiction regarding emotion in traditional and VR journalism. Whereas it is seen as an opponent to objectivity in the traditional setting (Sánchez Laws, 2020, p. 222), it is one outstanding strength in the VR context. This paper contributes to this discussion by offering results that are in line with the current body of journalism research and refer to strengths and obstacles of VR journalism. First, the results point to a close relation between VR and emotions in general (e.g., Baía Reis & Coelho, 2018, p. 1097; Kukkakorpi & Pantti, 2021; Nielsen & Sheets, 2021) and the potential of VR journalism to generate emotions such as empathy among its users (Mabrook & Singer, 2019; Sánchez Laws, 2020; Shin & Biocca, 2017). Second, they refer to a close connection between the users' emotional and immersive experience, which in turn is also

linked to the critical role of the VR apps' usability (Nielsen & Sheets, 2021, p.12). Usability, however, appears to be but one crucial factor for a functioning immersive and emotional experience, as the results indicate that in some cases the users were immersed emotionally despite technological flaws. These findings follow up on the current discussion that technology is not the only decisive factor in getting the users emotionally immersed (Hassan, 2020; Lecheler, 2020; Marini et al., 2012) and refer to the importance of a range of other factors including the users' individual experience and the script or storytelling that might cause a positive immersive and emotional experience.

Summarising the findings and points of discussion, one might cautiously argue in favour of an approaching restart of VR in journalism. While in its initial phase, VR journalism had major deficits which caused media and technology companies to scale back on their undertakings, certain variables have developed since then: First of all, the technological advancements and developments are ongoing and make an affordable, more easily applicable and easy-to-handle VR technology (for both journalists and users) more imaginable and tangible. Second, users have had more time to get used to the technology now, to play with it and to make their own experiences with a journalistic VR story. Hence, they are now more familiar with the technology than they were back in 2017, when the first journalistic VR stories entered the market. Third, journalists have also had time to collect relevant experiences and feedback in their handling of VR content and are now more proficient in its usage than before.

Finally, practicing journalists are well advised to invest in aspects of usability while at the same time continuing to place their focus on the storytelling of their journalistic VR content. Especially when it comes to the latter, they could borrow practices and insights from scholarly findings about longer journalistic formats, such as literary journalism, investigative journalism or longform journalism and digital storytelling (Planer & Godulla, 2021; Planer et al., 2020; Planer et al., 2022). On the management level of newsrooms and media companies, technological solutions (both hard- and software) that are both cheaper and easier to apply should be sought out. Journalists experienced in VR productions who either also function as journalism educators or who have the chance to pass on their practical knowledge to up-and-coming journalists should do so in order to prepare the latter for this particular format. Last but not least, journalism scholars could and should engage in the discussion about ethical conflicts, objectivity, uses and gratifications, and user agency in relation to VR, generating further empirical knowledge and possibly even a well-founded set of guidelines for producing journalistic VR content.

10. Limitations

First of all, the results of this study concentrate on 15 analysed VR apps published in the Oculus Store which can be experienced using Oculus Rift. Hence, further VR applications – for example published by further journalistic institutions which do not collaborate with the Oculus Store, or VR applications solely focusing on 360° videos – are left out and should become subject to further re-

search. Thus, our sample is limited to those 15 specific journalistic VR apps and does not allow generalizable statements about all existing journalistic VR apps. Furthermore, the number of comments per app varied greatly and, in some cases, only low numbers of comments were analysed, which might influence the statistically robust answers to the hypotheses. While this research focused primarily on stand-alone, completed VR applications, further research could also investigate the variety of journalistic VR features of different news outlets. Also, the analysed theoretical concepts of emotion, immersion, usability and utility are only four among a wide range of further, relevant concepts. Further research in the realms of journalism and VR could integrate further theoretical concepts, such as the concept of awe (Possler et al., 2018).

With regard to the people who access the Oculus Store, it is difficult to draw any precise conclusions about their characteristics or demographics within the quantitative content analysis. Nevertheless, it can be assumed that this group of users tends to be young individuals who have an affinity for technology and, with regard to the thematic focus of these apps, tend to be educated and interested in social, cultural, political, historical, environmental, and technological topics. The journalistic VR apps examined in this study can be accessed theoretically by all individuals who have internet access and the necessary technical equipment. Therefore, the population of this study represents all users who meet these two requirements and who are interested in journalistic VR apps or who are already using them.

Further research should also go beyond analysing the perceptions of users as expressed in comments and thereby address another limitation of this study that is inherent to the analysis of user comments: Comments only represent what certain users decided to share, so the experiences of other users who did not comment on the apps as well as the experiences that those commenting did not verbally express did not undergo the analysis. Therefore, this paper does not claim external validity for all users of the Oculus Store. Rather, it represents an investigation of the tendencies in user comments and here, commenting represents a purely self-selective phenomenon which provides information about the subjective opinions of users who wanted to articulate their praise or criticisms in a certain way. The motivation for leaving a comment is considered an important indication that using these apps has left a certain kind of impact on the users. In this context, it must be taken into account that the users' perception of usability and utility might have been influenced by novelty effects, which for example play an important role in the field of gamification (Rodrigues et al., 2022) and might also occur when using VR apps (for the first time).

The advantages of this work lie in the cost- and time-effective implementation, the low technical equipment required (compared to a laboratory study), and the collection of a sample that, compared to other methodological approaches, is not influenced by social desirability in users' responses. For the future, nevertheless, experimental studies and qualitative interviews with both users and producers could add important insights into the topic. By analysing the journalistic VR products themselves, another limitation of the present study could be addressed, that is the diverse sample that made it impossible to analyse the VR apps individually.

Hence, further studies could place a greater focus on specific VR formats, their development and also their content. Concerning the latter, a closer dive into the different aspects of immersion and emotion in relation to the displayed VR content would be worth analysing as well. Both the concepts of immersion and emotion are highly complex and seem dependent on different variables – next to the displayed content and the functioning of the technology, the individual predispositions users might also play a role.

Finally, researchers should also observe recent developments in AI technologies, which enable new forms of content creation for illustrating stories and rendering news more accessible and immersive. A trend-leading example of this are so-called deepfakes – AI-based manipulated (audio-)visual material (Godulla et al., 2021). It seems relevant for future research to examine the extent to which the use of AI technologies, such as deepfake software, can be beneficial to future forms of presentation in (VR) journalism and VR in general (Godulla et al., 2021). For example, recent research indicates that people show a higher level of trust towards deepfake faces compared to real ones (Gent, 2022). Due to the results of this study that positive immersion and emotion were also caused due to high-quality audio-visual effects, the use of deepfake videos for VR applications might also possess the possibility to evoke a high level of users' trust in the characters portrayed that in turn may result in an even higher level of immersive and emotional engagement. In addition, VR could also be used for an emotional and immersive experience in combination with deepfake technology by, for example, virtually bringing back to life people (e.g., family members) who have already died and thus, might help the user to exploit their grief (Kim, 2022).

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