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Paralympic VR: an immersive experience

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To Léa, Luiz Carlos, and Hilda,

for their love and motivation.

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ABSTRACT

KEYWORDS: Paralympic sports, wheelchair basketball, Virtual Reality, 360 video.

Paralympic VR: an immersive experience is based on exploratory research and consists in the production of a 360 video-prototype that aims to give special access to the wheelchair basketball training universe, bringing the users close to Paralympic athletes without the need to hide the impairment or hyper focus on the stories behind the disability.

Media coverage of Paralympic sports and the representation of disabled athletes have been changing, but still present a medicalised framing, a narrative where the athletes are commonly portrayed as heroes due to the overcoming of difficulties related to the impairment and not to the sports results. This present project work considers immersive journalism and the use of virtual reality technologies as the means by which an alternative approach and a better representation of Paralympians are possible.

The project presents the description of the workflow process, detailing conceptualization decisions, technical aspects and, mainly, the challenges and lessons learned. A user study combining focus groups and online survey was also conducted in order to have insights about the experience of watching the video with the headset Samsung Gear VR. Feedback provided by participants indicated that the prototype accomplished its aim. Recommendations to improve future work were also gathered.

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RESUMO

PALAVRAS-CHAVE: Desporto paralímpico, basquete em cadeira de rodas, Realidade Virtual, vídeo 360.

Paralympic VR: an immersive experience baseia-se em investigação exploratória e consiste na produção de um vídeo 360 graus que visa dar acesso especial ao universo de treino do basquete em cadeira de rodas, aproximando os utilizadores dos atletas paralímpicos sem a necessidade de ocultar a deficiência ou dar grande enfoque às histórias por detrás da deficiência.

A cobertura do desporto paralímpico nos media e a representação dos atletas com deficiência está a transformar-se, mas ainda apresenta uma abordagem medicalizada, uma narrativa em que os atletas são comumente retratados como heróis devido à superação de dificuldades relacionadas à deficiência e não em virtude aos resultados desportivos. O jornalismo imersivo e o uso de tecnologias de realidade virtual são considerados no presente trabalho de projeto os meios pelos quais é possível uma abordagem alternativa e uma melhor representação dos atletas paralímpicos.

O projeto apresenta a descrição de todo o processo de produção do vídeo-protótipo, detalhando decisões de conceito, aspectos técnicos e, principalmente, os desafios e lições aprendidas. Um estudo com utilizadores combinando grupos de foco e questionário on-line também foi conduzido para a recolha de perceções sobre a experiência de assistir ao vídeo com o *headset Samsung Gear VR*. Os comentários fornecidos pelos participantes indicaram que o protótipo atingiu seu objetivo. Importantes recomendações para a melhoria de futuras experiências também foram reunidas.

CONTENT

1. INTRODUCTION

"I think people still have not understood that parasport is serious sport. They often see us as if it were something of charity, to make happy who has a disability", Deepa Malik, as cited in Delmazo, 2016

The Rio 2016 Paralympic Games were a milestone to Deepa Malik: she was the first Indian woman to win a Paralympic medal in history. As other Paralympic athletes, she has an inspiring life story and has overcome important obstacles since a tumour in her spine resulted in paraplegia. Her silver medal in the shot put competition also meant overcoming, but overcoming hard training, measures in the shot put field, results. She is an athlete, and wanted to be seen as an athlete, as the non-disabled ones.

Every four years, after the Olympic Games, another big sport event takes place: the Paralympic Games. The word "Paralympic" derives from Greek preposition "para" (beside or alongside) and the word "Olympic". According to the International Paralympic Committee (n.d.-a), "Paralympics are the parallel Games to the Olympics and illustrates how the two movements exist side-by-side". The growing attention drawn by the Paralympic Games also shed light on media representation of impaired people. Beacom, French and Kendall (2016) emphasize that wider discourses relating to disability sport and representations of disability in general are influenced by media representations (p.58). According to the World Health Organization[1], over a billion people have some form of disability. It means about 15% of the world's population.

We assume here R. F. R. Marques, Gutierrez, de Almeida, Nunomura and Menezes (2014) definition of Paralympic athletes as individuals who practice and compete systematically and officially in one of the sports included in the Paralympic Games organized by IPC (p.991). Media coverage of Paralympic athletes has been changing, but it still presents a medicalised framing, a "triumph-over-adversity" narrative where athletes are seen as heroes that overcome difficulties related to the impairment. (Beacom et al., 2016; Maika & Danylchuk, 2016; Brittain, 2017). In addition to what researchers have found, the author's personal experience as a journalist was essential to this perception, having covered Paralympic sports and done hundreds of interviews with Paralympic athletes.

[1] http://www.who.int/mediacentre/factsheets/fs352/en/

We advocate the view that there is a need to better represent Paralympic athletes in media coverage. Immersive journalism is considered here the means by which this better representation could be possible. As Cordeiro and Costa (2016) remark, an immersive journalism benefit is that, when participating to the news, the user does not depend only on journalistic reporting (written, audio-visual, etc.) to form the understanding about a given event (p.113).

The main objective of this project is to create an immersive experience using virtual reality (VR) technologies that allows a more natural perception of disability and sport, portraying impaired athletes as athletes, without the need to hide or ignore the disability while telling stories about Paralympians. We hold the position that it is not necessary to choose between the sport's framing or the disability's framing, in accordance with McNamee (2017), who defends that "a dual lens is needed" (p.203). The secondary objective is to contribute to a better understanding of Paralympic sports in terms of rules and specifications.

Paralympic VR: an immersive experience is a project work based on exploratory research. It consists in the production of a 360º video-prototype that allows special access to the wheelchair basketball training universe, letting users feel really close to Paralympic athletes. As Vicente (2018) emphasizes, it is crucial for Digital researchers *not to study media*, but *in media*, as "the contact with the system structures that actually make digital media realities is a fundamental requirement to a simultaneously in and out meaning making".

The structure of this document is the following. Literature review is divided into four topics. In the *Sport, disability, and media* section, it presents a brief history of adapted sport and the growth of the Paralympic Games, as well as the studies regarding how media has been covering Paralympic sports and representing impaired athletes. The next section focuses on *Immersive journalism,* the key-concepts related to it and how virtual reality technologies have been used in media coverage in recent years. The third one, *Sports and VR*, revises different uses of virtual reality in this field, such as a training tool or an entertainment experience for users, both in third or first-person point of view. The last section in the literature review describes studies that bring *Lessons for VR storytelling*.

The next section, *Developing the experience,* is a detailed description of the entire production, shooting, and post-production process of the 360-degree video. It includes conceptualization decisions, technical aspects and, mainly, challenges and lessons learned.

The following section describes the *User study* conducted in the aftermath to have insights of how was the user experience when watching the video-prototype with a Head-Mounted Display (HMD) and what should be done differently in future work on the same purpose. Four focus groups were organized with this aim. Users discussed in-depth the experience after seeing the video, providing important feedback, which is further detailed. The *Overall discussion* presents limitations of the project and indications for future work concerning virtual reality technologies for Paralympic sport's storytelling. The challenge imposed by the medium when designing the experience and structuring the narrative is pointed out as well as the importance of transdisciplinary research in the Digital media field.

2. LITERATURE REVIEW

2.1. Sport, disability, and media

Sport and disability belonged to different worlds for much of history. DePauw (1997) states that impaired people were excluded from sport as they didn't meet "the socially constructed ideals of physicality, masculinity and sexuality" (p.421). The foundation of the first Sports Club for the Deaf took place in 1888 in Berlin. Nonetheless, the decisive push for the widely introduction to sports for people with disabilities happened after the World War II in Stoke Mandeville, England, where dr. Ludwig Guttmann used sports as a way for rehabilitation of patients with spinal cord injury. In 1948, he organized the first Stoke Mandeville Games, an archery competition with a total of 16 wheelchair athletes (International Paralympic Committee, n.d.-a).

The transition from rehabilitation sport to competitive sport occurred in the following decades, with the growth of the Stoke Mandeville Games (Blauwet & Willick, 2012). The ninth edition was held in 1960 in Rome, Italy – same place of the Olympic Games in that year – with 400 athletes from 23 countries, and it is considered the first edition of the Summer Paralympic Games (Goggin & Hutchins, 2017).

Since 1960 the Paralympic Games took place every four years, with an increasing number of sports including not only wheelchair athletes, but also individuals with other impairments such as amputees, people with visual and motor disabilities and cerebral palsy (J. C. Marques, 2017). The first Winter Paralympic Games were held in Ornskoldsvik, Sweden, in 1976. Ever since they have taken place every four years.

In 1964, Olympic and Paralympic summer events happened in Tokyo, Japan, but it was not until 1988, in Seoul, Korea, that both took place in the same city again, also sharing the same venues (Maika & Danylchuk, 2016). Additionally, in Seoul the Paralympics had its first own opening ceremony in the same spectacular expensive model of the Olympic ceremonies (Goggin & Hutchins, 2017), which is a key-factor for media coverage. Moreover, parasport had an increased formalization and institutionalization in the late 1980s, strengthened by the foundation of the International Paralympic Committee (IPC) in 1989. However, the media

representation of Paralympic Athletes has been slower, as Maika and Danylchuk (2016) point out: “It was not until the twenty first century that a partnership with the Olympic Games truly began to bring the Paralympic Movement to the attention of a broader audience of sport consumers”(p.404).

Media coverage in Paralympic Games

In 2000, 2,300 media representatives were on site to cover the Games in Sydney, Australia, while 3,103 worked in the coverage of Athens 2004, in Greece. This increasing coverage reached its peak in the Rio 2016 edition, in Brazil, the most broadcast in the history of the Paralympics. It was covered by television, radio and online outlets in a record of 154 countries (International Paralympic Committee, n.d.-b).

The portrayal of disabled people through the coverage of the Paralympic Games, even summer or winter editions, has been studied by several scholars. Thomas and Smith's (2003) analysis of articles from four British newspapers regarding the Sydney 2000 Paralympic Summer Games exposes the use of medicalised descriptions of disability. Almost one quarter of the articles in the sample shows a victimization of the athletes, depicted as “courageous people who ‘suffer’ from ‘personal tragedies” (p.172). The study also indicates that most of the photos used on the coverage seemed to hide the impairment and no amputee athletes were shown.

Studies of journalistic articles focused on more recent editions, such as London 2012 Summer Paralympic Games and Sochi 2014 Winter Paralympic Games, indicate the permanence of a medicalised framing. Beacom et al. (2016) note that, even though the general perception of media coverage of both events was positive, the small-scale qualitative analysis of the articles in two British newspapers (*The Daily Mail* and *The Guardian)* demonstrates that the media still tends to objectify disabled people and to promote the “triumph-over-adversity” narrative in order to sensationalize stories.

A first analysis of the Canadian coverage of London 2012 edition, as Maika and Danylchuk (2016) remark, shows that 61% of the articles surrounding the Games, in the *National Post* and the *Globe and Mail*, had a major focus on sports subjects, placing athlete's achievements in the forefront, not the disability. However, almost half of these texts have secondary narratives based on the medicalization of the parasport or the propagation of the

stereotype "Supercrip". Thus, the overall effect shifts “from a sport-focused narrative towards a feature or human interest story that paints the athlete as inspirational or heroic, not for his/her sporting achievements, but for the ability to persist in the face of his/her impairment” (p.410).

The concept of "Supercrip" is fundamental in the literature that examines the media discourse concerning parasport. Berger (2004) define the “Supercrips” as “individuals whose inspirational stories of courage, dedication, and hard work prove that it can be done, that one can defy the odds and accomplish the impossible”(p.798). The constant presence of the “Supercrip” approach, Berger argues, raises the concern regarding false expectations about what disabled people should be able to reach: they supposedly only need to try hard enough.

The “Supercrip” stereotype and the medical approach were not prominent in the articles analysed by Marques (2017) from two Brazilian newspapers (*Folha de S. Paulo* and *Lance!*) about the last edition of the Summer Paralympic Games, held in Rio, in 2016. The articles highlighted the achievements and results of the athletes, avoiding their representation as heroes who succeed to overcome the disability or as individuals whom we should look at with compassion or even strangeness, due to their impairment (p.13). The analysis of the photos that illustrated the articles, nevertheless, identified images highly focused on the disability itself or emphasising the idea of Paralympians’ vulnerability.

The broadcast companies, as Brittain (2017) summarizes, used to keep few people working on the coverage of the Paralympics, for the production of only some hours of recorded programs about the Games. In the last editions, the interest in the event has increased significantly, with live coverage and more people involved. The British Channel 4 is an example. It won the bid as the official broadcaster for 2012 London Paralympics with the promise of 130 hours of coverage. They did not stop there, continuing to broadcast a range of parasport events after the Games, and trying to improve the quality of their programming in order to “educate the general public about parasport and improve the visibility of people with disabilities across all of its programming” (p.256). Brittain ponders that, despite the growing coverage, the content still has a medical approach and uses the “Supercrip” stereotype, supporting the above mentioned studies regarding print press coverage.

Recent statistics confirm the rise of the broadcast of the Paralympic Games and the increasing use of digital media tools. According to IPC’s Annual Report 2016, the edition held

in Rio had a cumulative audience of more than 4,1 billion people. The total number of hours broadcast increased to nearly 5,110, more than the total hours broadcast for Beijing 2008 and London 2012 combined. Only the content available via the IPC's digital media channels leaded to 79 million video views across different platforms (International Paralympic Committee, 2016).

Athletes' view and empowerment

Some studies were centred on the athletes' point of view. Based on semi-structured interviews with 23 Brazilian Paralympic athletes, R. F. R. Marques et al. (2014) observe that, in regards to media coverage, most respondents prefer the focus on their athletic achievements and felt uncomfortable with the "Supercrip" discourse, although some accept this framing once it allows more media exposure. In a similar study, with nine Portuguese Paralympic athletes, R. F. R. Marques et al. (2015) found analogous results: they prefer the approach focused on sports performance to the detriment of the "triumph-over-adversity" discourse. However, some of them recognize that the "Supercrip" speech attracts broader audience.

It is also important to mention the growing use of Social Media platforms as a tool to provide voice to the athletes, who have found an easier way to communicate to the general public. Beacom et al. (2016) highlight that it has been changing "the construction of contemporary disability identities, enabling athletes to articulate their personal perspectives as competitors with disabilities" (p.58).

Another very discussed subject among scholars is whether the Paralympic Games is a viable platform for empowerment of individuals with disability in general. Purdue and Howe's (2012a) study - based on interviews with current and former Paralympians, active and retired disability sport administrators, social researchers and disability rights advocates - suggests that the Games may, to some extent, be considered as a potential tool to empower disabled people, once it creates sporting and lifestyle role models. However, the authors remark that "from the views of some Paralympic stakeholders, Paralympians may appear best suited to becoming empowered" (p.915).

Pack, Kelly and Arvinen-Barrow's (2017) study with five Paralympians who represented Great Britain in London 2012 shows that their experience as swimmers facilitated overall

quality of life, helping to reinforce an identity “which provided a sense of acceptance, purpose, and pride” (p.2068). Similarly, after interviewing six retired British Paralympians who had participated in a total of 22 Summer Paralympic Games, Braye (2016) holds the position that Paralympic athletes can contribute to equality for disabled people in general. Even though most part of the retired athletes don’t see themselves as activists, they consider they can be active “in trying to break down barriers, change attitudes and create opportunities” (p.1294).

Peers (2012) criticizes what she identifies as the two common types of elite disability sport research: media analyses and sport-as-empowerment research. She uses Foucault’s concepts of discourse in an analysis that “challenge the dominant scholarly trend of characterizing elite disability sport as a form of resistance, in and of itself” (p.311). The disabled activists affiliated to disability rights entities, who participated to another study carried out by Braye, Dixonand Gibbons (2013), show a particular view that also differs from the “sport-as-empowerment research”. They believe that the Paralympic Games promote an unrealistic view of the disabled people’s life and can be seen as counterproductive to disability rights. The Media portrayal of disability built through the coverage of the games is also seen as negative, once “heroic stories of super cripples seem more important than real everyday issues”, as one of the participants in the study stated (p.992).

Media challenges

Escaping from the approach of Paralympic athletes as "Supercrips" is considered here one of the main challenges for media narratives. It is also a hard task to deal with what Purdue and Howe (2012b) named as the “Paralympic Paradox”: when emphasizing the sports achievements and not the disability, it could help to empower people with impairment. On the other hand, when de-emphasizing the athlete’s disability, it can lead to a confusion among able-bodied audience, who needs to identify Paralympians as possessing some kind of impairment. At the same time, it can contribute to distance the viewers with disabilities from the athletes (pp.194-195).

This project is in line with Maika and Danylchuk (2016) position, according to which “hiding the disability in disability sport also risks reinforcing the impression that sport is for able-bodied, Caucasian, males” (p.412). Additionally, it is assumed here that it is possible to tell stories that highlight sports achievements without hiding or extremely focusing on the disability, and also without the use of heroic or “Supercrip” framing. The goal in this project is

to offer an approach to the Paralympic world in a very special perspective, seeking to contribute to a more natural view of sport and disability, as proposed by DePauw (1997):

> The transformation of sport culture will mean we are able to "see" sport and athlete with a disability without seeing any contradiction, without assuming a physical liability, stigma or deformity, and without assuming an impaired athletic performance. That is, we will see an athlete, an athletic performance, and a "sporting body" (p.424).

2.2. Immersive journalism

The aim of an immersive experience in journalism is providing a "special perspective". When introducing the concept of immersive journalism, de la Peña et al. (2010) explain that the person, typically represented in the form a digital avatar, participate of a virtually re-created scenario representing the news story as a visitor with first-hand access or through the perspective of a character which is part of the story. In both ways, "the participant is afforded unprecedented access to the sights and sounds, and possibly, the feelings and emotions that accompany the news" (p.292).

De la Peña et al. (2010) and other researchers highlighted three key-concepts regarding immersive environments. The first key concept is *Place Illusion (PI)*, a strong sense of being in a place even though you know that you are not in fact there, as defined by Slater (2009). He further asserts that PI is "the human response to a given level of immersion, and is bound by the set of SCs (sensorimotor contingencies) possible at that level of immersion" (p.3552). Slater also explains that *Plausibility (Psi)*, in turn, is the illusion that what is happening is actually happening, in a reliable relation to what would happen in reality and the actions you perform are responded by the environment. Moreover, there are correlations between external events not directly caused by you and your sensations. In this context, the consequence is what Slater calls RAIR, 'response-as- if-real'.

The third concept is *Body Ownership Illusion (BOI)*, described by Bergström, Kilteni and Slater (2016) as "the perceptual illusion that artificial body parts or full bodies can be perceived by healthy adults as their own". Unlike most studies where the posture of the real and virtual bodies is matched, they conducted a research which shows that the difference

between the posture of the virtual body representation and the actual person's posture can lead to a lesser perception of body ownership compared to situations where real and virtual postures are similar. The analysis also suggests that a virtual posture more uncomfortable than the real one can result in psychological discomfort.

One of the de La Peña's pioneering works observed a similar result: an immersive experience where the participant "enters" in the digital body of a prisoner in a cell in Guantánamo and he/she listens to the interrogation being held in an adjacent cell. The audio was produced based on the reading of real interrogations. The avatar was in a crouched position in an apparently wooden box. Even though the participants were sitting in a straight position, some reported the feeling of physical discomfort (de la Peña et al., 2010).

Domínguez-Martín(2015) remarks that immersive journalism is still a simulation, even if it is a reconstruction of real facts in which no alternatives are given. It is a narrative experience of a representation, where people and actions of a fragment of reality are simulated and users participate somehow (p.420). This kind of simulation for news purposes is one of the growing uses of virtual reality (VR), defined by Aronson-Rath, Owen, Milward and Pitt (2015) as "an immersive media experience that replicates either a real or imagined environment and allows users to interact with this world in ways that feel as if they are there". The virtual environment can be created based on video recording of real scenes or be totally built in Computer Generated Imagery (CGI). The access to this virtual world is possible by the use of head-mounted displays (HMD) which are evolving rapidly, along with technological advances in 360-degree, 3D-video capture and computational capacity (Aronson-Rath et al., 2015).

Other pioneering immersive experiences led by de La Peña are worth mentioning, firstly in the Immersive Journalism Group and more recently in the Emblematic Group. Domínguez (2017) highlights the following pieces of the "godmother of VR": *Hunger in Los Angeles*, *Project Syria* – described in http://www.immersivejournalism.com - and *After Solitary*, *Out of Exile*, *Kiya* and *Use of Force* – which can be found in www.emblematicgroup.com. She also points out that immersive formats are increasingly taking part in news coverage and this proliferation "is closely connected to the reflection on and narrative challenges of a language, which is taking its first steps" (p.3).

Here we remark some examples. *Vice News*' *The Millions March*[2], published in January, 2015 is one of the significant first 360-degree videos in the news landscape. Led by reporter Alice Speri, it provides an inside view of a march that took place in December, 2014, when 60,000 New Yorkers protested racial profiling by police. The 360º video, as explained by Tse et al.(2017), is created with a camera that simultaneously records all 360 degrees of a scene and footage is stitched so that users can pan and rotate the video's perspective to watch it from different angles.

Since November 2016, *The New York Times* has been providing daily 360-degree videos. In the article that introduces the feature, the pieces are described as "immersive videos put you at the centre of the scene, allowing you to look left, right, up, down and behind you" (The New York Times, 2016). Even before the publication of the daily 360º videos, the company had also been investing on actions to boost the consume of VR productions. In November 2015 the *NYT* attached to its Sunday paper edition a million of Google Cardboards, the simplest virtual reality headsets available, encouraging people to see *The Displaced* - stories of three children who were driven from their homes by war- in the new *NYT VR* app. Six months later, they did a "second round", sending out 300,000 Cardboard headsets to its "most loyal" digital online-only subscribers, promoting the VR production *Seeking Pluto's Frigid Heart*, a visualization of the dwarf planet based on data from the New Horizons spacecraft (Robertson, 2016).

Time Inc. is also investing on its virtual reality platform, TIME VR, which offers immersive experiences from some of their publications such as *TIME*, *People*, and *Sports Illustrated*. The purpose is to provide"360° video and interactive virtual reality experiences to engage every passion, including news, entertainment, sports, fashion, history, food, and travel". One of the most famous productions is *The People's house*, an "intimate journey" to Former President Barack Obama and Former First Lady Michelle Obama's White House in Washington D.C., United States (Time Magazine, 2016).

The Guardian's first virtual reality experience *6x9: a virtual experience of solitary confinement*, launched in April, 2016, places the user inside a solitary confinement prison cell in the United States, focusing on the psychological damage caused by long-term isolation. The

[2]https://with.in/watch/vice-news-vr-millions-march-nyc-12-13-14/

cell was designed with the Unity 3D game engine, using CGI. The user hears the real voices of seven people who have spent time in solitary confinement. A different voice can be listened depending on the viewer's gaze – from the toilet, the book, the letter. (Davies, 2016).

The Guardian is still investing on VR stories, as the more recent *The Party – a virtual experience of autism*, available since October, 2017. The user is put in Laila's shoes, a 15-year old autistic girl, at her mother's surprise birthday party, trying to manage the anxiety while dealing with stressful situations. The piece was written by an autistic writer, Sumita Majumdar, filmed with the Google's stereoscopic 360° camera (Jump) and had the participation of 25 actors. According to Francesca Panetta, executive editor, virtual reality in Guardian News & Media (as cited in GNM, 2017), "The Guardian's VR studio is interested in how we can work with researchers and academics to turn journalism into first person dramas".

Broadcasters such as *NBC News*[3] and *ABC News*[4] have special sections in their websites dedicated to VR/360º video production. Virtual reality projects have been under test in the *BBC Taster*[5]. In order to test technology and editorial potential of VR/360ºvideo, the tool provides works that people can try, rate and share. One example is *We Wait:* real stories of refugees are the basis for an animated virtual experience, which permits interactive eye-contact between audience and the characters (Conroy, 2017).

The BBC's *We Wait* was built specifically for the Oculus Rift VR headset. However, most part of the productions, as the majority of the above mentioned ones, are able to be experienced in different and simplistic ways: with only a smartphone, panning during playback by simply moving the device in any direction as a "magic window"; in a desktop, using the mouse to move the scene; or with headphones and different headsets.

The 360-degree video, or cinematic VR, is considered the most accessible type of VR. It provides a certain degree of immersion, but the user is in a central position that cannot be altered within the environment, as the Emblematic Group (2016) observes. On the other hand, the volumetric VR (or kinematic VR) allows the participant to move around inside the environment choosing among different viewpoints. It requires external sensors to track the

[3] https://www.nbcnews.com/storyline/nbc-news-vr
[4] http://abcnews.go.com/VR
[5] http://www.bbc.co.uk/taster/categories/virtual-reality/

position of the headset and adjust what the user sees in real time based on their position. “The range of experiences available to consumers is vast: from videos that simply offer a spherical field of view to interactive environments that deploy the artistry and techniques of video games in the service of journalism” (Emblematic Group, 2016).

In a recent article, with the purpose of reviewing a range of VR applications, Slater and Sanchez-Vives (2016) hold the position that VR is not going to replace traditional media. It is a new type of media for news reporting providing a different perspective, leading to another understanding of the events . “[T]he goal is not so much the presentation of ‘what happened’ but to give people experiential, non-analytic insight into the events, to give them the illusion of being present in them”(p.32).

Immersion: a technical or a cognitive aspect?

According to Slater and Sanchez-Vives (2016), immersion describes the technical capabilities of a system, the physics of the system, while the subjective correlate of immersion is presence, the place illusion of “being there” previously mentioned. The degree of correlation between immersion and presence was examined by Cummings and Bailenson (2016) in a meta-analysis of 155 effect sizes of 83 studies. Overall, it was found that immersion has a medium-sized effect on presence, while individual immersive features were found to vary in their effect sizes. According to the study, tracking level, stereoscopy and field of view have a stronger impact on user spatial presence compared to other features, particularly image quality and resolution and sound. It is important to remark that the study relied on self-reported information.

Specifically regarding sound, several researchers have presented arguments to emphasize its importance in immersive journalism. The contribution to direct user’s attention toward a specific part of the scene in the case of directional audio (Aronson-Rath et al., 2015); the power of evocation of real recordings (de la Peña et al., 2010); the help to minimize the negative effects of poor visual quality and the potential to facilitate storytelling events (Kauhanen et al., 2017) are some of the advantages highlighted, opposing to Cummings and Bailenson' (2016) findings that indicates audio as a less relevant feature than other characteristics to immersion.

Shin and Biocca (2017) investigated how users react to an immersive journalistic experience. The study combined questionnaires and an experiment designed in a 2x2 format, considering two levels of immersion (VR-content-based and flat-screen-TV-based) and two personality traits (high immersion tendency and low immersion tendency). The results indicate that technological properties alone do not lead to enhanced immersion. It strongly depends on the users' traits and contexts. "Rather than immersion being an external factor being given to users, immersion is a fluid state that is processed and determined by users" (p.13).

VR has been called the "empathy machine", which refers to "any attempt to make sensible to oneself the emotional experience of another via technology, often with the goal of inhabiting another body" (Bollmer, 2017, p.63). The possibility to empathise with another person is facilitated by a virtual reality experience, according to Schutte and Stilinović (2017)'s pilot study. The eight-minute long United Nations documentary 'Clouds over Sidra' was presented in two conditions: the VR one, in which participants saw the 360-degree video in a Samsung headset, and in the control condition, when the documentary was seen in a two-dimensional format. The study showed that participants in the virtual reality condition experienced significantly greater empathy for Sidra, the refugee girl featured in the film. In this case, the authors remark, the life in a refugee camp is a presentation of a group of others, once the Australian participants had no direct contact with that reality. Similar studies, they argue, should be replicated with larger samples and even test the impact of VR in situations where the participants have contact with the context/characters presented in the video.

Shin (2018) observes that becoming absorbed in VR can stimulate empathy and participants may feel other's emotions by being in the same space, and close to that character. However, he remarks that is still unclear if immersion has an impact on empathy or embodied cognition. A 2x2 between-subject survey, with a very similar format comparing to the previous one (Shin & Biocca, 2017) - indicates that high immersive devices may contribute to certain levels of embodiment and empathy, although the user's traits ultimately define those levels. "People who understood the issues in the story, and could relate to them, found it much easier to empathize and embody the content than those who did not" (p.71).

It is worthwhile to mention Bollmer (2017)'s contribution as a different point of view in the literature regarding empathy in VR. He questions the use of the term *empathy* when it

comes to digital media, once, according to him, technology presumes to acknowledge the experience of another, but inherently it is not possible. Instead of the statement that empathy can be provoked by digital media, reliant on VR, he proposes that media can contribute to foster *radical compassion*. Following the French philosopher Emannuel Levinas and other philosophers to discuss Levina's ethical relationship of faciality, and also bringing a historical discussion of empathy as an aesthetic category, Bollmer states that the "understanding" that came with empathy destroys the metaphysical relation Self-Other, converting the Other into an object to be consumed, absorbed. That's why he suggests the term *radical compassion*, which regards "the potentials of not understanding another, of not feeling what they feel, in a way that does not negate or ignore the experience of another but is open to it, even if it can never fully grasp it" (p.73).

2.3. Sports and VR

Liao (2015) identifies four main uses of VR in the field of sports: in the high-performance level, as a tool for training purposes so that athletes and coaches can interact with simulated environments to enhance their skill levels (systems developed in China for diving, trampoline and basketball are some examples given); in sports rehabilitation, with satisfying effects been achieved in areas such as spatial perception disorders, memory disorders, poor coordination and balance, among others; in what he calls "popular sports", mentioning Chinese examples of virtual environments for bowling and athletics; and in physical education, especially for sports technique analysis.

Gradl, Eskofier, Eskofier, Mutschler and Otto (2016) propose the combined usage of a large tracking area indoor localization system and virtual reality for sports training. They suggest the use of a calibration procedure to track head rotations of a HMD user and to correlate it with the positional tracking. A survey held among 227 sportsmen to assess the acceptance of the idea indicated that although most part had no previous knowledge about virtual and augmented reality devices, the majority declared interest in using it in sports training.

Slater and Sanchez-Vives (2016) mention several studies describing VR experiences in sports such as table tennis, football, rowing, baseball, handball, skiing, rugby, and shooting. They point out the need to carry out rigorous analyses to check if "small differences between the VR version and the real version might lead to poor skills transfer, or incorrect learning"(p.16). However, they highlight the advantage of VR to plan overall strategy and tactics in team sports.

Miles, Pop, Watt, Lawrence and John (2012), in a review of Virtual Environments (VEs) for ball sports, identified challenges that need to be overcome in delivering training environments. Besides costs, they draw attention to the importance of identifying types of skills best suited to training in VEs and technologies that achieve the best results in specific performance measures. Moreover, they consider important to evaluate the situations in which the use of stereoscopic displays and high fidelity systems are really needed. It is also critical to know how and when feedback should be delivered to the learner. The reliability of skills transfer from VE training conditions to real-world practices is another key-point highlighted.

Covaci, Olivier and Multon (2015) remark two topics not discussed by Miles et al. (2012): spatial perception in large VEs and the use of visual guidance. Both aspects are examined in their study for the development of an immersive training system for basketball free throws, an aiming and precision task. The natural motor behaviour and success rates of beginners when performing free-throws on a real court were recorded. Then, using a large-screen immersive display (LSID), researchers tested beginners' performance in three visual conditions: first-person perspective, third-person perspective, where the virtual ball is displayed in front of the user, and third-person with guidance feedback, where the circles displayed in front of the user show the ideal trajectory. Stereoscopic glasses were used and synchronized with the immersive room. Each result was also compared with the performance of experts in the real situation. Findings indicate that users more accurately estimate distance to target in the third-person perspective, and the visual guidance information also led to more natural motor behaviour.

Rowing is one of the sports in which the transferability of skills has been studied. The rendering of visual and auditory interactions with the environment are not enough for a realistic system, since rendering haptic interactions between oar and water is also essential,

as explained by Rauter et al. (2013), who tested a training simulator in a CAVE (Cave Automated Virtual Environment) system. In the study, eight rowers trained either exclusively on the simulator or on water. Biomechanical performance measures, video analysis, and questionnaires were used to assess the skill transfer/development. The results showed that the simulator fostered skill gains to a similar extent as training in the real environment and, thus, it can be used as a complementary training tool.

Kalivarapu et al. (2015) developed a VR experience for American college football in order to improve recruiting process of talented students. Using the Unity 3D game engine, a simulation of the Iowa State Cyclone game-day experience was delivered for a very high-resolution environment, a six-sided CAVE named C6, and for the DK2 Oculus Rift. A user study was held with sixty participants, equally divided between three modes: C6, HMD, and regular video. Presence and immersion were measured by questionnaires. Results indicate that the C6 and HMD improved upon the standard practice of showing 2D videos in terms of interaction and examination of the atmosphere. A greater degree of realism was experienced in the Cave, although both the C6 and HMD were scored similar in the rest of presence categories. Miller et al. (2017) did a very similar study with the same virtual game application, adding a more portable solution and even lower cost HDM, the Merge VR smart phone-driven, once C6 and Oculus Rift are considered costly and do not have the ideal portability. The tests with 82 students showed that Merge VR produces similar results to Oculus and C6 in most presence categories and could be a viable alternative.

Different sports have been investing on VR to watching. The National Basketball Association (NBA) - the men's professional basketball league in North America - partnered with Intel to provide virtual reality via the TNT VR app on Samsung Gear VR or Google Daydream. For the 2017-18 season, the fans are allowed to view the game from different locations throughout the arena, from high in the stands or taking the viewpoint of the photographers sitting on the baseline, for example. By integrating 360-degree volumetric video into the VR experience, Intel also let fans freeze a moment of the game and take the player's point of view in the court[6]. Post-game experiences in VR featuring highlights of selected matches have already been provided for fans of the United States' National Football

[6]http://www.nba.com/article/2017/11/07/new-partnership-brings-virtual-reality-nba-tnt#/

League (NFL)[7], while cricket fans in India are expected to try the VR experience in the Indian Premier League 2018 starting in April[8].

After delivering 85-extra hours of VR content in partnership with Samsung for the 2016 Summer Olympic Games in Rio, most available on the day after each event, *NBC* announced a step forward regarding the 2018 Winter Olympic Games in PyeongChang, South Korea: more than 50 hours of live VR coverage – including key-moments such as the Opening and Closing Ceremonies. Powered by Intel True VR technology, the tool is available to authenticated users with Windows Mixed Reality headsets, Samsung Gear VR, Google Cardboard and Google Daydream via the NBC Sports VR app (NBC, 2018). The Olympic Channel[9] also launched "Trending Gold", a VR seven-episode series produced by Jaunt (a virtual reality content and technology company) that let the users experience athletes' preparation for the 2018 Winter Olympic Games in six countries.

Sports watching turns into sports playing in *Wear the Rose*[10] experience, designed to Oculus Rift headset and launched in an immersive experimental event in 2014. In full 360-degree visual spectrum, the user is placed within a training session of the England Rugby Team, with a first-person point of view, as if he/she was one of the players receiving passes and participating of the training. The real images were captured by nine GoPro Hero 3 cameras. It took more than 160 hours of filming and 320 hours of development to create the experience (Williams, 2014b). After experiencing *Wear the Rose*, Williams (2014a) stated: "It's an utterly bizarre blend of the surreal and the truly believable; you flinch when you're tackled and twitch when it's your turn to drive. You can't help it, it just feels that real".

Iekura et al. (2015) advocate that, even though the use of HMDs using player viewpoint is considered the closest experience to the athletes, it moves the user away from other spectators. Therefore, researchers describe SMASH, an haptic system that allows the audience to feel the players' heartbeats and tactile sensations in the palm while enjoying sports watching with others. The athletes' heartbeat and tactile sensation became signals driven to a diversity channel receiver, then amplified and sent to the spectator's two-hand device

[7] https://www.nextvr.com/nfl-vr-experience-announce/
[8] https://gadgets.ndtv.com/apps/news/hotstar-vivo-ipl-2018-live-stream-vr-1801343
[9] https://www.olympicchannel.com/en/playback/trending-gold/behind-the-scenes/trending-gold-go-behind-the-scenes-of-the-new-virtual-reality-series/
[10] https://sportandentertainment.mcsaatchi.com/project/o2-wear-the-rose/

through a bluetooth transmitter. This research focused on the audience device and on how to share accurate player experience, leaving the implementation of the athlete's side system for future work.

Regarding Paralympic sports, Morais, Rezende and Goncalves (2015) propose the development of a virtual environment for the training of shooting, in a computer game format, following the rules established by the competent bodies concerning the weapons included in the game, the amount of ammunition, the size of the targets, and distances between the athlete and the targets. In the model described, the interface shall adapt to the size of the display window in which the game is used. The image acquisition is performed by a webcam that interacts with the software, processing analyses of the images in matrix form. Results are displayed dynamically, providing the user with instant feedback. The goal is to allow the practice in any environment, including at home, without the need to go to training stands.

Similarly, Ribeiro, Faria, Paulo Moreira and Reis (2017) describe an ongoing work to create a boccia simulator that will be able to adapt automatically to various disabilities. It is expected to increase the athletes' autonomy to control the ramp, since a robot will move it based on the athlete's orders, considering their limitations. A multimodal interface (MMI) allows the user to indicate the more adequate way of interaction with the simulator (keyboard, joystick, head movements, voice recognition, facial expressions or hand movement). The representations of the field of game, the ramp, and the balls follow official specifications. To make it even more realistic, elements like standings, benches for the player's teams, a scoreboard, a clock and even two referee models were added to the sports hall. Unreal 4 and V-REP were respectively the game engine and the robotic simulator chosen. Comparison tests using real and virtual throws indicate that the simulator offers great similarity to the reality: 10cm was the maximum difference between the measures obtained.

All the VR experiences for sports above described shed light on technical aspects and expose achievements and limitations that, somehow, can be useful in this project. However, the sport – specifically a Paralympic sport - here is the subject of an immersive experience with a journalistic purpose. Thus, in the following section, some lessons that came up with VR storytelling experiences described in the literature are briefly reviewed. Even if most are exploratory studies and/or conducted with small or aleatory samples, there are important indications to the development of the present project.

2.4. Lessons for VR storytelling

The first experiences headed by de La Peña in Second Life[11] platform have already shown the importance of integrating primary source material documenting the physical space within the virtual environment to strengthen the narrative and the sense of immersion. Moreover, after conducting a case study of the production of a VR documentary – following its planning, field production, post-production, and distribution – Aronson-Rath et al. (2015) list some recommendations for journalists seeking to work in virtual reality, such as the importance to understand, before production starts, the form and what raw material the finished work will need. Another suggestion:

> If directors want to avoid relying on 2D video, or other overlays, it appears they will need to capture the action, or the interviews, as they will be experienced by the viewer; that is to say, without cuts other than the starts and ends of the scene (p.65).

They further advise journalists to choose a place on the spectrum of VR technology: delivering for higher-quality devices linked to computer or for mobile devices, with less computer power and restrictions for interactivity. The Emblematic Group (2016) also recommends the decision of the platform very early in the production process, once the type of headset will determine overall parameters of the piece, and it is important to be aware of the platform capabilities. Domínguez-Martín (2015) lists 10 resources or strategies to an immersive rhetoric, such as realistic and detailed graphic style, fluidity of movement through space (which conveys the feeling of "being there") and constant ambient sound, which helps in the feeling of expectation and atmosphere in the environment.

Newton and Soukup (2016) draw attention to the amount of visual and sound information. In their studies to explore the audience's experience in VR, when the scene had more than one focal point, some participants reported FOMO (fear of missing out). The researchers highlight that FOMO has strong potential to distract, taking the audience out of the experience, "but may also be a storytelling tool to create suspense or illicit curiosity". FOMO was also reported by participants in Jones' (2016) focus group study, when watching a

[11] http://www.secondlife.com

sample of twelve journalistic 360-degree videos on various HMDs, and in Tse et al.'s (2017) findings: 35% of the 40 participants mentioned experiencing FOMO in a study carried out to explore if 360 viewing platform (magic window / Google cardboard) and headphone use (with / without) have an effect on immersion for 360-degree videos. Jones (2016) also mentions users' feeling of discomfort for having their personal space invaded by characters very visually close in the scene. Some declared will to take off the headsets, especially in situations like protests.

A study led by Passmore et al. (2016) comparing the user experience of 360-degree video across three platforms (headset, phone and flat screen) draws attention to the fact that users in the headset condition reported less concentration on the narrative because of the possibility of looking around: they had more doubts about what they should attend to, compared to screen viewers. The voice over is another feature that should be used carefully according to the authors. In 360º video, the user needs to check, by looking around, if there is someone talking on camera or it is a voice over.

One of the problems reported in the user study led by Kauhanen et al. (2017), in an ongoing work to design a biography of a Finnish artist as a VR experience, is related to camera positioning. Some participants reported negatively that the perspectives were different from what they were used to, which indicates the importance of careful planning of camera position.

3. DEVELOPING THE EXPERIENCE

The purpose of this project work is the production of a 360-degree video that brings users close to the Paralympic sport's environment by telling a story without the heroic or the "Supercrip" framing regularly used by traditional journalistic reporting. A 360-degree video, as previously mentioned, is considered by the Emblematic Group (2016) the most accessible type of virtual reality, and the same view is assumed in this project. It provides a cinematic experience, which means that the agency is to look around from a fixed central position. The workflow process of the video-prototype will now be depicted in detail. The goal is to report the challenges and lessons learned, in order to improve upcoming work related to the present subject.

As it is a prototype, we consider that, besides this first step of immersion in VR, it is an opportunity to contribute to a deeper level of immersion and interaction in a second part of the experience, a game that provides a first-person point of view. This will be developed in future work in a transdisciplinary partnership with Raquel Macedo, a Master's student in Computer Science and Informatics Engineering in the Faculty of Sciences and Technology (NOVA/FCT). Some of the recordings done for the present project were also sent to the partner for the development of the game.

Step one: which sport and which platform?

Two important decisions were taken in the very beginning of the project. The first one regards the sport that will be the subject of the narrative. The second one is the platform to which the experience will be delivered for the users' tests. A meeting with the Portuguese Paralympic Committee was scheduled early in April, 2017, before the official start of the project, in order to know what are the Paralympic sports practiced in the country at the high-performance level. The options took into consideration after the meeting were: athletics, boccia, cycling, judo, shooting, swimming, and wheelchair basketball.

In October, 2017, the sport chosen for the experience was the wheelchair basketball[12], due to the facts that: a) as a prototype, it was considered important to choose a sport not so challenging to be understood by people not used to it. In terms of rules, the wheelchair

[12] https://iwbf.org/

basketball and regular basketball are similar, and the latter is most known by the general public; b) technically, it is believed that it is possible to reproduce the sport's environment in a virtual world without so many difficulties in the game development led by Raquel Macedo.

The other decision, concerning the platform, was also made in the early stage of the project. Tricart (2017) remarks that what turns a 360º video into a VR experience is the possibility of seeing the content in a VR headset, not in a flat screen. The 360º video, thus, would be delivered to a VR headset used with a mobile phone, such as the Samsung Gear VR. It is an option for a broaden group of users, once there is no need to be attached to a computer.

3.1. The production process

The next step was to get in touch with the Portuguese wheelchair basketball team to check the feasibility of the recordings. A meeting with Augusto Pinto, president of the Wheelchair Basketball National Committee of the Portuguese Basketball Federation was scheduled in November, 2017. In this meeting we were told that the national team would have a three-day training in the High Performance Centre of Vila Nova de Gaia (North of Portugal) in December, 2017. We agreed that the recordings would be allowed in the first day and in the morning of the second day. A test recording was scheduled before the shooting in Gaia. Augusto Pinto suggested a training court in Sintra, 30 km away from Lisbon, once the features of the court are similar to the ones we would see in Gaia in December.

November 23rd: preliminary testing

The test took place at the "Pavilhão Municipal Serra das Minas", in Sintra, during a 1h30 regular training session of the local team ("Associação Portuguesa de Deficientes" – APD-Sintra). The main goal was to try camera position while different activities were taking place. The equipment list used in the test is the following: Kodak Pixpro SP360 4K camera (with two MicroSD Cards); tripod; Roland R-44 audio recorder (with one SD Card); 4 microphones Behringer C-2; extra battery for the audio recorder.

Fifteen scenes were shot, depicting the warm up stage, the coach giving instructions, and a variety of exercises: dribbling, passing, free throws, among others. The camera was

positioned in different parts of the court such as centre, sides, the three-point arc and under the basket.

The raw material was revised the day after. The first challenge was the size of the files: the Pix Pro has two cameras in order to form the full 360º spherical video, which means that every shot has two files. The shots in the test had an average of 4 minutes and the two files together reached 5GB for some of the scenes. Therefore, we comprehended that was counterproductive to shoot so long scenes if the Pix Pro were the camera chosen for the official recordings in Gaia. The camera ran out of battery with one hour and a half of use, which was also an important lesson: as we were planning an all-day shooting, only one camera wouldn't be enough. Another challenge faced was to match audio and video files, since the shots were not identified during the test. Therefore, it took a long time to find the audio file correspondent to each video file. It was a constraint that couldn't be repeated in Gaia.

The softwares used for the stitching process were *VideoStitch Studio* and *PTGUI Pro*. The tripod and the audio recorder (placed under the tripod) were obviously seen in the images and it would be definitely a challenge for the post-production process, when masking out the rig. A decision was taken: try to replace the tripod for a monopod and look for a smaller audio recorder equipment before the shooting in Gaia.

Some shots were sent to the partner in NOVA/FCT for the second step of the experience. Real scenes of a wheelchair basketball training, even if they are monoscopic footage (flat, without depth), will be useful in the conception of the game. Photos of wheelchairs used in the sport – which differ considerably from the regular ones – were also provided to the partner.

Planning Gaia

From the test (November, 23rd) to the official recording (December, 8th – 9th) in Vila Nova de Gaia, three process were led simultaneously. The first was the conduction of interviews with the coach of the national team, Marco Galego, and the captain of the team, player Márcio Dias. Those interviews were done by phone with the purpose to know their journey in the field of Paralympic sports, namely in wheelchair basketball. Having a previous idea of their careers and thoughts was essential once they are the main characters of the 360º video.

The second process was providing the equipment. As mentioned previously, efforts were made in order to get a monopod and a smaller audio recorder. Both were not possible due to financial constraints, so the tripod and the Roland R44 were kept. Besides the four microphones, a fifth one – a wireless lavalier mic - was added to the list, so as to replace one of the other four in the moment of the interviews. The main change comparing to the test was the choice of the camera. Samsung was contacted and agreed to lend two cameras Gear 360 (2016) and two smartphones Samsung Galaxy S7 through which it would be possible to follow the shooting via the Gear app. The Gear 360 (2016) is a small and lightweight camera that comes with dual fisheye lenses. It can capture high-resolution (3840×1920) 360-degree video that also supports 30 megapixel still images. It only provides monoscopic footage and does not produce stereoscopic footage (with depth and 3D effect). The final list of equipment was the following: 2 Samsung Gear 360 (2016) cameras (with chargers); 3 MicroSD cards; 2 smartphones Galaxy S7 Edge (with chargers); tripod; Roland R-44 audio recorder (with one SD Card); 5 microphones (four Behringer C-2 and one wireless lavalier mic); extra battery for the audio recorder; SD Card reader; a Mac book (to check the files before the second day of shooting).

The third challenge was to set the team up. Besides the author of this project, three people have voluntarily agreed to participate to the recording of the project. Davide Mancine[13] is an Italian multimedia journalist and content creator with experience in video, photo, and written content for different online media and organisations. Rui Avelans Coelho[14] is a Portuguese film director, Digital Media researcher, and an audio expert. Catarina Gomes[15] is a Portuguese journalist and impact manager at an immersive storytelling studio specialized in content production and VR experiences for media and Non-Governmental Development Organization (NGDO).

[13]Davide Mancine also funded and run a company providing new technologies for online video gathering adopted by publishers and brands in different countries.

[14]Rui Avelans Coelho also taught “Sound Editing” and “Audio Post-production” in several Portuguese schools, as well as “Experimental Video” and “Interactive Video". He coordinated cultural projects for Portuguese museums producing multimedia guides and interactive sound environments.

[15]Catarina Gomes also holds a Master’s degree in Journalism from the University of Aarhus (Denmark) and University of Amsterdam (Netherlands).

Script

Based on the shooting test on November 23rd and considering both the previous experience of the author of this project covering wheelchair basketball and the discussions with the team, a list of 22 shots was defined as the essential raw material needed in the official recording. Most of them were training scenes and eight shots were designed as 360º video interviews (see Appendix 1).

Considering it is a prototype, the team agreed that it would be important to try a shot as close as possible to the athlete's perspective, placing the camera in the training wheelchair, even though shots in movement are considered very risky in 360 shooting. In Jaunt's Cinematic VR Field Guide, the concern is remarked: "Of all issues related to cinematic VR none is more important than that of moving the camera as it has the potential of literally making your audience sick" (Jaunt, 2017).

Besides the eight shots with interviews in 360º predicted in the list, we decided that a linear audio interview must be recorded with Marco Galego and Márcio Dias. This audio would be used as a voice over on the edited video, trying to keep the audience engaged in the narrative and not only having a sequence of shots.

A short script for the linear audio interviews was also prepared as a guide (see Appendix 2). Phone interviews done before the official recording proved to be essential to think about the main questions. The ones related to rules and specifications of the wheelchair basketball, as well as the differences/similarities and motivation for training impaired athletes, would be driven to coach Marco Galego. The motivation of being an athlete and the more interesting skills in that sport would be asked to the player Márcio Dias. Both would be questioned about how they see sport and impairment.

3.2. Shooting 360: unlearn to learn

The author decided not to think of a complete screenplay of the final video previously. As it was conceived as an immersive journalistic piece, it was considered relevant to pay attention to what would be happening at the moment, to unpredicted scenes and to the best answers in the interviews before the final design of the experience. Therefore, we arrived in

Gaia with the script of shots and interview questions as initial guides, with the awareness that different shots and different questions would raise depending on how the training would be led.

The Jaunt' field guide remarks that trying to force the linear video sensibilities and film language into the new medium is a common mistake. They also mention a very famous phrase of one of the Star War's characters:

> As Yoda once said, 'You must unlearn what you have learned.' While it is of course natural to build on the skills that you already know as a filmmaker it is also important to embrace this for the new canvas that it is and experiment with new techniques and new ways of telling stories unencumbered from the past (Jaunt, 2017).

In this sense, it was a challenge not to think of close-ups, panning, zooming, and also to not count on future cuttings in the shots. In 360º video/VR, other elements can play similar roles. When discussing a narrative grammar in 360º video, Lescop (2017) remarks that the challenge to draw the viewer's attention can be overcome by elements like cinematic direction, lights/shadows, and sounds. Lescop highlights that sound can change the attention from one point to another. A sudden sound, for example, can be a tool to produce the effect of a jump cut or a close-up, focusing attention.

All the time we tried to bear in mind the reason why the 360º video was chosen to deliver this message: to provide a special perspective to the user, immerging him/her in the training routine in order to make him/she fell closer to the athletes; to facilitate the understanding of rules and specificities of the wheelchair basketball; and, at the same time, contribute to a view of sport and disability without contradiction.

Start shooting

Each Gear 360 has two cameras (front and rear), but the rec button and the files produced are unique. As we were working with two Gears, we identified each one as 1 and 2. We didn't shoot anything with both Gears at the same time: as soon as one Gear's battery was off, we started working with the other one, while charging the first one. Every time we started using each Gear, it was required to pair it with the mobile device (the Galaxy S7) using the Samsung Gear 360 app. It allowed us to follow the shooting (only the images, not audio) even though we were out of the scene.

This is one of the main differences between a linear video and the 360º recording: as the camera simultaneously records all 360 degrees of the scene, you have to leave the place. We used two "hiding places": behind the wall that separates the locker rooms from the courts and also the bench in the side of the court, where we sat and followed the training among the staff members.

The audio recorder has four recording channels and allows independent listening of each channel, or grouped in stereo. No internal processing was used during recording (equalization or limitation / compression). The four microphones were fixed on a stand in an XY format perpendicular and 90 degrees apart from each other. For the interviews, one of the microphones Behringer C-2 was replaced by the lavalier mic. The files were recorded in a monophonic way. In order to facilitate the synchronization of video and audio, once we were rolling, we identified each scene saying it's number and also clapped about 50cm above the microphones, aligned with the axis of the tripod.

The author of this project was in charge of the production of the scenes and shared direction with Catarina Gomes. Rui Avelans Coelho was responsible for the audio and Davide Mancine organized the shooting: identifying and writing down the shots, checking if audio and video were in fact recorded.

Two courts of the High-Performance Centre in Gaia were used in the wheelchair basketball training. The illumination was uniform, so that we didn't have challenges with this issue (Figure 1). As Vanderborght (2016) highlights, deformation gets bigger when moving closer to the rig. The Jaunt's field guide indicates that the minimum distance recommended by a headset enterprise as Oculus is .75 meters before the viewer starts going cross-eyed. With this reference in mind, we asked the players to try to be at least one meter apart from the camera.

Figure 1: The author placing the Samsung Gear camera and the tripod on the court of the High-Performance Centre in Gaia. The uniform illumination was helpful in the recording.

Another aspect we paid special attention to was the "seam area" of the camera, placing it headed to the wall or to places with less movement and objects, to simplify the stitching process. According to Jaunt (2017), it is also important to shoot clean plates of the ground that the rig (the tripod and the audio recorder, in our case) will be covering. We decided to take pictures of every place we put the rig, in order to facilitate the process of painting out the ground below the camera in the editing process.

Right choices, mistakes: lessons learned

We had a start guide of 22 shots and we ended up shooting almost 60 scenes (see Appendix 3), considering the repetition of some shots, which was proved to be a right choice, mainly in the interviews. We tried hard to identify every shot and every audio in order to not lose time in the post-production.

It was crucial to follow the shots through the Gear 360 app in the smartphone, so we were able to correct camera position very often. However, we didn't manage to follow the audio, only the video, thus the content of the interviews (what Marco Galego and Márcio Dias were saying during the shots) was later unveiled to us. We planned eight interviews in 360º

video, but we realised they would not be possible without disturbing the training programme. Thus, Marco agreed to shot 2 questions and Márcio answered 3 questions in 360º. The remaining questions were recorded only as linear audio.

It was a challenge to interview in 360º due to fact that we had to hide ourselves. We posed the question, left the scene and asked the interviewees to wait for our signal to start answering, looking at the camera. We had to repeat some shots because we planned with characters the beginning, but didn't plan the end of the scene, therefore they didn't know what to do after the answer. With the instructions of how to finish the answers – and consequently the shots – we repeated the scenes and then it was considered satisfactory. We tried to keep the camera at the same height as the player's eyes while sat in the wheelchair. It was done in most part of the shots.

Although we had decided to shoot shorter scenes comparing to the ones in the test (with the average of 4 minutes), we changed our minds due to the fact that, in the first longer shots, we had non predictable and interesting events, such as the ball hitting the tripod and producing a very curious effect, or a player fall of the wheelchair with the consequent recover in a very interesting way. Most part of the shots therefore had more than 4 minutes. Sometimes it was not possible to take a picture of the ground after the shot due to the speed of the training: we had to quickly take the camera out of the place to avoid disturbing the continuity of the practice.

Concerning the camera itself, the Gear 360 (2016) doesn't have a support under it, so the camera gets very close to rig. Consequently, the tripod was clearly seen in the images, more than in the test, when we used the Kodak Pix Pro camera. In the first shot, we realised it would be a considerable challenge to remove the tripod from the images in post-production. We also had a permanent care about the security of the camera. Hence we gave up shooting scenes such as the training match with the camera in the centre of the court. We replaced it for another camera position on the side of the court.

Once we arrived in the hotel, we transferred the files to the computer and realised a flaw: the Gear 360 has different options of image resolution and we had forgotten to check the configuration before start shooting. Consequently, we had one camera with lower resolution (1920 x 1080) and the other one in the highest resolution available in the camera

(3840 x 1920). On the second day, we repeated some shots firstly recorded in 1920 x 1080 now with the higher resolution available, even though it was impossible to repeat every shot.

3.3. Post-production

All the raw material was transferred to a computer at iNOVA Media Lab, the digital creation laboratory where this project is incubated. Vanderborght (2016) indicates the importance of organizing the files clearly, also marking the incomplete takes. It was the first post-production step: all files were identified, audio and video files were matched and organized in folders. The audio recorder automatically generated a folder for each shot, which made organization easier.

Every shot was watched carefully and a total of 21 were chosen for the stitching process as options for editing. The best part of each shot was selected and the interviews were transcribed. Thus, the script for the prototype was designed. The video was recorded in Portuguese once the characters are Portuguese and they manage to express themselves better in their mother language. (see in Appendix 4 the script with the full video's content translated to English). The video was conceived with nine main scenes, each one lasting at least 25 to 30 seconds. One of the main recommendations indicated in Jaunt's VR field guide concerns the time needed by users to immerse themselves in each scene. "Cut too quickly and your viewer will be frantically looking about trying to figure out what is going on and what to look at all while you are tiring them out" (Jaunt, 2017).

Editing

The 21 shots[16]chosen were automatically stitched with the software *Gear 360 Action Director*. The next part of the editing process was done in *Premiere Pro cc 2018* and led by the author and Rui Avelans Coelho. The script was implemented in order to have a "rough cut" to be analysed with a HMD. The main purpose, in this stage, was to check if all scenes would be kept, with a special concern with three of them. In the final moment of the scene where Márcio shows typical plays, he tries the three-point throw five times before succeeding. We

[16]Some shots already stitched were also sent to the partner in order to help the creation of the virtual environment for the second part of the project.

used an acceleration tool in this part and, with the HMD, it clearly caused motion sickness, so we decided to cut it out. On the other hand, we kept the scene in which we attached the camera in the athlete's wheelchair in movement (Figure 2). As a prototype, we consider that users should evaluate this scene so as to have a broader feedback, even though it was the only part of the video where the camera was in movement, which could cause strangeness or confusion.

Figure 2: A frame of the shot in which the camera was attached to the wheelchair.

The third main concern referred to the scene in which Marco (the coach) explains the classification system in the wheelchair basketball[17]. It is an issue that requires special attention. As the scene was too long, more than one minute of explanation without the possibility of editing in between - once it is a 360º video recording -, we decided to cut it out. This scene was in the middle of the video and it could break the rhythm of the piece, becoming an easy way to lose the user's interest in the rest of the experience. We also identified small parts of the other scenes that could be cut in order to achieve the running time of about five minutes.

In a second moment, we tested the transitions between the scenes. As the scenes were mainly recorded in the same place (the court), we considered that the use of fade-out/fade-

[17] https://iwbf.org/the-game/classification/

in instead of hard cuts or dissolve tools was more appropriate. We also realised that it was necessary to use titling to introduce the video and some scenes. As Brown et al. (2017) point out , we cannot predict where the user will be looking at any given time, so the positioning of the subtitles or, in our case, the titling, is a challenge. We displayed the titling at three positions, located at 0^o, 120^o, and 240^o about the viewer, in the centre of the VR environment, based on the subtitle behaviour called "120-degree" by Brown et al (2017). We also had to identify Márcio and Marco, as their voices are the guides of the narrative. With this purpose, we put their credits in scenes where each one is very close to the camera and speaks for a longer time, so that their visual presence + voice might attract the user's attention and he/she could see the identification.

As previously observed, masking out the rig (tripod + audio recorder) was one of the main difficulties. For some scenes, we had the pictures of the floor that worked as clean plates and it was used in the editing (Figures 3 and 4).The pictures were crucial, but if we had taken them with the Gear 360, it would have made the process easier. As we took the pictures with different smartphones, an extra effort was necessary in terms of colour correction. For the scenes we did not manage to take the floor pictures, we used the blur tool to mask the rig.

Figure 3: A stitched frame of the shot Change of wheelchairs. Masking the trip was a challenge in post-production.

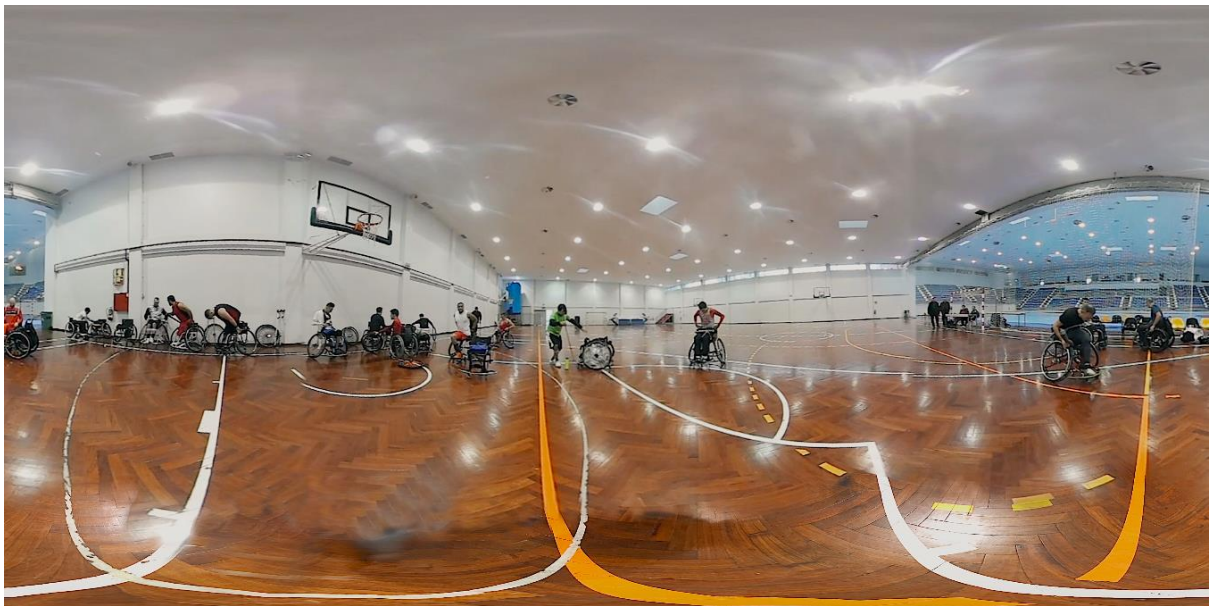

Figure 4: A frame of the same shot (Change of wheelchairs) after masking out the tripod with a picture of the floor.

A soundtrack was added to video in order to give more rhythm to the piece. As we were working on a video that already gives the user 360 degrees to be observed and also has a voice over expected to be understood, we chose a very simple and instrumental soundtrack, in order not to deviate the attention from the narrative.

Regarding audio editing, the four audio files of each scene were synchronized directly in *Premiere Pro cc 2018* by comparing the reference audio from the camera with the files that came from the audio recorder. This way, they were grouped with the video file. Voice over and soundtrack were added sequentially. In the scene of typical plays, it was necessary to manually put the audio of the lavalier microphone correctly into the space as Márcio moved too much along the scene and the audio of the lavalier microphone did not have spatial information.

Once video editing was complete, the various audio tracks were separately exported. Editing was finished in *Reaper*, an audio software that uses the *Facebook 360 Spatial Workstation* plugins. The next step was exporting a file with 360 audio and another one with stereo audio, also called a headlock, which includes sounds that are reproduced regardless of the direction of the head. The three contents - video, 360 audio, and headlock audio - were gathered in *Facebook Encoder*.

The file was exported in a.mp4 format and the codec chosen was H264. The frame rate was 23.976fps, the bitrate encoding was VBR, 1 pass and the target bitrate was 50Mbps. Firstly it was transferred to the smartphones that were connected to the headsets for the user study. After finishing the tests, an audio and video fine-tuning was made. By using the *Final Cut Pro X*, version 10.4, a colour correction was applied.

The final file was uploaded at the iNova Media Lab's account in Youtube: https://www.youtube.com/watch?v=eW_e02pSaG4&t=5s. Although it is possible to see the video in the computer or moving the phone as a magic window, it is strongly recommended to experience it with the use of a HMD, namely the Samsung Gear VR, in order to have a similar experience to the one tested and described below.

4. USER STUDY

After finishing the editing of the prototype, a user study was conducted aiming to get insights about how was the experience of watching the video with a headset and gather suggestions for future work. It was also important to comprehend if the video allowed a better understanding of the sport and if it contributed to seeing athletes as athletes, not as Supercrips or superheroes, without the need to hide the impairment. In order to get qualitative data, namely in-depth perceptions, the main research method chosen was focus groups.

As Krueger and Casey (2014) remark, the intent of focus groups is not to generalize, infer or make statements, but rather to understand, to provide insights, to gather opinions. Parker and Tritter (2006) highlight the difference between the dynamics of a group interview and a focus group: in the former, the interviewer looks for answers; in the latter, the moderator seeks group interaction and he/she has a peripheral role. The crucial aspect is the discussion among participants.

One of the main advantages of focus group methodology, according to Poels, De Kort and Ijsselsteijn (2007) is its exploratory nature, letting the researchers get to know the audience's thoughts in detail. Krueger and Casey (2014) indicate that the ideal size of a focus group is five to eight participants when it comes to non-commercial topics, as in the case of this project. Thus, we decided to organize four focus groups with the size suggested, each one characterized by certain homogeneity, as explained below.

An invitation letter and a link to a previous online survey were sent to potential participants. The aim was to check the familiarity with Paralympic sports in general and with wheelchair basketball in particular. They were also asked about the previous experience with 360-degree video and the use of headsets. All-in-all, 23 participants (15 male, 8 female) were selected to attend the focus groups, aged between 23 and 53. They were informed in advance that there would be no compensation for participation.

4.1. Groups set up

Group 1 aimed people that have a direct interest or a strong link to Paralympic sports (but not being Paralympic athletes) and without experience with HMDs. Staff members of different sports, people from associations/organizations related to adapted sports and athlete's family members were invited. Five people (participants 1 to 5) attended the focus group 1 which took place on March, 1st at iNOVA Media Lab in NOVA School of Social Sciences and Humanities from Universidade NOVA de Lisboa (NOVA/FCSH).

Group 2 was formed by PhD and Master's students in the Department of Informatics from the Faculty of Science and Technology (NOVA/FCT). They had no/little familiarity with Paralympic sports. Six people (participants 6 to 11) attended the focus group 2 held on the Department of Informatics' building on March, 2nd .

For group 3, wheelchair basketball's athletes from the APD-Sintra team were invited, all of them without previous experience with HMD's. Seven people (participants 12 to 18) attended the focus group 3 at APD-Sintra headquarters on March, 5th.

Group 4 was formed by students and staff from NOVA/FCSH randomly chosen few hours before the test. The homogeneity was the unfamiliarity with Paralympic sports and no/few previous experience with HMDs and 360-degree video. Focus group 4 took place at iNOVA Media Lab on March, 6th.

The same procedures were applied for the four groups. After welcoming participants, the author introduced the project, explaining context, motivation, and the production process of the video-prototype. The importance of their feedback for future work was also highlighted. Then, Ana Figueiras, PhD in Digital Media and researcher at iNOVA Media Lab, introduced herself as the moderator. She explained how the focus group would be leaded and emphasized that the discussion would be recorded even though participant's names would be omitted.

Following this presentation, participants had to see the five-minute video and answer an online survey about the experience. The devices used in the testing were a Samsung Gear VR (2016) + a Samsung Galaxy S7 (equipment 1) and a Samsung Gear VR (2016) + Samsung Galaxy S7 Edge (equipment 2). Both smartphones had the same Android 6.0 operating system.

Participants were explained how to wear the devices and they also wore headphones. They were able to choose if they wanted to experience the video standing or sitting. Participants were clarified that if they felt any discomfort, they could stop the experience at any time. It was also explained that they had the possibility to look around in all 360 degrees.

After all participants saw the video and answered the online survey, the moderator started the discussion guided by three main open-ended questions. For each one, other auxiliary questions were also prepared in order to foster discussion and interaction, if necessary (see Appendix 5).

4.2. After-experience online survey

The after-experience online survey was an auxiliary instrument for the user study, once the main research method was the focus groups. Participants had to answer how strongly they agreed to each statement on a 5-point Likert scale (from 1 - Completely disagree to 5 - Completely agree). The questions were divided into six main subjects: comfort (questions 1-3); attention (4-6); presence (7-8); narrative comprehension (9-10); comparison to traditional media (11-12); relation sport/disability (13). Some of the statements were adapted from questionnaires presented in previous studies: question 4 (Jennett et al., 2008), questions 7, 9 (Busselle & Bilandzic, 2009), and question 8 (Wiebe, Lamb, Hardy, & Sharek, 2014). The other ones were defined considering the more relevant aspects of this specific experience. The survey results - minimum (Min), maximum (Max), average (Avg) and median (Mdn) - can be seen in Table 1.

Few participants agreed or completely agreed with *feeling motion sickness* (3/23) or *discomfort with the HMD* (2/23). Five answered they wanted to *take off the HMD before the video ended* (5/23).

Regarding attention, most of the participants reported that *the content of the video caught their attention* (22/23)*, the video length was satisfactory* (21/23) and *they were able to follow the voice over* (16/23), having answered Agree or Completely Agree. The rest of the answers, for these three statements, was neutral.

Similarly, there were no fully negative answers for the statements about presence. The majority reported that, *during the video, the story world was closer to them than the real world* (21/23) and *they lost track of the world around them* (18/23). The other answers were neutral.

Two participants (2/23) *found difficult to understand what was happening in the video* and more than half of them (14/23) informed *learning new things about the wheelchair basketball*. In these cases, the answers were Agree or Completely Agree.

Almost all participants (22/23) reported *feeling closer to the athletes in the video than in traditional Media coverage* and also considered that *the video is a more effective way of presenting Paralympic sports than traditional Media coverage* (21/23), again with Agree or Completely Agree. The other answers for both statements were neutral. All participants completely disagreed with *feeling some discomfort when watching people with disabilities playing sports*.

Overall, the answers provided a positive feedback about the prototype and showed a similar behaviour among participants in 22 out of 23 statements, as the averages indicated. The exception was the statement regarding the learning of new things about wheelchair basketball. As predicted, answers varied more (average 3.83) once the groups had both people who had no/few contact with Paralympic sports, namely the wheelchair basketball, and people who are very used to it, such as the group formed by athletes. The deeper and detailed feedback was given during discussions in the four focus groups.

Table 1: After-experience online survey results

Statement	Min	Max	Avg	Mdn
1) I felt some motion sickness while watching the video.	1	5	1.78	1
2) I felt discomfort while wearing the head-mounted display.	1	4	1.60	1
3) I wanted to take off the head-mounted display before the video ended.	1	5	1.74	1
4) The content of the video caught my attention.	3	5	4.74	5
5) I found the video length satisfactory.	3	5	4.48	5
6) I was able to follow the voice over that I heard in the video.	3	5	4.39	5
7) During the video, the story world was closer to me than the real world.	3	5	4.35	4
8) When I was watching the video, I lost track of the world around me.	3	5	4.26	4
9) I found difficult to understand what was happening in the video.	1	5	1.52	1
10) I learned new things about wheelchair basketball when I saw the video.	1	5	3.83	4
11) I felt closer to the athletes than in traditional Media coverage.	3	5	4.65	5
12) I think the video is a more effective way of presenting Paralympic sports than traditional Media coverage.	3	5	4.48	5
13) I feel some discomfort when watching people with disabilities playing sports.	1	1	1	1

4.3. Focus groups discussion

As explained previously, the objective of the focus groups was to get in-depth insights about the experience. Here we highlight the more remarkable ones. The first main subject discussed in each of the groups was how participants evaluated the experience of watching a 360-degree video with a head-mounted display (HMD). Participant 5 (group 1) remarked the high level of concentration because of the use of the HMD and headphones, as it has the ability to abstract the sound around. He compared it with the experience of watching television in which a lot of extra elements around could be distractions.

Participants in all groups highlighted the excitement with the possibility of exploring the 360 degrees of the scenes. Some of them reported Fear of Missing Out (FOMO), that had already been found in Newton and Soukup (2016) and other studies. Participant 12 (group 3)

stated: “I tried to look for as many things as possible, I was really looking for what was happening in all the scene”. Similar to what Passmore et al. (2016) described, Participant 2 (group 1) specified one scene where he felt particularly in doubt about what to look for: “When the player was trying the triple, I didn’t know if I had to see him throwing or if I had to follow the ball. Do I look here or there”?

The enthusiasm with the exploration of the scenes was remarked as the reason why sometimes they got distracted and lost attention to the voice over that guides the video. Participant 23 (group 4) said: “If I had seen this on my computer, I would have watched again. As it was my first experience with the headset, I was very excited, I enjoyed all those perspectives so sometimes I got dispersed”. Similar feedback was given from at least two participants in all groups, highlighting a challenge that comes out with the 360-degree video for the construction of the narrative.

Participants in groups 1, 3, and 4 reported sensations such as “I felt I was there” (Participant 1); “It put ourselves really inside the video” (Participant 14) or “You feel as if you were part of the group there” (Participant 22). As being formed by students from the Faculty of Science and Technology (NOVA/FCT), it was not surprising that the use of the term “immersion” or the variance “being immersed” came out much more often in group 2 (seven times) than in the other ones (one time in each). Overall, participants commented positively on the immersion they felt with the experience, due to the interest in the story and to curious scenes and sounds. Participant 10 emphasized the immersion in the scene shot under the basket while participant 6 commented on the scene in which the players exemplify their skills, when he considered being more immersed, losing track of the real world around him. Another scene, that shows an exercise on just one side of the court, provoked different feelings. As the ball comes and hits the tripod, it gives the impression that it comes towards the viewer. According to participant 10, it was the moment that broke the immersion for few moments, as he tried to catch the ball and then realised it was not possible. At this moment, participants 8, 9 and 11 showed disagreement shaking their heads, and participant 8 said he felt the opposite, more immersion, as the ball passed so close to him and it was a funny moment, as he described.

Participants in all groups noticed a difference in image quality between scenes, which was predictable once we had shots in a lower resolution. However, nobody reported it as a

problem that significantly affects the experience, even in group 2, formed by students that theoretically could have been more critical to technical aspects. Participant 16 (group 3) reported realising difference among scenes when looking at the background of the court. Participant 21 (group 4) explained that she felt some discomfort in the shift of scenes, when one with higher image quality, more focused, changed to another with lower resolution. Nevertheless, what caused a remarkable discomfort, according to her, was the shift of perspective: from a fixed camera, during most part of the video, to the scene that approximates the participant to the first-person point of view, once the camera was attached to the wheelchair.

This was another predictable topic of discussion, as the scene was kept in the video exactly with the purpose of having in-depth feedback. Participant 21 stated: “Our brain was already so used to the fixed camera, and suddenly we are on the top of a person, that… I was not dizzy but I felt discomfort because then the video comes back to a continuous line”. Participants 20 and 23 agreed with her while participant 22 expressed a different feeling, being excited with the sensation as if he was playing. In all groups, this scene was the topic that provoked considerable controversy. Similarly, in group 1, participant 1 said she really enjoyed the perspective and wished the scene would be longer, an opinion shared by participant 4. On the other hand, participant 2 stated: “If it had lasted a little longer, I would have had to take off the headset; I was standing and almost lost balance”.

Group 2 led this discussion to a more technical debate. Some participants said it was an interesting perspective, while others, as participant 8, reported feeling a dissonance, as the actions he carried out didn’t get the expected response by the environment, what could be considered a break of Plausibility, as explained by Slater (2009). Participant 11 added: “It was confusing. You turned your head to one side the athlete in the wheelchair did not turn”.

In group 3, besides debating this first-person scene and also having controversial opinions, the camera positioning topic came out in another moment. Participant 16 realised that the point of view was that of a person sitting, which he considered a positive aspect. However, he found that it was a little higher than he wished, causing the sensation of being taller than the athletes showed in the video. His opinion was supported by other participants and it was another essential feedback concerning camera positioning.

The second part of the groups' discussion focused on the content of the video and the narrative. Overall, participants considered the content useful for learning about the sport and praised some strategies used in the narrative construction and the design of the experience, as in the following examples. In group 2, participants pointed out the importance of the first scenes - the locker room and the change of the wheelchairs - not only as an introduction to the athletes as characters but also as an introduction to the possibility of exploring the 360 degrees of the scene. We considered this feedback as an important insight for future work: giving time to users to "understand" how the new medium works. On the other hand, some people reported feeling discomfort with the characters very close to them. It happened to participant 18 (group 3) in the locker room scene, supporting Jones (2016)' findings: "I considered the most interesting part of the video. At the same time, I had a strange feeling when they were talking. They seemed to be almost in my face, very close".

The scene when Márcio demonstrates some typical plays, talking directly to the camera, was considered for most participants the best example of a scene that helps the user to follow the narrative. Participant 21 summarised: "It had the role of geo-referencing. If he was saying he's going to try the triple, I thought 'now he is going to the middle of the field'. He was guiding me".

The importance of typical sounds of the sport such as the dribbling or the shock of the wheelchairs in the narrative was emphasized by all groups. As discussed in Kauhanen et al. (2017)'s study, the sounds helped to minimize the negative effects of the scenes with poorer image quality. For future work, participant 4 (group 1) suggested a lesser use of controlled sounds, as the voice over, and the wider use of environmental sounds and practical explanations, when the character is speaking directly to the camera, such as in the scene just mentioned above. She explained: "Sometimes, I saw the visual impact but it did not come together with the auditory impact, and it could have contributed to transmitting more intensity".

According to participants from group 1 that don't have a direct relation to wheelchair basketball (three of them) and participants from groups 2 and 4, they managed to learn new things regarding the sport. As predictable, for participants in group 3, formed by athletes, information was not new. However, they considered didactic and positive how the video showed the rules and other details about wheelchair basketball. Participant 13 remarked that

it goes well to make known the sport once it explains the rules and situations that can happen in the game.

The final part of the discussion was related to the message of the video. Participants commented on the representation of Paralympic athletes, comparing to traditional media coverage, and talked about the usage of the 360 video for Paralympic sports' storytelling. Any participant in all groups reported feeling pity or, on the other extreme, seeing the athletes in the triumph-over-adversity perspective. Overall, they considered the 360-degree video as a good medium to make people feel closer to the athletes, contributing to see them as what they are: athletes.

According to participant 10 (group 2), who is not an athlete, there is a shift in the perspective, especially due to the camera positioning. "As we were 'sitting' all the time, this brought us closer to the athletes. We also saw that it is a sport with impact, people fall, get up and continue to play and it is perfectly normal". Participant 20 (group 4), not athlete as well, considered it helped to approach to players without reducing the experience to compassion, as it is possible to see them playing with much energy.

Participant 12 (group 3), a wheelchair basketball athlete, stated: "We have different angles and feel the experience itself. When I watch television, I do not feel the intensity. Here one really feels the environment, the communion that exists. It is a much closer experience of reality, of being there". Another athlete, participant 18, said that she disliked the representation of the athletes on television once, according to her, the goal is generally to emotionally draw attention to the life stories and not to the sport. "On the contrary, this technology draws attention to the practice, for what we actually do", she added.

However, some participants highlighted that the medium, the technology alone is not enough. The way the experience was designed and how the narrative was built were also considered crucial for the message. Participant 5 (group 1) said that the 360-degree video has much potential once it helps to show the reality of Paralympic sport as it is, but it depends on the message, which can be good or not in any medium. Participant 23 (group 4) said:

> I think technology helps a lot, in the sense that we put ourselves totally in that environment full of energy and ran away from that idea of pity. However, it obviously depends on the use of the narrative, how it was constructed. It must be a good purpose

with the push of the technology. If the technology was used to show them crying, it would also work well, as the tears would be very close to me.

Another positive feedback was related to the position assumed in this project that there is no need to hide the impairment. In the video, as the players were very close to the viewer, especially in the locker room scene, the disabilities were really visible. According to participant 8, for example, he paid attention to the impairments in the beginning. As soon as the athletes started playing, he stopped being attentive to the disability: “In the locker room, you notice the ones that are not in the wheelchair, one has no leg, you don’t see half the leg from the knee. Once they are playing, never again in the video I noticed it”. Participant 7 reported noticing, out of curiosity, how the legs were attached to the wheelchairs in order to prevent them from falling. “But the fact that they were in the wheelchair made no difference to me”, she said.

All participants in group 3 considered that experience provided a fair representation of the athletes. Participant 13, who has been playing wheelchair basketball for 28 years, remarked:

> It can contribute to push away those clichés that the media outlets traditionally use, in my opinion in a wrong way. We are athletes and, as in the non-adapted sports, there are better and worse players, not all are great stories of overcoming. He has a disability, that's okay, it limits him in the day by day, but that does not prevent him from practicing a sport, and it can be practiced at a higher or lower level of performance. It is the same with people without disabilities. We often see it: “Spectacular, he is a great athlete!”. But he is not, he is a normal guy, he is not a Cristiano Ronaldo[18]. There are few “Ronaldos” in the same way. I hope this technology can potentiate this, but it always depends on the framing. Technology is just technology.

[18]Cristiano Ronaldo is a Portuguese professional football player that has five *Ballon d’Or* awards as the best player of the world. (https://en.wikipedia.org/wiki/Cristiano_Ronaldo#cite_note-5)

5. OVERALL DISCUSSION

The main objective of this project was to contribute to building bridges between Paralympic sports and people who are not used to it. These bridges were represented by a new medium: a 360-degreee video that, when experienced with the use of a head-mounted display, allowed users to get closer to the wheelchair basketball players, to learn about the sport, to see disabled athletes as athletes, without the need to hide the impairment or hyper focus on the stories behind the disability. According to the feedback provided by participants in focus groups, the prototype accomplished this goal. At the same time, it was possible to gather important indications to improve future work.

The limitations of the project are of diverse natures. Technically, it was crucial to count on the support given by iNOVA Media Lab and Samsung. However, we worked with conditions that limited the final product, such as the absence of a monopod and other rigs that could have made possible different camera positioning. By accepting the challenge of an applied research in the Digital Media field at a Master's level, time proved to be a constraint. A delicate "time engineering" was necessary to conceive the project, follow the whole workflow process of a 360-degree video production, organise a user study with four focus groups and, finally, systematise the results. Moreover, important decisions were based on the term available to finish the project. One example is the choice of an automatic stitching software instead of another that permits a manual process. The latter would have resulted in better stitching lines for the scenes. Some of the mistakes made in the shooting process, namely the flaw in the resolution settings of one camera, also restricted the quality of the final video. As a prototype, we considered all those limitations acceptable. Most of them also became important lessons for further research.

The user study was centred on the focus groups method and had the after-experience online survey as an auxiliary instrument. This decision pondered the exploratory nature of this project and the objective of getting insights and opinions rather than inferring or generalizing. Besides having a small sample size (23 people), both research methods are based on self-reporting. Future work on similar purposes - the use of virtual reality technologies for Paralympic sports' storytelling -, should consider objective measurement, such as tracking techniques to get data about the user's body and eye movement during the experience.

There is another limitation that must be mentioned. The upper bodies of wheelchair athletes are in line with the historical, social, and cultural notion of a "sporting body". Therefore, seeing impairment and sport together is supposed to be easier with wheelchair basketball as the subject of the narrative. Future work must embrace the challenge of creating engaging experiences related to sports that include more severely disabled athletes, who are under-represented in reporting on the Paralympic Games (Brittain, 2017).

Paralympic sports practiced by visually impaired - football five-a-side and goalball are good examples - could be interesting subjects of experiences conceived mainly by sounds. As Lescop (2017) suggests, the narrative grammar in 360 must be fulfilled with sound design. A step further should be the design of experiences focused only on spatial audio in a first-person perspective, for instance as if the user was a football five-a-side player.

Neither the prototype nor the above mentioned suggestions of future work have the purpose of substituting traditional media reporting. Immersive experiences are here presented as an alternative that provides a different perception, having as a result an approach to Paralympic sport's world and a fairer representation of the athletes. Domínguez (2017) emphasises that it is important to consider for which journalistic stories the immersive experience is the best way to "achieve the aim of making people care about what happens in the world" (p.9). We argue that the present subject is definitely one of these cases.

We also hold the position that even being the first step, the most accessible type, a 360-degree video can be considered a virtual reality experience once it is viewed with the use of a HMD. Aylett and Louchart (2003) defend that "being there" is the defining characteristic of VR. As our user study and previous ones indicate, a monoscopic 360-degree video can lead to a certain level of presence. In other words, the sense of "being there".

The lack of interactivity could be mentioned as the main obstacle to the acceptance of an experience with 360 video as VR. Another time, it is important to remark that an initial level of agency is provided. Although the camera is fixed and it is impossible to walk around in the environment, the opportunity of exploring the visual scene in 360 degrees is already a completely different experience comparing, for instance, to audio-visual pieces from traditional media outlets. Looking is doing, as remarked by Newton and Soukup (2016):

> Looking gives the audience agency, not to change or affect the story in VR, but to choose which pieces of the story they take in, make meaning out of and combine with other information to form a story in their minds. In this way, no two individuals experience the exact same story, because no two individuals look at the exact same things in the exact same order.

In this respect, it is possible to state that a 360º video also faces the "narrative paradox" (Louchart & Aylett, 2003). The conflict, in this case, is between pre-authored narrative structures and the freedom of looking/hearing. Even though there is no physical movement or interaction, there is agency that prevents the author from fully defining the user's experience.

Regarding journalistic stories in VR, there is a clear narrative challenge especially when the medium is a novelty to users. The excitement with the possibility of exploring the 360 degrees of the scenes can be a remarkable distraction to the story being told. Studies should be performed to find out the best strategies to catch user's attention to the crucial parts of the narrative. Our study provided some insights such as the use of scenes where the character guides the audience while explaining an important issue, in our case, the main plays of the wheelchair basketball. It is necessary to improve the narrative grammar to VR, particularly to its first level, the 360-degree video.

Considering VR as a specific narrative medium (Aylett & Louchart, 2003), the journalistic experience should be designed in accordance with the nature of this medium. Domínguez (2017) additionally argues that more experiments are required to clarify which elements of the narrative in VR favours the sensation of presence, while the aspects of the system that can lead to it have been systematically studied. We advocate the view that those studies don't need to be conducted "in different worlds".

As Vicente (2018) proposes, digital media research needs to embrace a triple helix structure (hardware, interface, and software), and integration among disciplines is considered the path to develop "new theories, concepts, methods, and applications around common problems". It is crucial to foment the break of the boundaries between what should be considered communication studies and computer science or informatics studies. There are mutual challenges that can be faced together, strengthening the transdisciplinary nature of digital media research.

In this regard, the partnership with Raquel Macedo from the Faculty of Sciences and Technology (NOVA/FCT) is an important contribution. The second step of the present project is a change of perspective: instead of being a visitor with special access to the training, the aim is to provide a first-person experience, as if the user was playing the wheelchair basketball. In the *Paralympic VR Game - Immersive Game using Virtual Reality Technology*, Macedo will use both 360º video recording resulted from the present project and Computer Generated Imagery to create the virtual environment in a game engine (Unity 3D). The interactivity will be present, as the user's actions will have consequences, influencing the results of the game. Models of the 3D elements will be built: when a user interacts with an element, it is expected that the physical model behave similarly to what would happen in reality as consequence of the interaction. The outcomes of the game's development and the feedback provided by users about the first-person experience will be extremely valuable.

In the lecture "The (In)Visibility of DisAbility: Cultural Contexts and 'sporting bodies", DePauw (1997) affirmed that sport can "provide a context for resistance and a site of social chance" (p.418), not only reflecting societal values or reproducing social inequalities. The present project shed light on different paths to further research: regardless of the perspective – first-person or third-person point of view-, the sport chosen or the framing of the study, the common line must be the awareness that (digital) media representation of sports - and adapted sports in particular -, can and should play a similar role of contributing to social change.

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LIST OF FIGURES

APPENDIX 1 – INITIAL SHOT LIST

Shot	Scene	Camera positioning
1	Change of wheelchairs (the regular ones to the training ones)	Among the players, ideally placed in a circle
2	Warm up	Centre of the court
3	Exercise on just one side of the court	Between athletes and the basket
4	Exercise of passing	Centre of the court, players on both sides and ball passes over the camera
5	Coach speaking	Among the players placed in circle
6	Exercise of shooting and rebounding	Under the basket
7	Training match 1	*Evaluate If it is safe to put the camera in the centre of the court*
8	Training match 2	Side court
9	Training match 3	Under the basket
10	Training match 4	Bench
11	Portugal!	Among the athletes, when they shout “Portugal”
12	End of training	Among the athletes changing again the wheelchairs
13	Relaxing moment	Off the court
14	Rules (Interview 360)	Interviewing Marco Galego and the training match happening behind him
15	Motivation (Interview 360)	Interviewing Marco Galego while another training exercise is happening
16	Demands (Interview 360)	Interviewing Marco Galego while another training exercise is happening
17	Classification (Interview 360)	Marco Galego explains and gives examples with the help of two players
18	Skills (Interview 360)	Márcio explains and performs three different plays
19	Memorable match (Interview 360)	Interviewing Márcio
20	Motivation Marcio (Interview 360)	Interviewing Márcio among the players
21	No Supercrips or heroes (Interview 360)	Among the players, while they are changing the wheelchairs
22	First-person perspective	In the wheelchair, at the same height as the player’s eyes

APPENDIX 2 – QUESTIONS FOR THE INTERVIEWS

To coach Marco Galego

- You've been a coach in the regular basketball. Why did you decide to train a wheelchair basketball (WB) team?
- Could you talk about the player's autonomy? What skills are interesting to highlight?
-What differs the WB from the standing one in terms of rules? Are the court size and other measures (as the height of the basket) the same?
- Players are assigned points as their classification, from 1 to 4.5. Could you explain this classification in the WB? What is the sum of points we can have in the field?
- Do you demand from the Paralympic athletes the same that you demand from standing basketball athletes?
- Do you think there are heroes in parasport?
- Is it possible to see sport and disability naturally, without seeing any contradiction?

To player Márcio Dias

- How did you get to know the adapted sport? Why did you choose the wheelchair basketball specifically?
- You've been in the squad for over 10 years. What was the most memorable game?
- Which skills of a WB player and typical plays do you highlight?
- Especially when playing in Spain, you lived a full time athlete's routine. How was this experience?
- Do you think there are heroes in parasport?
- Is it possible to see sport and disability naturally, without seeing any contradiction?

APPENDIX 3 – FINAL SHOT LIST

Shot	Scene	Camera positioning	Camera	Day
1	Change of wheelchairs (the regular ones to the training ones)	Among the players, ideally placed in a circle	1*	1
2 (3X)	Coach speaking	Among the players placed in circle	1*	1
3	Warm up	Centre of the court	1*	1
4	Throws	Below the basket	1*	1
5	First instructions	Between the two courts	1*	1
6 (2X)	Stretching	Among the players	1*	1
7 (2X)	Running	Between the two courts	1*	1
8	More throws	In the court, close to the players	1*	1
9	New throws	In the court, even closer to the players	1*	1
10	Bench	From the bench's perspective	1*	1
11	Exercise of passing	Centre of the court, players on both sides and ball passes over the camera	1*	1
12	Table/passing	Still the exercise of passing, from the referee's perspective	1*	1
13	Relaxing moment (Drinking water)	Out of the court	1*	1
14	Training match	From the bench's perspective	1*	1
15	Training match 2	Side of the court	2	1
16	Training match 3	Under the basket	2	1
17	Exercise on just one side of the court	Between athletes and the basket	2	1
18 (2X)	Exercise of shooting and rebounding	Under the basket	2	1

19	Portugal!	Among the athletes, when they shout "Portugal"	2	1
20 (2X)	Skills (Interview 360)	Márcio explains and performs three typical plays	2	1
21 (2X)	Memorable match (Interview 360)	Márcio talks about the best match	2	1
22 (2X)	Rules (Interview 360)	Interviewing Marco Galego and the training match happening behind him	1*	1
23	Training match 4	Under the basket	1*	1
24	Training match 5	In the angle of the court	1*	1
25 (2X)	Classification (Interview 360)	Marco Galego explains and gives examples with the help of two players	1*	1
26	Exercise without ball	Between the court and the players waiting for entering the court	1*	1
27	End of the training	Side of the court	1*	1
28	No Supercrips or heroes (Interview 360)	Márcio among the players, while they are changing the wheelchairs	1*	1
29 (3X)	Locker room	Among the players, while preparing for the training	1	2
30	Corridor	In the corner	1	2
31	Warm up / chair	Attached to an empty wheelchair	1	2
32 (4X)	Courtside/chair	Attached to an empty wheelchair	1	2
33	Ricardo explains	Close to coach Ricardo (the other court)	1	2
34 (2X)	First-person perspective	In the wheelchair, at the same height as the player's eyes	1	2
35	Training match 6	From the bench's perspective	2	2
36	Training match 7	Side of the court	2	2
37	Training match 8	Under the basket	2	2
38 (3X)	Galego's evaluation	Among the players	2	2

39	Portugal! (2)	Among the athletes, when they shout “Portugal”	2	2
EXTRA	Linear audio	Interview – Marco Galego	___	1
EXTRA	Linear audio	Interview – Márcio Dias	___	1

*Shots recorded with the lower image resolution: 1920 x 1080. The other ones were recorded in 3840 x 1920.

APPENDIX 4 – FILM SCRIPT

Titling: Wheelchair basketball

Titling: Training of the Portuguese national team

SCENE 1 – Team preparation

Shot: Locker room
Audio: shot
1'05" (Timecode based on the video file)
(It begins with the entrance of the athlete with the red t-shirt)
João says: "Guys, it is time to train"
Márcio: "Let's go!"
(They start leaving the locker room passing very close to camera. Keep until 1'30", when Márcio leaves the scene)

Titling: Vila Nova de Gaia / December, 2017

Scene 2 – Introduction to Márcio

Shot: Change of wheelchairs
Audio: Voice over
39" (Timecode based on the linear audio file)
"I had never done adapted sports until I was 13 years old and It was not possible to practice regular sports because my limitation did not allow me. At the age of 13, a colleague from my neighbourhood invited me to try adapted sports, because there was an association in my city, Barcelos. Every since there have been 24 years of adapted sport.
+
Shot: Stretching
Audio: shot
1'56" (Timecode based on the video file)
(Márcio shows the movement)
"Relax your arms, let's stretch everything, let's go"
(Stop in 2'14")
Márcio: "This also goes for the dance! Okay, Okay, Okay.".

Titling: Rules

Scene 3 – Rules

Shot: Training match
Audio: Voice over
04'37" (Timecode based on the linear audio file)
"There are few differences comparing to stand up basketball. Let's say three main differences. The first is that you cannot run outside the court. In stand up basketball you can run anywhere without the ball, while in the wheelchair basketball, even without the ball, if you run outside

the court, the referee stops the game and you have to step back and go into the court from where you left. The second is the situation of the steps, so here if you give more than two impulses to the wheels with your hands without dribbling the ball it is considered a step. The third is the situation of the dribbles: in stand up basketball if you dribble and grab the ball, you cannot dribble again. Here you can dribble, grab, dribble, grab, whenever you want". 5'21"

+

Shot: Training match 8

Audio: voice over

05'31" (Timecode based on the linear audio file)

"The height of the table continues at 3.05m, the field has the same dimensions, the free throw line is at the same distance, the ball has the same size and the same weight, everything is exactly the same". 05'41"

Scene 4 - First person

Shot: First-person perspective

Audio: voice over

02'34" (Timecode based on the linear audio file)

"In our basketball, the wheels have to be moved with the arms and we have the ball, so we have to make a game, a mental game much stronger that is: 'look, you have to move the chair in that direction, receive the ball, make this move', that in two seconds, or in half of a second". 03'01"

Titling: Typical plays

Scene 5 – Skills

Shot: Skills (Interview 360)

Audio : shot

1'06" (Timecode based on the audio file of the mic 4)

"I will start by explaining the *abafanço* in the act of launching .... (Márcio shows). Now I'm going to talk about the launch on two wheels ... (he shows). And, to finish, the triple shot (he tries it and doesn't succeed). See, we also fail sometimes".

1'40"

~~Keep the shot until 2'41", trying the acceleration of the shot from 1'51"to 2'41". The last phrase is "After one, two or three attempts, it's in there.")~~

~~Scene 6 – Classification~~

~~**Shot: 25 Classification**~~

~~**Audio: shot**~~

~~35 "(Timecode based on the video file)~~

~~"Well, we will try to explain the classification in wheelchair basketball. Here we have Henrique, player with classification 1 and João, classification 4. The differences begin in the chairs they use. Henrique has a relatively lower chair than João and Henrique is sitting a little further back in terms of his trunk than Joao, who can turn the trunk to both sides. And also we have differences when catching the ball. Henrique picks up the ball with more difficulty than João, who can catch the ball with relative ease. In the national team, we can only have 14 points on~~

~~the court, that is: in the combination of the five players on the court, with different classification from 1 to 4.5, we can have maximum 14". 1'45~~

Scene 7 – Athlete

Shot: Exercise on just one side of the court
Audio: voice over
06'54" (Timecode based on the linear audio file)
"In my opinion, the athlete is not the person who comes here to pass the time and think: 'Ok, as I have a physical disability and I like to play sports, so I'm here'. Athlete is that person who has a goal, who wants more than what is being received". 07'09"

Scene 8 – Demands

Shots: Training match 7
Audio: voice over
3'21" (Timecode based on the linear audio file)
"I demand exactly the same thing".
03'27 "
"For me, they are athletes. There is no difference between athletes. Whether they are in a wheelchair, without a wheelchair, with an arm, with two arms, in any case, the demand has to be the same. "
09'18 "
"They are neither pitiful people nor superheroes. Neither 8 nor 80. They are just athletes, there is no other term to identify them".

Scene 9 – Magic + Shout

Shot: Exercise of shooting and rebounding
Audio: voice over
09'21" (Timecode based on the linear audio file)
"There is the magic of basketball, which is to work as a team, to achieve all the same goal and to be part of the final squad in the call to represent Portugal in the European Championship".
+
Shot: Portugal!(2)

Final credits

Paralympic VR: an immersive experience

Concept and production
Carol Delmazo

Recording crew
Carol Delmazo
Catarina Gomes
Davide Mancine
Rui Avelans Coelho

Audio capture and editing
Rui Avelans Coelho

Video editing
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Thanks
Samsung
Comité Nacional do Basquetebol em Cadeira de Rodas - FPB
Associação Portuguesa de Deficientes – Sintra

(logo iNOVA Media Lab)

APPENDIX 5 – QUESTIONS FOR FOCUS GROUPS

Main question 1: How was the experience of watching the 360-degree video with the head-mounted display?

Auxiliary: Did you feel any remarkable discomfort?

Auxiliary: Did you have that sense of forgetting the world around you and being totally focused on the video?

Auxiliary: Did you realize difference of image quality among the scenes?

Auxiliary: Were you able to pay attention to the background voice?

Main question 2: What is your opinion about the video content?

Auxiliary: What did you learn of what was shown and said?

Auxiliary: Did you manage to identify the characters, the athlete and the coach?

Auxiliary: Is there something important that the video didn't show?

Auxiliary: If you had the opportunity of redoing the video, what would you do differently?

Main question 3: Do you think 360-degree videos like this one is a good way to present the Paralympic sport?

Auxiliary: Did you see the impaired athletes as you see the non-disabled athletes, in other words, just as athletes?

Auxiliary: Did the video caused a sense of pity or similar feelings because you clearly saw the impairments?

Auxiliary: Do you think 360 videos could be more effective than traditional media news? Why?

Auxiliary: Do you think the video makes it easier for people to see sport and disability naturally?