Narrative and development of immersive content: application of virtual and multisensory systems of virtual reality in journalism

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Abstract
It describes an applied study about the possible uses of virtual reality technology in the consumption of informative content, within the recent theme called immersive journalism. The work is based on the need of big newsrooms to adapt the delivery channels of their products to the situation of fragmentation of their traditional audiences and cultural changes already identified in the media consumption habits of the new generations. The project, still in progress, is based on theoretical update and development of a prototype for experimentation and evaluation, via questionnaire, addressing six areas related to usability and fundamental concepts of immersion and presence. Among the results already obtained, the propensity to physical discomfort and the need for more intuitive interfaces to enrich the experience of use were highlighted.
Keywords: Immersive journalism. Virtual reality. Digital Interfaces. Immersion. Presence.

Introduction

The journalistic activity was somehow born and developed out of an impossibility: being ubiquitously present at times and places where facts of our interest take place. In this regard, journalism was humanity's solution to circumvent this absence, through the work of reporters and an entire chain of professionals and procedures that, in the end, manages to give us an information package with data, contextualization, opinions, and records, capable of satisfying our curiosity and making us aware of facts, as if we were close to them. We call this chain production process; we call this package news, and we might call this sense of closeness presence.

Despite being one of the most recent discussion topics in our field, having generated studies with different approaches – for instance, Francesco and Nakagawa's (2017) research that discusses narrative and physiological aspects of virtual reality (VR) experience, and Shin and Biocca's (2017) study that focuses on users' previous experiences as determining factors for their evaluation when testing such content –, immersive journalism (IJ) can be

imagined not as something totally new, but as a technologically updated and perhaps more effective version of what journalism has always set out to be: a process of intermediation between people and events, capable of making us feel closer to facts, being our eyes and ears, classic expressions used by media to represent their role.

In order to contextualize the emergence of immersive journalism, we have used an analysis tool that considers three action vectors – technological, cultural, and economic – in processes of technological diffusion[1].

The use of virtual reality systems (technological factor) with some development and application time in several areas enables the journalistic content to be oriented to operate on two concepts: immersion and presence. Such tools offer producers new narrative possibilities, and consumers a more realistic experience than the one usually faced when flipping through a newspaper or even getting information using a digital screen from their favorite website or mobile app (cultural factors).

For news organizations, producing such content joins their list of attempts to handle audience fragmentation and competition of social media platforms and major technology companies (including Google and Facebook), which are now acting as information distribution channels. This tendency has reduced their profit margins and put newsrooms in a constant search for attention and engagement through various metrics monitored by analytics applications in a scenario that casts doubt upon the very business model on which they have been sustained for decades (economic factors).

In this study, based on the discussion of two concepts – immersion and presence – we selected a report of an ongoing research project. From the development of an immersive system for news consumption, so-called "project Jumper"[2], we aim to investigate the narrative possibilities offered by systems that allow us to be immersed in 360º imageries or to actually interact with simulations of fully synthetically reconstructed real environments by means of computational resources and game-creating applications, such as Unity[3]. This initiative follows the epistemological paradigm of Design Science[4], which is still uncommon in the field of Applied Social Sciences.

Concepts of Immersion and Presence

The concept of immersion as a mental process[5] is a very complex construct that has received the attention of several areas of science, including Psychology, Psychiatry, and Cognitive Sciences. Overall, immersion is associated with some sort of distance or dislocation (either psychological, physical, or both) from what might be called the real world and present

1 For more information on the three vectors, see Santos (2016).
2 For more information on the project Jumper, see https://youtu.be/1qM2V6DT0pI (only available in Portuguese). Accessed on: 28 jul. 2019.
3 Available at: https://unity3d.com/. Accessed on: 28 jul. 2019.
4 For more information on design science, see Santos (2016) and Dresch, Lacerda and Antunes (2015).
5 We have used this term only aiming to exclude from our considerations those related to Physics and Fluid Dynamics.

time. Immersed in our thoughts, we might be walking down a busy street without paying attention to the people around us; focused on one task, we might be oblivious to everything around us and later realize that time has already passed. A memory, a place or a person can trigger these internal attention flow and dialogues that move us into another situation that is not directly linked to the here and now we experience. Dreams represent a special type of immersion where, in addition to what we have described so far, we can feel present in other environments and even experience agency (MURRAY, 2003), i.e., control over our actions in this new location.

Within the studies on virtual reality and immersive environments, two currents stand out. The first one focuses on the subject and associates immersion with a psychological state characterized by the perception or sensation of being included, involved or interacting with an environment that offers continuous sensory stimuli (WITMER; SINGER, 1998). For this line of thought, the immersion levels are connected to:

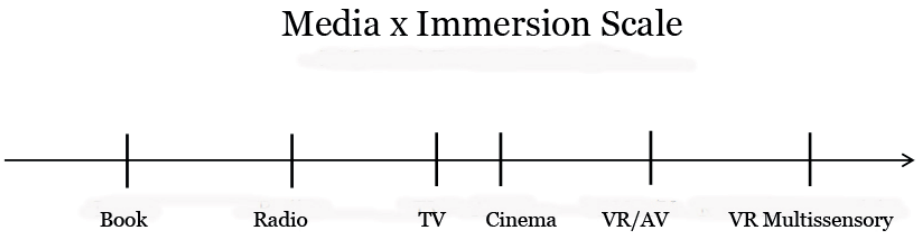
a. isolation from the physical world;
b. perception or feeling of inclusion in the virtual environment;
c. possibility of interaction and control of the virtual environment;
d. ability to move within the virtual environment.

The second current focuses on technology and considers immersion as a product of systems that may facilitate the production of multisensory inputs along with individuals who somehow connect to those systems. Slater and Wilbur (1997) consider that immersion is related to the level of efficiency that a computer system can achieve by offering the illusion of an artificially generated reality.

In terms of narratives, Murray's (2003) study on digital environments allows us to think of immersion as something related to the potential for displacement or distancing of certain content, obviously varying from individual to individual and from given physical and psychological contexts. One simple oral storytelling can either transport us to another (diegetic) world[6] or be extremely tiring, depending on the type of bonds or contact points we may establish with it. Considering the two aforementioned currents and McLuhan's (2007) assumption that media are sensory extensions of humans, we can establish a potential scale of immersion levels that can be offered by media based on the four previously mentioned conditions.

6 For more information on the concept of diegetic world (constructed from the narrative), see Aumont (2007).

Figure 1 – Potential range of media immersion



Source: elaborated by the author.

The figure above represents a **potential**[7] scale of media-associated immersion levels, based on the factors we have previously listed, i.e., the ability to isolate or channel a particular flow of sensory stimuli and to provide the feeling of inclusion within the environment created by content, besides the possibilities of interaction, control, and movement. Thus, depending on the individual vs context binomial, a book may generate a more immersive experience than a TV show. However, from the factors we have considered, a book does not exclude visual stimuli from our surroundings, whereas films partially do and virtual reality devices completely do. It is important to understand that the scale applicability is based on these factors and not on other criteria more linked to subjectivity and individuality, which would make it imprecise. The proposed comparison has the specific purpose of guiding the development of systems and products in which immersion is a desirable feature, something that we have identified in the content that has been produced within immersive journalism. The last two instances – Virtual Reality Environments (VE) and Multisensory VR – constitute the sets of computational systems that are most oriented to operate on immersion within these parameters. Most products currently available on virtual reality devices, in which hearing and sight are the main information stream available on the system, are in the first modality (VE). For the second modality, there are still few experiments and products in which besides hearing and sight, more senses are triggered.

The development of prototypes using Multisensory VR is quite new in Brazil and comes from teams in the fields of Exact Sciences, for instance, the study performed at the Federal University of Espírito Santo by Salame and Santos (2015). Internationally, startups such as FeelReal[8] have already released a new generation of head-mounted displays (HMD), which in addition to video and audio streams, brings the simulated experience of heat, odors, wind, and humidity, as well as vibrations. Thus, the potential of this type of equipment for many areas, including marketing and advertising, seems to be very extensive. However, we raise the question of positive or negative interference of these more complex devices on the experiences of immersion and presence. If they work well, the human-machine contact

7 Author's emphasis.
8 Available at: http://feelreal.com/. Accessed on: 28 jul. 2019.

metrics would increase; however, if they were not efficient, the transparency of the content-delivery medium, and therefore the overall experience, would be strongly compromised.

Another fundamental concept related to virtual reality is presence. Most authors agree that the idea of presence is defined by the perception (and our level of belief in it) of being within the environment, the world recreated by the computer system. Thus, presence implies a physical sensation of being in a different place from our original and actual location (SHERIDAN, 1992; ZELTZER, 1992). Some authors, such as Sheridan (1996), establish differences between telepresence and virtual presence. The first one is the traditional virtual reality experience, and the second is our experience when talking by Skype[9] video or some other videoconferencing tool, where the system simulates a closer approximation between two distinct locations than actually the sensation of moving to another place.

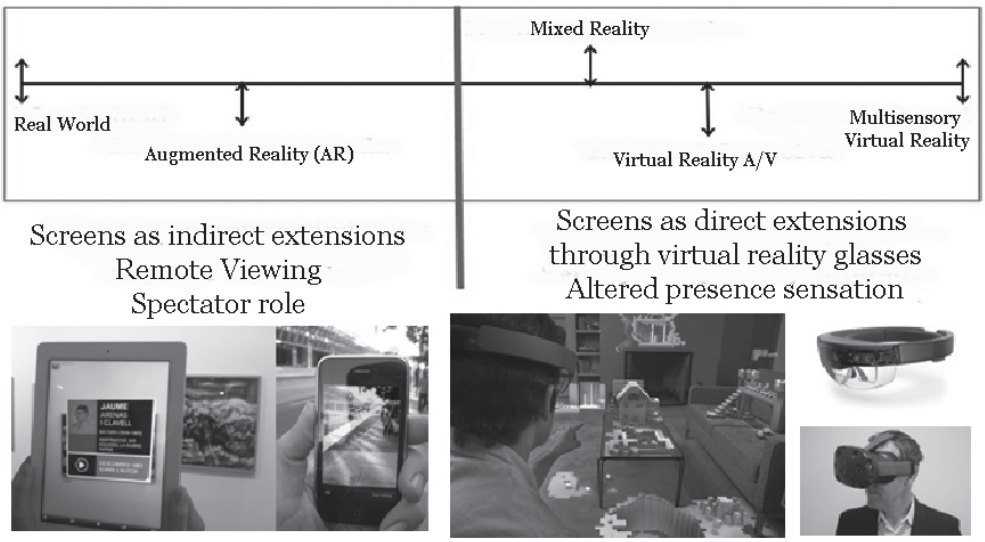
Lombard and Ditton (1997) present a definition of presence that seems to be more applicable to our discussion on narratives and immersive journalism. For these authors, presence is also related to a non-mediation illusion, i.e., to a transparency situation, according to Bolter and Grusin (2000), of the medium involved in the generation of the virtual environment. The more this absence (of the medium) is effective, the better the level of presence, i.e., of realistic experience for the user connected to the system that is simulating the virtual environment.

In the scale ahead, expanded from Azuma's (1997) proposal, we detail some possibilities regarding the medium transparency that generates the connection between the user and the virtual-offered content. We define two ends in the scale: at one end, the real world apprehended in everyday life, and at the other, a fully synthetic virtual reality environment, built using a game development tool for instance. Between the ends, we highlight some intermediate possibilities. First, augmented reality (AR)[10]. It does not eliminate what is learned from the real world but adds to it digital files that are superimposed on what the device camera, such as mobile phone or tablet, can see. It is worth noting that in the experience of augmented reality, we are usually holding the device, we need to position it correctly, and we always see the result of the merged real and virtual images on a screen as traditional viewers and yet with all the real world around us.

9 Software that allows communication via the internet through audio and video connections. Available at: https://web.skype.com/. Accessed on: 28 jul. 2019.

10 For more information on the use of augmented reality in journalism, see Santos (2015).

Figure 2 – Medium transparency scale between augmented reality and virtual reality technologies



Source: elaborated by the author.

From the dividing line that we have traced, through devices that attach to our body, the distance between image and user is reduced, operating initially as presented in the augmented reality example, but through semi-transparent glasses (described as mixed reality) and reaching the last two points, where traditional virtual reality glasses isolate us from our physical surroundings. Real-world images captured using 360º cameras are called immersive reality; and totally synthetic environments, digitally created, such as games, are called virtual reality. This differentiation is adopted to establish more specific parameters between these two types of content, which normally constitute nowadays what is presented when the material is characterized as immersive journalism.

Moving forward in the scale, despite the hassle of still using the current virtual reality glasses, we can increase the medium transparency with regards to the isolation that it provides us from the real surroundings and potential presence induction, reconfigured for a new environment where in many situations, we can view as well as act and move.

The term "presence" is also quite complex and can have various connotations and meanings. For instance, social presence, i.e., the sensation of being connected to a particular group either physical and direct, such as a class of students and family, or digitally generated or organized, as in contemporary social media platforms. As for the term "immersion", it is important to narrow the various possibilities and applications of the concept to more specific conditions, capable of guiding the development of solutions for the narrative content delivery, such as immersive journalism.

Therefore, authors such as Stanney et al (1998) indicate seven measurable factors related to the level of presence experienced:

a. ease of interaction with the generated environment;
b. user-initiated sense of control;
c. pictorial realism of the environment offered by the system;
d. length of exposure;
e. social factors, such as the presence of other individuals in the same environment;
f. internal factors related to the differences between people who experience the environment[11]. Subjective issues previously discussed in this paper can be cited in this item. However, more objective factors, for example, visual problems such as myopia, are also part of this topic;
g. system factors, such as differences between control interfaces and whether the device has its own screen (e.g. Oculus Rift[12]) or it depends on an attached phone (e.g. Samsung Gear VR[13]).

Project Jumper – modeling an environment for immersive journalism consumption

Based on the assumptions previously described, the Convergence Media Lab (LABCOM)[14] started to develop in 2015 a virtual reality system capable of presenting news content to users exploring various delivery modalities. The initial planning characterized the experiment not as specific contents to be produced in virtual reality, but as a system that would work with a player of such content. Thus, unlike many other immersive journalism projects, which rely only on the production of a particular article or documentary using immersive or virtual reality, project Jumper focuses on exploring control interface issues and how the user will operate it (especially considering the usability and ease of understanding the drive logic), as well as the impacts of these narratives on the production process, when they have to be planned and ported to an immersive environment.

The big question that guides the project is: how will the news industry deliver its product to new generations? Considering, today, children and young people from locations with available Internet infrastructure, it is possible to identify patterns of media consumption that deviate from the traditional ones, such as reading newspapers and magazines and watching TV content through the program schedule[15]. Such changes, which can be also perceived in other age groups, can be amplified over time via the adoption of new information consumption habits. Considering such scenarios, this experiment does not intend to find

11 Authors such as Shin and Biocca (2017) indicate the degree of importance between previous experiences and perception of VR content.
12 Available at: www.oculus.com. Accessed on: 28 jul. 2019.
13 Available at: www.samsung.com. Accessed on: 28 jul. 2019.
14 Available (only in Portuguese) at: www.labcomdata.com.br. Accessed on: 28 jul. 2019.
15 See the survey National Household Sample Survey (PNAD) Internet.

a new definitive solution for future delivery. It aims to explore possibilities in terms of narrative and user-contact, aligning the content offered with characteristics valued by new consumers, such as immersion, gamification, and interaction, and potentially constituting at least one of the alternatives that deserve to be further explored. Resource investments and the growing interest of all major technology players, such as Google, Facebook, Apple, Samsung, and LG, in the virtual reality ecosystem represent a strong indicator of a possible acceleration in the adoption process of this technology.

In its current phase, the project has focused on three aspects:

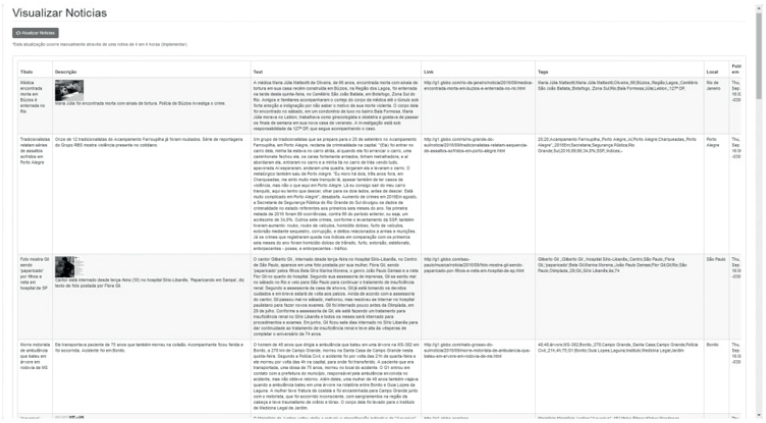
a. production of immersive content (360º images) and virtual reality to be used in the project;
b. development of a control interface as intuitive as possible, capable of simplifying navigation and the overall user experience;
c. execution of usability tests with volunteers in order to evaluate the interface and factors related to immersion and presence.

Content Production

Currently, Jumper navigation allows three distinct experiences based on a news-collection module that extracts material from more than 100 web information sources or channels. This module allows administrators to enter or delete addresses on the Internet and attempts to identify words or terms within texts that characterize some sort of location. When this search finds information considered to be geolocation, the software inserts metadata[16] into that content by classifying and associating it with a map, thus linking locations to the facts that have occurred in them. This functionality is used in the second type of experiment that we will later describe.

16 For instance, data coupled with digital files that can more accurately describe them and enable classification and operation in newsroom management systems.

Figure 3 – Automated newsreader screen



Source: elaborated by the author.

In the first visual modality, the user reads the news text and views photos, as in common streams characteristic of social media applications, in a vertical column that can be supplemented with additional lateral material.

Figure 4 – Reading the news in text format in VR environment

Source: elaborated by the author.

The second visual modality allows the user to feel at the location of a particular fact or event. For this purpose, the tool identifies the geolocation metadata in the text of the collected article by connecting to Google Maps[17] database and checking whether or not there

17 Available at: https://www.google.com.br/maps. Accessed on: 28 jul. 2019.

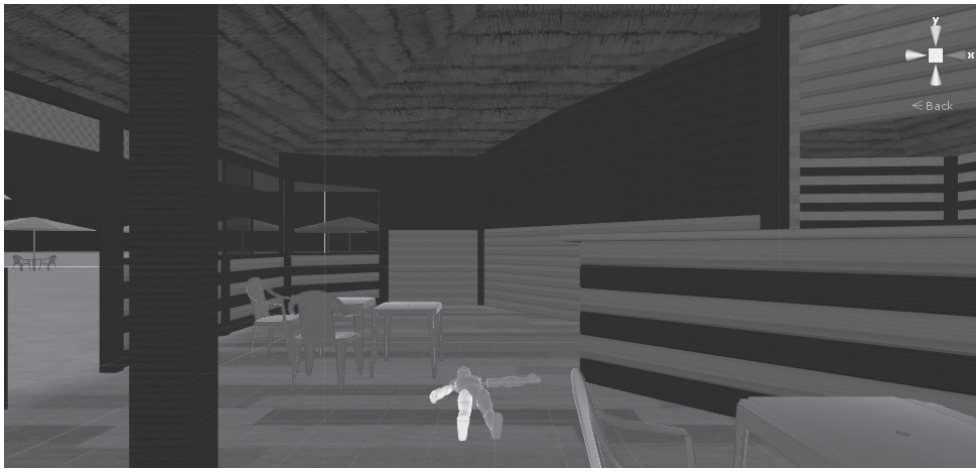
is a Street View function that offers 360º images of the location. If this type of image is available, the user can then transport to the site, having a stronger experience of presence by being able to see around and explore the location described by the news. For testing, we used the case of the Bataclan attack, in Paris. The same news is viewed in text and photo formats in the first modality, and then via control interface, the street where the theater is located can be accessed through a 360º view from Google Street View.

Figure 5 – Visualization using Google Maps Street View function in VR environment

Source: elaborated by the author.

The third modality is different. Based on the real murder case of the journalist Décio Sá on the Litorânea Avenue in the municipality of São Luís (state of Maranhão, Brazil), the crime scene was reconstructed using the Unity game development tool. It created a totally synthetic environment in which the user can explore the details of the event and get to know its story through photos, narration, and additional material distributed throughout the recreated synthetic space. Thus, there is a hybridization of languages, and previous material that had been published at the time are inserted in the virtual reality experiment. Space can also be explored by the first-person user through a subjective camera that allows panning and viewing from all angles, via movements that can be controlled by the computer keyboard or using a game joystick.

Figure 6 – News preview on death of journalist Décio Sá rebuilt in VR



Source: elaborated by the author.

Control Interface Development

In the project, the navigation between the visual modalities and exploration of each one occur through a control interface that is inserted in the virtual environment through a Leap Motion[18] sensor that was coupled to Rift[19] glasses, virtual reality device in the tests. The sensor identifies the position of the user's hands and transfers the movements to digital hands recreated by the software in the virtual environment. Thus, the user can control some aspects of the experience, selecting possibilities and even moving in some scenarios.

The interface was initially a sort of bracelet that appears around the forearm of the user's digital hand, in which the navigation buttons were available. While it was used, a problem on the arm position was identified as it had to be slightly raised for the buttons to activate, and in longer sessions, hassle and tiredness had been noted. Due to that, a second interface was created with the figure of a tablet, which could be held with an open hand and had the control commands inserted. This second modality has been tested, and although it minimizes the effects of the first one's hassle, it seems to be more difficult to activate as the hand position must be more accurate so that the interface appears. A third and friendlier interface is under development.

18 Available at: https://www.leapmotion.com/. Accessed on: 28 jul. 2019.
19 Available at: https://www.oculus.com/rift/. Accessed on: 28 jul. 2019.

Figure 7 – Detail of the sensor that reads the position of the user's hands and represents them in the virtual environment to trigger one of the control interface models

Source: elaborated by the author.

Usability Tests and Methodology

In order to evaluate the tool and survey deficiencies and suggestions for improvement, a call for volunteers was created within the academic community of the Federal University of Maranhão. Through the LABCOM[20] website, the interested candidates filled out a form in which they indicated whether they had visual problems and provided their preferred testing schedules.

In the first evaluation phase, the volunteers were between 19 and 27 years old. There was no data collection regarding their news consumption habits nor whether they already had previous knowledge about the narrative used in the test model. The event had happened about two years earlier, and even though it was widely reported, we assumed that prior knowledge of the crime would have no greater impact on the test as it was more focused on usability, efficiency of the control interfaces, and immersive experience offered by Jumper.

Based on an initial evaluation of the register data, tests in which the volunteer would be sitting and try the tool for five minutes were scheduled in order to facilitate their first contact with virtual reality. Then, the volunteer would be standing for another five minutes and could explore more interactively the views offered.

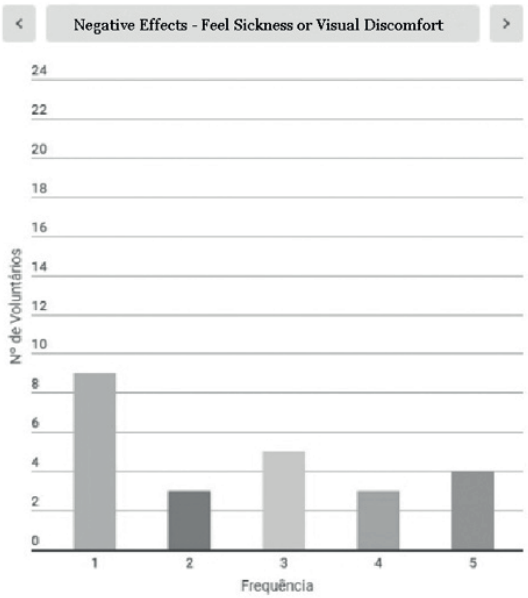
The tests were applied by two undergraduate students who are from the scientific initiation scholarship program of the laboratory: one from the field of Communication or Design, who explained the test proposal and basic information about the project, and one from the field of Computer Science, who participated in the development of the tool and acted as a system operator, initializing the solution, putting on the virtual reality glasses in the volunteer, and assisting in the control operation.

After the use period, users were asked to fill out a stepwise (sections) form that included questions mostly using a Likert scale to evaluate the various aspects of their experience, choosing numbers from 1 to 5 to regard the worst or better rating, respectively. The form had six sections: ergonomics, interface, immersion, presence, understanding of the information presented, and suggestions. Finally, in the last step, there were some open questions to collect suggestions and criticisms for implementation and correction in future versions of the tool[21].

20 Available (only in Portuguese) at: www.labcomdata.com.br. Accessed on: 28 jul. 2019.

21 The form can be accessed in Portuguese at: https://goo.gl/forms/g1KxWuXijCnarYKA2. To date, fifty individuals have participated, and the preliminary results are available in Portuguese in a spreadsheet at: https://docs.google.com/spreadsheets/d/1HlpvSNN6os0A7hCr1zgm7Z58GEeod4r0JbHEPHtdGzw/edit?usp=sharing. Test results so far can also be viewed in Portuguese in an interactive chart version available at: https://infogram.com/evaluation-jumper-phase1-1gj725dk3q55p1l.

Figure 8 – Example of test data visualization in the negative effects question, in case of feeling sick or uncomfortable, where most users indicated some level of discomfort and only nine people said they felt nothing



Source: elaborated by the author.

Final considerations

As this study is still ongoing, several issues on the solution development process are still open-ended. However, we believe that the motivation to explore new content-delivery forms seems solid and supported by data on media consumption habits of new generations.

Regarding the production of content with immersive images (360º), this type of activity can be inserted in the process of constructing news, respecting the needs of agility and rapid publication. However, a set of technical difficulties is related to this type of production. Among them, we have listed the most significant ones, i.e., the ones that generate the biggest changes in content production:

a. shooting angles and distortions that "wide-angle" lenses impose on the images produced, which easily place people or elements in general either too far or too close;
b. presence of the production team in the image, which naturally appears in a capture that shows all angles or must be deliberately hidden;
c. directing the viewers' attention and resources to familiarize and encourage them to explore the 360º environment;

d. time for sequences that allows the viewer to adapt to the scenario and to explore it, making fast-paced edits and short takes unrecommended;
e. difficulties, including bodily, of any camera movement that can generate some effects among users such as hassle, headache, and dizziness. These factors, regardless of movement in the recording, may be experienced by people who seem to be more sensitive to the reconfiguration of the visual space they perceive.

For such a set of questions, there are no definitive solutions yet in most projects, and several new narrative resources have been tried. It has been passing through the construction phase of a specific language, as the cinema medium lived in the early 20th century during the so-called "cinema of attraction" or "first cinema" (CESARINO, 1995, p. 34).

The development of fully synthetic environments, such as São Luís crime, requires significantly more time and, so far, is only viable for large reports and investigative stories, which have more time between the start of the project and the moment of distribution.

Regarding interfaces, its development work has become a learning guide with enormous possibilities, even though in essence such resources should, regardless of the solution, generate a positive experience in contact with content. Therefore, further studies are still ongoing.

One of the most important aspects of the project seems to be the interdisciplinarity of the team involved in it. Due to it, the project can be carried out by bringing together journalism, radio, and TV content producers, designers, and computer scientists – all of them from calls of the Institutional Scientific Initiation Scholarship Program (PIBIC – *Portuguese acronym*) or the Institutional Program of Initiation Scholarships in Technological Development and Innovation (PIBITI – *Portuguese acronym*). The project also had the collaboration of Geography and Information Science students, who were part of the scholarship program as well and have also contributed to its development.

Finally, the initiative for the development of technological products in the field of Applied Social Sciences is perhaps the greatest challenge, since at least in part, it has to complement the training directed at interpretation and description by predictive and prescriptive skills, dealing with real issues and situations and contributing to the constitution of a set of propositions that will be added to a certain category of problems, in this case, the improvement of the user experience in contact with news product.

With the use of virtual reality technology or not, the information content production industry needs to join these two sides to shape the construction of a more efficient news delivery that is integrated with contemporary technological, cultural, and economic changes.

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