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360° AUDIOVISUAL JOURNALISM:

a study on user perceptions of sense of presence and credibility

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ABSTRACT – The increasing use of high technology in journalism has led to new formats of content production. In this paper, we focus on one of these formats: 360° audiovisual reports. This format uses virtual reality (VR) and aims to produce a certain sense of presence in virtual environments. We seek to understand the relationship between this sense of presence and credibility, in addition to identifying which user perceptions may be linked to credibility. Our methodology involved developing a reception study which included experimental research, conducting interviews, and applying a questionnaire. The results point to a positive correlation between the variables, reinforcing relationships pointed at in other studies and demonstrating the importance of perceptions like freedom of choice, less manipulation/more transparency, and sensationalism.
Key words: Sense of presence. Credibility. Virtual reality. 360° audiovisual journalism.

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JORNALISMO AUDIOVISUAL EM 360°: estudo sobre a percepção dos usuários acerca da sensação de presença e da credibilidade

RESUMO – Em um contexto de crescente utilização de alta tecnologia no jornalismo, novos formatos têm sido incorporados à produção de conteúdo. Neste artigo, nossa atenção se volta para o estudo de um desses formatos: reportagens audiovisuais em 360°, que utilizam a realidade virtual (RV) e visam provocar algum nível de sensação de presença em ambientes virtuais. Buscamos entender a relação entre sensação de presença e credibilidade, além de identificar quais percepções dos usuários podem estar ligadas à credibilidade. Metodologicamente, desenvolvemos um estudo de recepção, envolvendo pesquisa experimental, realização de entrevistas e aplicação de questionário. Os resultados apontam uma correlação positiva entre as variáveis, reforçam relações apontadas em outras pesquisas e demonstram a importância de percepções como liberdade de escolha, menos manipulação/mais transparência e sensacionalismo.
Palavras-chave: Sensação de presença. Credibilidade. Realidade virtual. Jornalismo audiovisual em 360°.

PERIODISMO AUDIOVISUAL EN 360°: estudio sobre la percepción de los usuarios sobre la sensación de presencia y credibilidad

RESUMEN – En un contexto de creciente uso de alta tecnología en el periodismo, se han incorporado nuevos formatos a la producción de contenidos. En este artículo, nuestra atención se centra en el estudio de uno de estos formatos: los reportajes audiovisuales en 360°, que utilizan la realidad virtual (VR) y pretenden provocar algún nivel de sensación de presencia en entornos virtuales. Buscamos comprender la relación entre sensación de presencia y credibilidad, además de identificar qué percepciones de los usuarios pueden estar vinculadas a la credibilidad. Metodológicamente, se desarrolló un estudio de recepción, involucrando investigación experimental, realización de entrevistas y aplicación de un cuestionario. Los resultados apuntan a una correlación positiva entre las variables, refuerzan relaciones señaladas en otros estudios y demuestran la importancia de percepciones como libertad de elección, menos manipulación/más transparencia y sensacionalismo.
Palabras clave: Sentido de presencia. Credibilidad. Realidad virtual. Periodismo audiovisual en 360°.

1 Introduction

New formats of journalistic content have emerged over the last decade. Many factors have contributed to this emergence, one of which is the development and availability of technologies that have the potential to provoke news experiences (Pavlik, 2019), such as virtual reality (VR) and augmented reality (AR), which go beyond merely presenting the facts. These technologies also result in increased use of resources such as artificial intelligence, robots, and drones, resulting in a heightened application of high technology

in journalistic production (López-García & Vizoso, 2021). In terms of consumption, we discuss the evolution of networks and mobile devices and the resulting popularization of smartphones (Canavilhas, 2021). In terms of the media landscape, we emphasize the growing dependence on digital platforms dominated by algorithms which, although stimulating innovation and offering pre-formatted structures for product development, impose rules that destabilize the sustainability of news production and have contributed to the gradual loss of autonomy and credibility in journalism (Dijck et al., 2018; Napoli, 2021; Rodrigues & Lima, 2022).

This complex context involves strong connections to trust in journalism and its relevance as a provider of information, so much so that credibility is considered one of the great contemporary challenges (Fink, 2019). In journalism, being reliable means that the reports "[...] are supported by verifiable information, do not contradict reality, and are in line with the facts" (Christofoletti, 2019, p. 64, our translation). When credibility is questioned "[...] the activity itself becomes questioned in terms of its legitimacy within a democracy" (Grossi & Santos, 2018, p. 52, our translation). The survival of journalism, therefore, involves not only the (re)construction of credibility but the constant preservation of it. However, engaging in actions that inspire credibility is not enough; the public needs to recognize them. This recognition, or perception, is an objective and subjective process that can vary from political and sociocultural changes to the emergence of new media contexts, including new media forms (Kerunga et al., 2020; Chung et al., 2012).

In addition to the innovative formats and narratives they produce, we question whether emerging technologies that invest in immersion and user experience might also be able to help (re) construct journalistic credibility. We then direct our attention to 360° audiovisual journalism, which uses virtual reality to place the user in the scenes and choose which viewing angle they prefer to see. The main feature behind consuming this type of narrative is how it can develop (to some degree) a sense of presence in virtual environments. A number of studies have suggested a positive relationship between the sense of presence and credibility (Kang et al., 2018; Sundar et al., 2017; Vettehen et al., 2019).

Consequently, our main objectives in this article were: a) to understand how the relationship between the sensation of presence and credibility occurs in 360° audiovisual reports, and b) to identify which sensations and perceptions of user experience might be linked

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to credibility. To do this, we developed a reception study with a quali-quantitative approach, which involved a bibliographic review, experimental research, semi-structured interviews, and a questionnaire. The discussions are part of the results of a doctoral study focused on the consumption experience of 360° audiovisual journalism.

Despite the current decline of these types of productions, we believe that VR continues to be increasingly applied in several areas, and large technology companies continue to invest in developing and popularizing it. What's more, the development of hybrid universes between the virtual and the real (called metaverses) has resulted in discussions and investments from different sectors, thus opening up new narrative possibilities in journalism (Cordeiro & Santos, 2022; Stanescu, 2022). One example of a growing initiative in the metaverse is *Decentraland*[1], a 3D virtual world browser-based platform that includes games, virtual reality, and cryptocurrencies.

However, we are not going to extremes and saying that VR, as a technology, only brings benefits to news production. We do, however, believe that it still has untapped potential in journalism (Damas & Gracia, 2022) and the decline in its use that we are currently experiencing "[...] does not indicate the end of the format, but perhaps a conditioning for a resurgence" (Silva, 2021, p. 2, our translation). Thus, VR technology has become more accessible, and easier to handle and apply, already having parameters from previous experiences that contribute to more efficient and conscious use of devices (Seibert et al., 2022). Virtual reality is far from being the great savior of journalism, but it may be able to help point the way. This study is guided by the responsibility of academia to be aware of changes in the media ecosystem and bring about reflections that can reduce uncertainties and demonstrate practical routes.

2 360° audiovisual journalism

The end of the 2000s culminated with a strong development of digital media which introduced new journalistic narratives. During this period, the term immersive journalism was coined, described as "[...] the production of news in a form in which people can gain first-person experiences of the events or situation described in news stories" (De La Peña et al., 2010, p. 291). The concept was based on VR experiences through the development of virtual environments

mainly using computer-generated images. Depending on how the news piece is constructed and the device it is consumed on, users are represented by an avatar and can choose the angle they wish to view the story, also being able to change their position and perform several actions. De La Peña (2019) cites 360° videos in her study, claiming that there is much more to immersive journalism. From the perspective of those who coined the term, immersive journalism is a very specific format that, so far, has not been used much in journalistic production, but does offer a number of possibilities for users besides a 360-degree view.

However, almost all the immersive content adopted by mainstream journalism does not allow users to do much more than move their heads and choose viewing angles. 360° video has become the predominant material for building news pieces (Fidalgo & Ambrosio, 2022; Gracia, 2019; Pérez-Seijo, 2021; Rodrigues, 2021). More simple than reconstructions made entirely on a computer, 360° videos are produced from cameras that record the entire surroundings of an environment. There was no specific concept for this type of content, however, a considerable number of researchers used immersive journalism. The term inspired diverse investigations, resulting in considerable research development in immersive and experience-based journalistic narratives.

However, as investigations continued, other terminologies were created and discrepancies were pointed out in studies between what the concept says and what was actually being produced by the market (Lima & Barbosa, 2022). Hidalgo et al. (2022) noticed that "[...] although there are many references in theoretical frameworks on the influence of Nonny De La Peña, no example can be found that follows in her footsteps" (p. 22, our translation). Silva et al. (2020) point out that not all theoretical propositions on immersive journalism were applied in practice, advising "[...] the need to update the term, based on theoretical and empirical reviews" (p. 6, our translation). De Bruin et al. (2020) suggest that the focus of studies shift from analyzing the effect of less-advanced immersive productions which only offer the user a 360° view.

In light of these disagreements, some researchers have rearranged the very concept of immersive journalism to include 360° videos. This is the case for Gracia (2019) who used the term immersive 360° video reporting and Pérez-Seijo (2021) who adopted two modalities of immersive journalism, one with VR and the other with 360° video. Other researchers however have broken from the concept and created other

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terms, some less comprehensive than others, such as virtual journalistic representation (Rocha, 2020), 360° telejournalism (Rodrigues, 2021), immersion-oriented journalism (Fonseca, 2020), experiential journalism (Pavlik, 2019), and complex narratives (Longhi, 2020).

That said, we position ourselves among the researchers who decided to break from the term immersive journalism. Our perception is that when this definition is used for products with more limited interaction (different from what the concept refers to) it creates the expectation that it is something it is not by ascribing attributes to the product that the journalistic mediums do not offer. Therefore, in an attempt to move away from the expectations associated with the label of immersive journalism, we adopted the operational definition of 360° audiovisual journalism, encompassing audiovisual pieces with journalistic purposes that allow the user to choose the viewing angle by offering 360° images, regardless of how the audio and images are constructed. For more in-depth content, we also use the term 360° audiovisual reporting as an alternative term.

These are digital native products built for VR. Based on researchers such as Aronson-Rath et al. (2015), Biocca (1996), and Domínguez (2013), in this paper, we understand virtual reality as a means of communication that aims to provide experiences mediated by sensory stimulating equipment of immersion and interaction to promote a sense of presence in virtual environments in which the user has a 360° view.

Based on Domínguez's (2013) readjustment of the levels of immersion, we believe that VR can produce different experiences according to the different sensory stimuli. A basic level of sensory stimulation involves the user coming into contact with virtual environments via devices that do not restrict their view, such as laptops and smartphones. At an average level, this stimulation occurs via devices that restrict one's vision and hearing, such as VR glasses with headphones. In this case, interaction occurs through the use of head movements to choose the desired viewing angle. The high level, in turn, includes everything that the medium level does but also uses other stimuli and possibilities, such as the user's ability to change his or her position and become an avatar. Thus, 360° audiovisual journalism occurs at medium and low levels of sensory stimulation, while immersive journalism occurs at the highest level.

So, we think of consuming 360° audiovisual journalism as a mediated experience, one which aims to bring the event closer to the individual (Fonseca et al., 2020) through the use of equipment

and production strategies of an experiential nature. We do, however, believe this experience does not exactly occur within the virtual space/environment, but within each individual, according to how the experience "inducers" affect them (Braga, 2010).

3 The centrality of the sense of presence in virtual reality

After examining various lines of thought about the sense of presence (Domínguez, 2013; Shin & Biocca, 2017; Schubert et al., 2001), we understand it to be a multifactorial perception; it is a psychological effect on the user, who experiences the sensation of being present in a virtual environment in which they know, consciously, that they are not physically present in. Scholars claim that the sense of presence is strongly propelled by devices that provide greater immersion but is also influenced by narrative techniques (Pérez-Seijo et al., 2023; Seibert et al., 2022). Research shows that a sense of presence is a central component of narratives built for virtual reality (Aronson-Rath et al., 2015; Rose, 2018). As such, it has a direct influence on user experience.

In this study, we hold the position that a sense of presence is a central element of the 360° audiovisual journalism consumption experience. To support our experimental research, we initially needed a way to vary the sense of presence to be able to compare different levels of sense of presence with levels of credibility. Other studies have shown how the sense of presence varies when using different equipment to provoke different sensory stimuli (Sundar et al., 2017; Vettehen et al., 2019). We tested this theory using VR glasses and laptops. Our first hypothesis was developed in order to prove that, in this study, a variation in the sense of presence actually exists. Thus, H1 predicts that participants who use VR glasses will develop a higher level of sense of presence when consuming 360° audiovisual journalistic content than participants who use laptops.

4 360° audiovisual journalism and credibility

Several studies have already investigated the credibility of media messages. However, there is no one way to perform these analyses; it always depends on the peculiarities of the investigation. Chung et al. (2012) conducted a study in which they understood credibility as a quality perceived by recipients based on several factors

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including the trust one places in the product and the journalistic organization. The results suggest that perceptions of credibility are partly influenced by media, design, and format, with hypertextuality being one of the most important features. These same researchers also stated that as new forms of news production and consumption are developed, new criteria to assess credibility need to be constructed as the same parameters do not always work for all formats.

Some studies have shown a positive relationship between the sense of presence and credibility. One such study by Vettehen et al. (2019) looks at expertise (the communicator's qualification or ability to know the truth) and reliability (perception of the communicator's motivations to tell the truth) as being central to assessing credibility. Many hypotheses have posited that the level of credibility is higher for participants who watch a 360° video than for those who watch a 2D version of the same video, and credibility is measured by the sense of presence.

These hypotheses were confirmed quantitatively and the conclusion was reached that immersive formats can help recover credibility in journalism. Sundar et al. (2017) had similar results. In their study, consumers with VR headsets and smartphones registered higher levels of credibility than consumers who read a text. A study by Kang et al. (2018) showed that perceived credibility was connected to the message, the source, and the medium. They wanted to know whether the sense of presence, which they called telepresence, could affect the credibility of VR news consumption. They concluded that this type of content has the potential to improve the perceived credibility of the news.

Other references mentioned in this paper presented similar results, all pointing to the sense of presence influencing perceived credibility. However, they are also unanimous in thought when stating that more studies are needed to broaden this discussion. Consequently, H2 posits that the higher the level of sense of presence, the higher the level of credibility.

Several explanations have been put forth to justify this positive relationship. One of them is sensory depth (Kang et al., 2018), which offers richer details than 2D videos, thus leading to the belief that VR journalistic content is more reliable because it provides more details. Sundar et al. (2017) look to the "seeing is believing" heuristic, which is triggered by virtual environments that provoke convincing and, consequently, more reliable experiences. Another explanation is the cognitive aspect (Vettehen et al., 2019), which suggests that since the brain's processing capacity is overwhelmed

as a result of developing the sense of presence, there are not enough cognitive resources left for the user to question credibility.

We also put forth the idea that the user, when using VR glasses, is not aware of the limits of the screen, which can then produce a feeling of non-mediation (Domínguez, 2013). This can make one believe that there is less manipulation of reality and more transparency, a belief that is heightened by the ability to choose viewing angles, giving the appearance that nothing is being hidden as the individual is able to see everything around.

5 Methodology

This is a reception study in which we not only seek to test hypotheses quantitatively but also to identify elements qualitatively by analyzing user perceptions. The term 'reception' in contemporary research does not simply refer to a passive receiver to whom messages are addressed; it is shaped by the new social media realities and encompasses the exchange of intentions within the communication chain. Thus, receivers have the freedom to "[...] act in different ways with the media – from simple consumption and use to a more relevant social application", they are producers of meaning, "[...] who negotiate, reinterpret, and rework media messages" (Winques & Longhi, 2020, pp. 3-4, our translation).

In addition to a bibliographical review, we conducted experimental research where we manipulated variables "[...] within an aspect of reality, within previously defined conditions, in order to observe whether certain effects are produced" (Santaella, 2001, p. 141, our translation). For research to be experimental, it must aim to demonstrate a cause (independent variable) and effect (dependent variable) relationship (Cozby, 2003). In this paper, the independent variable is the sense of presence and the dependent variable is credibility.

5.1 Experimental research design

According to Santaella (2001), tests for investigating variables can be conducted in more natural conditions, outside of laboratories. This is what we did. We conducted our tests in the homes or workplaces of the participants, places where people naturally consume information. On one hand, we lose some control over general conditions related to

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the environment, but on the other, we reduce the artificial atmosphere that is found in a laboratory (Cozby, 2003).

When building our sample we did not use probabilistic selection methods, as a result, the sample is not considered representative and it is not possible to generalize the results. Thus, our sample was built from a selection by convenience, that is, the individuals included in the study were conveniently available. We started by asking people who are close to us to participate (colleagues and family members). At the same time, we used the snowball method in which participants are asked to identify other participants. Our sample consisted of a total of 80 people with different ages and professions/occupations.

We chose two 360° audiovisual news stories for our stimulus material, both of which refer to issues of human suffering. The first story is entitled *Bento Rodrigues – The Village that Ceased to Exist* (2016)[2], published by the Veja group. It tells the story of a village flooded by a mudslide caused by a burst dam in the municipality of Mariana, in the state of Minas Gerais, Brazil. The story shows what the village looked like months after the disaster had taken place. In addition to using 360° video, the story included texts with some identifications, audio excerpts that were recorded on the day the event took place, and low-volume background music. There was no voice-over narration but people were filmed while giving their eyewitness accounts of what had taken place without any reporter present at the location.

The second report was published by El País and was entitled *Aleppo Patrol with Syrian White Helmets* (2016)[3]. It tells the story of a group of volunteers called the white helmets who helped remove people from the rubble after bombings in the city of Aleppo. The story was told in Portuguese. The 360° video footage shows the group driving through the city looking through the rubble. The reporter is shown interviewing a person while a voice-over narrates information about the story to the sound of instrumental background music.

5.2 Data collection tools

5.2.1 Interview

We conducted a semi-open interview based on pre-structured questions. The researcher asks the questions and is also able to ask follow-up questions to obtain more in-depth responses or clarify the

answers (Duarte, 2006). The interviews were conducted after the content was consumed and before the questionnaire was distributed in order to avoid any chance of the questionnaire influencing the participants' answers to the interview questions.

The interview questions were linked to a full doctoral study in which we analyzed several variables. In this paper, however, we focus solely on the sense of presence and perceptions of credibility. Table 1 lists all the questions. The statements included in this paper come from the total number of responses.

Table 1

Interview questions

Questions
1) How old are you and what is your profession or main occupation?
2) Talk about what you felt while consuming the report in terms of both your feelings and sensations.
3) Speaking to your contact with this format (which allows you to look around and choose the viewing angle), what positive aspects, if any, can you identify when comparing it to conventional video?
4) What negative aspects, if any, can you identify?
5) Did you have any difficulties understanding the audio while viewing the images and looking around? Can you describe your experience?
6) How did you feel about the environments in the report? Did they produce different sensations or were they similar to the environments you see on television?
7) If you had seen this report on television in conventional video format do you think you would have understood the issue just the same? In other words, does the ability to look around the environment make you think differently about the content? Do you think it is basically the same as conventional TV video?
8) Do you think this is a good tool for journalism? Why?
9) Was there anything about this video format that made you feel uncomfortable or generated any cause for concern in terms of the ethics or credibility of the journalistic material you consumed?
10) How do you think this type of consumption would fit, or not, into your news consumption routine?
11) How do you currently consume your news?

5.2.2 Questionnaire

The averages for the sense of presence and credibility were reached through sets of questions that, when put together, result in a single number that represents a certain level of expression of the

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variable (Cozby, 2003). The questions for each variable were selected based on studies that made similar measurements, except for three credibility questions that we developed. We used a five-point *Likert* scale to score the participants' responses where number 1 represented "I totally disagree" and number 5 represented "I totally agree". Tables 2 and 3 present the questions and references.

Once the questionnaire was completed, we asked the respondents to state their age and gender, among other demographic data. We also include the following non-mandatory question: If you would like to write something about your experience while consuming this content, please write below. The responses were analyzed in conjunction with the interview statements.

Table 2

Measuring sense of presence

Questions	Measures	Foundation
1) I felt like I was in the story as it unfolded in the report. 2) It was as if I had been temporarily transported to the place where the news report took place. 3) It felt like the people and objects in the report were actually around me.	Sense of "being there"	Jennett et al. (2008); Kang et al. (2018); Sundar et al. (2017); Vettehen et al. (2019).
4) I felt like I was participating in the story. 5) There were times when I felt I was actually interacting with the characters in the report. 6) It seemed like the characters in the report were aware of my presence.	Interaction	Jennett et al. (2008); Sundar et al. (2017); Vettehen et al. (2019).
7) The places, people, and objects I saw in the report seemed real. 8) The events in the report seemed to actually be happening around me.	Realism	Sundar et al. (2017).
9) It felt like I was actually a part of the news story, without actually being there. 10) I felt like I was actually in the places I saw in the report and not just looking at images.	Sensation of having lived an experience	Jennett et al. (2008); Kang et al. (2018); Sundar et al. (2017).

Table 3

Measuring credibility

Questions	Measures	Foundation
-The content you consumed was prepared by a team of journalists. Evaluate the team according to the following characteristics: 1) Reliable 2) Experienced 3) Qualified	Credibility of journalistic team	Lee and Sundar (2013); Sundar et al. (2017); Kang et al. (2018); Chung et al. (2012); Vettehen et al. (2019).
-Now evaluate the content of the news report. 4) It seemed to be pretty consistent. 5) It didn't seem to contain ANY sensationalism. 6) It seemed to be based on fact and not fiction.	Credibility of content	Lee & Sundar (2013); Chung et al. (2012); Vettehen et al. (2019).
7) It seemed to better express reality in a LESS manipulated way. 8) It seemed to express reality in a MORE transparent way. 9) I trusted the report more because I was free to choose where I wanted to look.	Manipulation, transparency, and freedom of choice	Prepared by authors.
10) I believe it meets the criteria of public interest.	Civil credibility	Kang et al. (2018).

We divided the participants into four groups of 20. Two groups used VR headsets and the other two used a laptop equipped with a headset and a mouse. All participants answered the questionnaire and 24 participants were interviewed. Table 4 shows the division of groups. We created a code to facilitate data management and used it to identify statements in the text, along with the age and occupation of the participants, all of which are elements that place the reports in social and generational contexts. This research was approved by the CEP-FAR/UFBA Ethics Committee and complies with the anonymity guidelines of the participants.

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Table 4

Division of groups

Forms of consumption	Content 1 Bento Rodrigues	Content 2 White Helmets	Data Collection
VR - VR Glasses	Group 1 – C1VR 20 participants	Group 3 – C2VR 20 participants	All participants answered the questionnaire and six participants from each group were interviewed.
LT- Laptop	Group 2 – C1LT 20 participants	Group 4 – C2LT 20 participants	

All tests took place in December 2021 and January and February 2022. All participants are residents of the state of Paraíba. Ages ranged between 18 and 64. The average age of the participants was 37.23. The average age per group was similar: G1 (36.2), G2 (39.2), G3 (35.4), and G4 (38.1). 43 participants (54%) were female and 37 (46%) were male.

5.3 Analyses

Wilcoxon tests were conducted to test the hypotheses that compare measures. They were used to confirm or reject the null and alternative hypotheses, formulated from the study hypotheses. These tests are non-parametric alternatives to paired t-tests and student's t-tests. Non-parametric tests are applied when sample data do not come from a normal distribution, that is, they are not homogeneously distributed. Spearman correlation coefficients were calculated to determine the strength of the relationship between variables (the magnitude of the effect). In some cases, we also used linear regression to understand the influence and measure the effect of one variable on the other.

We used the interviews to conduct a qualitative analysis based on Duarte (2006), which requires separating the whole into parts that express nature, functions, and/or relationships. We did not measure the answers with a quantitative focus. We sought to understand different ways of perceiving the phenomenon, identifying similarities between the various reports. We included several excerpts from the interviews to clarify, support, and exemplify the reflections. We

highlighted in bold the words and expressions that are important for understanding the analyses. Some excerpts were edited to remove repeated words and expressions which are very typical in spoken language as they hindered the understanding of the written language.

6 Results and discussions

6.1 Sense of presence

Looking at table 5 (which measures the sense of presence) shows us that this sense was developed by most participants in all groups as the averages are above 3, which is the middle point of the Likert scale. However, all groups registered minimum values well below the average, indicating that some participants may not have experienced a sense of presence, which illustrates the individuality of the experience. When comparing the averages of the groups that consumed the same content but using different equipment, we noticed that the stimuli from the devices influenced the levels of sense of presence.

To support this finding, Wilcoxon tests were performed using data from the two groups that used VR glasses (G1 + G3) and the two groups that used laptops (G2+G4). The p-value was calculated with the knowledge that if it were less than 0.05, the null hypothesis would be rejected. Thus, we obtained a p-value of < 0.001 at the 5% level of statistical significance. This leads us to reject the null hypothesis that the average sense of presence is the same for both groups.

Table 5

Comparison of averages for sense of presence between groups

	Minimum	1st Quartile	Medium	Average	3rd Quartile	Maximum
G1 C1VR	2.10	4.20	4.85	4.45	5.00	5.00
G2 C1LT	1.10	2.875	3.80	3.52	4.175	4.90
G3 C2VR	3.20	3.85	4.55	4.34	4.90	5.00
G4 C2LT	1.50	2.675	3.25	3.375	3.95	5.00

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The comparison of the averages together with the results of the Wilcoxon tests gives us enough evidence to confirm the H1 of the study. According to the conditions in which this study was conducted, the participants who used VR glasses developed a higher level of sense of presence while consuming 360° audiovisual journalistic content than those participants who consumed the content on a laptop.

6.2 Sense of presence vs. credibility

We compared the credibility averages of the four groups listed in table 6. We can see that there is no strong difference between these groups. The laptop group averages were slightly lower, but overall we found that the level of perceived credibility was high for all groups, above 4.50.

Table 6

Comparison of credibility averages between groups

	Minimum	1st Quartile	Medium	Average	3rd Quartile	Maximum
G1 C1VR	3.40	4.70	5.00	4.785	5.00	5.00
G2 C1LT	3.70	4.60	4.80	4.735	5.00	5.00
G3 C2VR	4.00	4.575	4.90	4.775	5.00	5.00
G4 C2LT	3.70	4.375	4.50	4.530	4.825	5.00

We tested H2 to determine whether the sense of presence had a strong positive correlation with the credibility variable and if this correlation is statistically significant for the data set. To do this, Wilcoxon tests were conducted based on the responses from all groups on the null hypothesis that the correlation between levels of sense of presence and credibility is equal to zero, and on the non-null hypothesis that the correlation between levels of sense of presence and credibility is different from zero. We obtained a p-value of < 0.001, which at the 5% level of statistical significance, rejects the null hypothesis. This evidence leads us to believe that the variables are correlated to the value of 0.3987. This correlation is considered moderate and indicates that the variables have a modest relationship with each other.

In addition, we adjusted a linear regression model to understand the influence of one variable on the other. We saw that

the regression coefficient for the sense of presence is statistically significant at the 5% level (p-value = 0.005 < 0.05). This indicates that the sense of presence variable significantly influences credibility, and if the regression coefficient did not demonstrate significance, then the correlation was non-existent. Thus, the adjusted regression model shows that each unit added to the average sense of presence increases the average level of credibility by 0.17492.

As we have seen from tests with general data, we have evidence to believe that the higher the level of sense of presence, the higher the level of credibility. However, we question whether this trend worked the same way for the groups that used VR glasses and the groups that used laptops. We then performed new tests with data from each of the consumption devices: VR glasses (G1 + G3) and laptops (G2+G4).

For the VR headset groups, the p-value is < 0.001 at the 5% level of statistical significance. This leads us to reject the null hypothesis that the correlation between the level of sense of presence and the level of credibility is equal to zero. This shows that the variables are correlated. The correlation value of 0.6157 is considered strong, indicating that the variables have a positive relationship with each other. Furthermore, the regression coefficient for a sense of presence is statistically significant at the 5% level (p-value < 0.001). This shows that the sense of presence variable significantly influences the level of credibility. The adjusted regression model shows that each unit added to the average sense of presence increases the average level of credibility by 0.32104.

As for the laptop groups, the p-value = 0.99 > 0.05, at the 5% level of statistical significance. In this case, we do not reject the null hypothesis that the correlation between the level of sense of presence and the level of credibility is equal to zero. These findings lead us to believe that the correlation in the value of -0.0011 is not statistically significant. This correlation is considered null and indicates that the variables are not related to each other. Furthermore, the regression coefficient for a sense of presence is not statistically significant at the 5% level *(*p-value < 0.891). This means it is not possible to prove that the sense of presence variable significantly influences the level of credibility of the report when consumed on a laptop.

Of note is that some premises of linear regression in these analyses are violated, such as the origin of the normal distribution of observations. As a result, regression cannot be taken as an absolute

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truth. However, the regression results in all cases were interpreted in connection with the other statistical tests.

These analyses, therefore, provide enough support to evaluate hypothesis 2, which predicts that the higher the level of sense of presence, the higher the level of credibility. We consider this hypothesis partially confirmed. Looking at the data from all respondents, we can state that when the level of sense of presence is higher, so too is the level of credibility. However, when we separated the data by consumption device, the tests for respondents who used VR glasses showed a strong relationship, in addition to following the positive trend shown by the general data. However, this same trend was not confirmed in tests carried out on data from participants who used laptops. This is not to say that there is no such relationship at all. What it does mean is that, given the soundness and characteristics of our sample, we were unable to prove that the sense of presence influenced the level of credibility for participants who used laptops to consume the content.

These findings show H2 to be partially confirmed since the hypothesis strongly applies to those who used the VR glasses but cannot be applied to the laptop groups. The result was possibly influenced by the lower levels of sense of presence for those who used the laptop, making it impossible to prove this relationship through statistical calculation.

6.3 Credibility based on user perception

Furthering the analysis of perceptions of credibility, table 7 lists the averages of the answers for each question, dividing the data into two groups representing the device used at the time of consumption. Although we separated the devices in order to make comparisons with quantitative data, the excerpts from the interviews are not always presented separately; however, we did make note of different connotations we observed between respondents who used different devices.

Table 7

Average credibility comparison per device used

Questions	Credibility: Averages per Question		Measures
	VR Glasses (G1 and G3)	Laptop (G2 and G4)	
1	4.87	4.82	Credibility of journalistic team
2	4.75	4.50	
3	4.77	4.77	
4	4.77	4.70	Credibility of content
5	4.67	4.30	
6	4.82	4.97	
7	4.77	4.55	Manipulation, transparency, freedom of choice
8	4.82	4.52	
9	4.70	4.55	
10	4.82	4.62	Civic credibility

Of note is that question 6 obtained the highest averages for both groups. This question asked the participant to assess whether the content seemed to be based on facts and not fiction. The high averages obtained indicate that the 360° audiovisual report can produce a strong confidence that the content was based on events that actually happened. At this point, we can make reflections based on the statements of the participants who expressed a perception of realism, one of the measures present in the questions about the sense of presence. Sundar et al. (2017) understand that a sense of realism is associated with greater confidence in the news. Some of the respondents' statements confirm this relation. "We were able to visualize all the content around us, making it more realistic and not misinforming us" (Tax auditor, 61 years old, C1LT). "It is quite comprehensive as it shows the reality of that place. And if you tell the story to someone else, you know that the events actually happened. It didn't show anything that distorts reality" (Telemarketing supervisor, 32 years old, C2LT).

We found that the participants who used VR glasses felt realism through a direct connection with the sense of presence. "What you feel there is much more real than what you see on a normal flat screen" (Superintendent, 27 years old, C1VR). Other statements attributed realism to the sharpness of the images. "[...] I noticed that it is very clear, it seems very real. It feels like you are at the place" (Homemaker, 34 years old, C1VR).

We found that the expression of realism was more subtle in the

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statements of those who used laptops. This is evident in their accounts of how much more detailed the news reports were. "What I noticed were the details. The colors, details of broken objects, broken walls, colors, all the details" (Businessman, 60 years old, C1LT). "[...] I could practically see the people's expressions, the expressions on people's faces, what was going on, it wasn't just an image" (Computer Scientist, 33 years old, C2LT).

Closely connected to realism is the sense of proximity, which can also be a factor that leads to credibility because "if the audience senses the news components closer and in a more immersed manner in VR news than traditional news, an assumption of high credibility is possible" (Kang et al., 2018, p. 4). Through the respondents' statements, we found that the idea of proximity is also related to the sense of presence. "It's like you're there, in person, you know? You have the feeling that you are very close to the person, the images, the whole thing, you know?" (Teacher, 62 years old, C1VR). Proximity was also cited as a factor that brings the user closer to the feeling of the events. "[...] you can see what the children are feeling, like when they're playing, trying to have fun even when everyone around them is in a very precarious situation, you know? Buildings, bombs, these things. You manage to get closer to the people" (Software engineer, 35 years old, C2VR).

Perceptions of proximity and realism seem to add to the "seeing is believing" heuristic, which some researchers suggest is related to credibility in 360° audiovisual journalism (Sundar et al., 2017; Vettehen et al., 2019). Some statements exemplify this relationship. "[...] it is better to have the truth, to see it with your own eyes, to see everything, than to take in only a part of it, only part of the news and see only part of the events" (Mechanical Engineering Student, 19 years old, C2VR). "And the images also speak for themselves, right? They show what happened, the destruction, everything [...] Of course we will have a much better idea of what is happening" (Doctor, 63 years old, C1LT). "[...] when you use the tool to move around, you really see what is in that environment there…it shows more of the truth, you know?" (Businessman, 60 years old, C1LT).

This reflection also includes the sensory depth argument (Kang et al., 2018, p. 4), since 360° audiovisual reports "[...] can transmit more detailed content elements through the immersive experience. Hence, VR news can be viewed as a medium that can increase credibility". We found that several of the participants' statements related to sensory depth, based on the words and/or expressions they used. "[...] it gives you more elements, more resources for you to understand as much as possible about what is happening in a given space, circumstance"

(Journalist, 30 years old, C2VR). "[...] you have more information than what you see. At one point she said: there were two bedrooms, a living room here'... but you couldn't see it very well. But when you turn around, you can see it much better" (Doctor, 63 years old, C1LT).

For some participants, the possibility of seeing more helps them confirm (or not) what the narrator or person is saying in the story, thus increasing credibility.

"When he says 'over on the right side you can see a guy breaking a concrete slab'. So I went there and saw it. I can actually go there myself and see what is happening [...] It is not about what the camera is showing. I search for what I want to watch, right there in the environment" (Computer Scientist, 33 years old, C2LT).

This last statement raises two other issues that were also mentioned by participants: the opportunity to be able to choose what they want to see and not be restricted by the camera frame. "[...] if you look at this content in a conventional video, you'll only see the image that the cameraman or production team wants to show you. But through this 360° content, you can choose what you want to see" (Telemarketing supervisor, 32 years old, C2LT).

We found that more freedom of choice was also associated with the impression of less manipulation and more transparency. "[it's different] than an edited video, which shows some things and hides others, you know? The normal ones [2D videos], I think they show more of what the journalist wants to show, you know?" (General services assistant, 31 years old, C2LT). "Because a still image shows what the cameraman wants to show, what the company wants to show. If you can see it in 360°, you have more content to assimilate with the news" (Mechanical Engineering student, 19 years old, C2VR).

We believe that these impressions of less manipulation and greater transparency can explain why question 1 obtained high averages for both devices. The question reads: evaluate how reliable the journalistic team seemed to you. We believe that if the team does not restrict the viewing angle, if you are able to look around and confirm what they are talking about, if the content seems less edited, and if reality appears to be more transparent, then one might trust the team more.

Another aspect that contributed to some of the participants' perception of credibility was the fact that in content 1 the residents themselves talk about and show what happened, having more freedom to speak without any reporters on the scene. "[...] people could talk more freely about what they were experiencing in that

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place. What they were seeing, and expressing their feelings. Not something put on by the interviewer" (Dentist, 37 years old, C1LT).

None of the participants mentioned anything about sensationalism in their statements. On the contrary, the perception they had was that the journalistic team could have opted to include stronger scenes in the content. But the fact that they did not was seen as a positive, reinforcing the credibility. "He also didn't show much of the bloody parts in the place. He didn't show people all messed up, you know? [...] I found it interesting because he did not go further with this. Going further with this would be a little more unscrupulous, you know? (Computer Scientist, 33 years old, C2LT).

All these interconnecting elements identified in the statements and issues related to credibility were not conscious views of the participants. While interviewing the participants we asked them if they had seen or felt anything that caused them any discomfort or concern in terms of ethics or credibility. All interviewees said that "they couldn't think of anything". "It didn't cross my mind. I didn't feel anything like that. Not at all" (Housewife, 34 years old, C1VR). "No. For me it was a normal report. I didn't really think much about that part" (Computer Scientist, 33 years old, C2LT).

This last statement assumes that the explanation related to cognitive load (Vettehen et al., 2019) makes sense for the perception of credibility. The researchers make a point to state that processing the sense of presence can be very "taxing" on the brain, reducing one's free mental capacity, "[...] which in turn cannot be spent on questioning the credibility of the news report" (Vettehen et al., 2019, p. 27). We can give a few examples of statements that demonstrate an impression of a certain cognitive overload. "The guy is describing, but there is a gap between the real scene and what he is describing. Understand? It opens a gap and the brain cannot keep up with two things" (Physician, 65 years old, C2VR).

> [...] my understanding is that my brain was so focused on the images and so concerned about exploring them, that it couldn't even make room for... I don't know how to explain it... for my cognitive side to take in what the audio was saying and correctly read the information. (Journalist, 30 years old, C2VR).

Following these analyses, we systematized the main findings and reflections. Table 8 lists the discussion points raised in other studies which we were able to reinforce and/or further, making interconnections based on the participants' statements. Table 9 highlights new discussion points about perceptions of credibility in 360° audiovisual journalism. The relationship between these points and credibility was not directly found

in the reviewed literature, consequently, they are inferences in this study.

In general, separating the discussion points and indications in the participants' statements helped better visualize the findings and reflections in this study. However, as is evident in participant quotes throughout the analysis, in practice, there is not too much separation.

Table 8

Discussions raised in other studies

Discussion Point	Reference	Interconnecting participant statements
Realism	(Sundar et al., 2017)	Trust; opinion that the report was well produced; feeling that reality is not distorted; impression of being more truthful; more sharpness; able to see the details.
Proximity	(Kang et al., 2018)	Sense of seeing more closely; explore further; to be closer to people, environments and situations; approximation of people's feelings.
"Seeing is believing"	(Sundar et al., 2017) (Vettehen et al., 2019)	See with your own eyes; to have the most complete truth; the images speak for themselves; you are really seeing.
Sensory Depth	(Kang et al., 2018)	View more; see better; see the environment; more elements and more resources to help understand what is happening; wider view; see further; more information; explore further; allows you to see more and confirm what the narration or characters say.
Cognitive Load	(Vettehen et al., 2019)	Don't stop to think about credibility; the brain doesn't keep up; the brain does not allow space to capture images and narration.

Table 9

New discussions raised in this study

Discussion Point	Interconnections based on respondent statements
Freedom of choice	Choose/control what you want to see; less restricted view; less confining and less limited.
Less manipulation and more transparency	Not subjected to what the journalist/cameraperson/ company wants to show; have your own view of the situation; nothing hidden; less edited; see more of what has happened; come to your own value judgment; characters seem more free to speak; statements are less practiced; the character speaks and shows reality.
Sensationalism	Feeling of calmness/relief/comfort for not seeing shocking scenes; sensationalism makes the content biased; sensationalism can cause user instability; opinion that the report is good because it is not appealing.

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7 Final considerations

In this paper, we first aimed to understand the relationship between a sense of presence and credibility. We use two hypotheses to support this relationship. H1 presupposes that participants who used VR glasses would develop a higher level of sense of presence when consuming audiovisual journalistic content in 360° than participants who used laptops to view the same content. Initially, we found that the sense of presence developed in both forms of consumption. This leads us to confirm hypothesis 1, which adds to the evidence that different consumer devices can lead to different levels of sense of presence. However, we do not believe that the equipment determines the user experience, but it can be a strong trigger of perceptions and sensations. This argument was reinforced by levels of sense of presence among participants that deviate from the tendency of the majority, showing that the experience is individual.

Hypothesis 2 presupposed that the higher the level of sense of presence, the higher the level of credibility. This hypothesis was partially confirmed. The analyses made from our data set showed a moderate correlation between the variables and the data from tests conducted with the participants who used VR glasses to consume content showed a strong correlation between variables. However, analyses based on content consumed on laptops did not confirm this correlation. We attribute this result to the lower levels of sense of the presence of the laptop groups, which are insufficient to prove this relationship through statistics.

The other objective of this study was to identify user perceptions of credibility. The results reinforce and further five discussion points indicated in other studies: realism, proximity, "seeing is believing", sensory depth, and cognitive load. Realism and proximity were the discussion points that connected the most with the sense of presence according to the participants' statements. In addition, we identified three new discussion points with the ability to influence credibility while consuming 360° audiovisual reports: freedom of choice, less manipulation/more transparency, and sensationalism.

Upon conclusion of the analyses, we understand that, in addition to giving rise to different forms of consuming journalistic content, virtual reality presents sensory stimulus tools that lead to credibility. This study indicates which discussion points journalists

can invest in to obtain more credibility in immersive narratives. The excerpts from the statements compiled in this paper show how the participants expressed these points based on their perceptions and sensations, contributing to greater clarity of reflections. However, more than applying strategies to be perceived as more credible, these types of content need to be built with reliable criteria that include journalistic ethics. We believe that the discussions conducted here go beyond 360° audiovisual journalism and other formats that invest in immersive and experiential technologies. The participants addressed broader questions about their relationships with journalism that could be used to support general discussions about credibility.

Despite the importance of the discussions, we do recognize that this study has several limitations. We stress that the results in this paper are valid for our selected sample, and there may be a possibility of finding new results from other samples. When several methods are applied there is always the possibility of failure at some stage and/or biased results due to uncontrolled variables. On that account, future studies could be conducted by replicating the methodology and identifying possible oversights, thus confirming (or not) the results. Research should continue to investigate credibility, especially at a time when journalism is being questioned and devalued. Research should also continue to discover new narrative formats that could be introduced by new technologies, searching for solutions and innovations in news production.

NOTES

1 Available at https://decentraland.org/ Access on Sep. 30, 2022.

2 Available at www.youtube.com/watch?v=fVrWFzdVKyI&t=1s Access on Sep. 30, 2022.

3 Available at www.youtube.com/watch?v=B4KfPv5zb84 Access on Sep. 30, 2022.

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