Player Experience, Gaming and Virtual Reality Technologies

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Abstract

This paper uses a communication sciences methodological approach (arts-based research[1]) in the way it combines speculative thinking, game design and game theory to the interpretation and future use of new gaming devices and software for Virtual Reality game and play experiences. Starting with the following research questions: Is it possible to combine game engines and virtual reality HMD's to enhance presence? Can these peripheral devices sometimes ruin the gaming experience? The aim of this article is to generate and disseminate knowledge in the game design field, in general, and in the use of new devices applied to game and play environments, in particular.

Keywords: virtual reality, oculus rift, gaming experiences and play installations.

Título: Experiência do Jogador, Jogos e Tecnologias de Realidade Virtual

Resumo

Este artigo usa uma metodologia exploratória própria das ciências da comunicação e da investigação em artes que combina pensamento especulativo, design e teoria de jogos com experiências de uso de tecnologias de realidade virtual. É possível combinar engenhos de jogo e dispositivos de realidade virtual para assim aumentar a sensação de presença? Podem estes dispositivos por vezes arruinar a experiência de jogo? O intuito deste texto consiste em gerar conhecimento na área do design de jogos, em geral, para a construção de futuras experiências e, em particular, disseminar o uso dos novos dispositivos de realidade virtual aplicados aos jogos.

Palavras-chave: realidade virtual, oculus rift, experiência de jogo e brincadeira.

[1] For more on arts-based research please Cf. O'Donnell, D. (2015), "So You Want to be an Artist: when social scientists don the beret". In https://medium.com/@darrenodonnell/so-you-want-to-be-an-artist-when-social-scientists-don-the-beret-a9d32f272fb5 (accessed 25.10.2015).

I. Introduction

Gaming history is prolific in creating rooms or devices to enhance game experience and to create a perceptual feeling of presence and/or immersion. From Morton Heilig's arcade concept (1962) to Ivan Sutherland's *Head-Mounted Display, The Sword of Damocles* (1965-68) ideas. From Myron Kruger's *Videoplace* (1974) to *cave* software (cave automatic virtual environment, Electronic Visualization Lab at University of Illinois Chicago, 1996[2]). The pioneers of virtual reality (VR) wanted to research new possibilities of escaping into alternative worlds, rabbit holes or dream spaces. In the abstract of "Virtopia: Emotional Experiences in Virtual Environments", a 1996 article, from Jacquelyn Ford Morie and Mike Goslin, is stated "few people create virtual worlds in the context of artistic expression. Key to providing intriguing and engaging worlds is an understanding of the power of emotional content. The authors propose that an emotive response can be elicited in a subject through strategic use of imagery and sound in a virtual environment, which will enhance the sensation of immersion in the simulation and thereby help to compensate for the inadequacies of contemporary technology. Their artwork, *Virtopia*, draws on psychology in its implementation of virtual-reality technologies to produce aurally and visually immersive environments that engage the participant on an emotional level."[3] (Goslin & Morie, 1996: online)

Mixed and virtual realities support in the immersive environment our feeling of presence and recreate our sensorial apparatus, a *Holodeck*, a fictional facility featured in the *Star Trek* universe in which our entire body can interact with digital objects or assets. Console and interface pioneers did the rest to make us feel inside a digital world. William A. Higinbotham gave us interaction with a meaningful purpose with *Tennis for Two* (1958).

According to us presence is connected with immersion in a dynamic interactive process where presence is our phenomenological capacity of engaging in the world (Merleau-Ponty, 1945) and immersion our ability to perceive the illusion created by the environment or mediated apparatus in connection with the participant/player's body. Both modalities are connected in an embodied dynamic process and they cannot be separated without losing both dimensions of the corporeal experience. As stated elsewhere we consider "that our experience in the world already encapsulates a capacity to simultaneously transform us into spectators and participants, in constant tension between an illusion of unity of the "I", which our conscience intends to supply, and the fragmented multiplicity of our perception" (cf. Gouveia *et al*., 2008). Embodied experience implies a continuum between the player and the game world. For some researcher's presence and immersion are distinct concepts. Immersion being the ability of technology to create illusions (cf. Cruz et al., 2014) is a disembodiment approach which ignores the dynamic process between the body and the technological apparatus. Our approach considers that we cannot measure neither immersion nor presence due to its subjective embodied nature. Immersion in first person perspective environments might work differently from those in third person collaborative 3D virtual worlds but a lot more research needs to be done.

[2] CAVE was designed and created by Margaret Dolinsky one of the few women working in Virtual Reality. For more information on this please cf. Hrvoje Prpic article named "We Need More Women in Virtual Reality!" In https://www.linkedin.com/pulse/we-need-more-women-virtual-reality-hrvoje-prpic (accessed 19.11.2015).

[3] Goslin, M. & Morie, J. (1996), "Virtopia": Emotional Experiences in Virtual Environments". In http://www.researchgate.net/publication/275697472_Virtopia_Emotional_Experiences_in_Virtual_Environments [accessed 19.11. 2015].

Steve Russell invented the first *shoot'em'up* (*Spacewar!* 1962). Ralph Baer created the *Brown Box* (1966) and Nolan Bushnell the gaming industry (1972). Douglas Engelbart imagined the mouse and the chat room and Alan Kay gave us a fiction to interact with, windows to organize and the programming environment to play with. As David Greelish states in his interview with the author: "Alan Kay is known for the Dynabook — his decades-old vision of a portable suite of hardware, software, programming tools and services which would add up to the ultimate creative environment for kids of all ages. Every modern portable computer reflects elements of the Dynabook concept — the One Laptop Per Child project's Xo Above All Others — and yet none of them have fully realized the concept which Kay was writing about in the early 1970s." (Greelish, online: 2013) Dynabook had the intention of merging all the portable devices (tablets, smart phones and personal computers). The casual revolution reinvented vintage devices and created new players (Juul, 2010).

During the nineties VR gaming machines started to appear and the field was divided into two different branches, one, with a focus in art and design installations and, another, connected with entertainment software, mainly digital games. Today we find a rebirth of indie connections between gaming and art installations. (cf. Gouveia, 2013) Andy Bossom and Ben Dunning argued in their book about game industry, "we should consider how the medium is being transformed as video games enter a period of cultural maturity. Away from the gilded halls of the big business that dominate the industry and their AAA titles, indie games have become a thriving playground for fresh ideas, uniquely styled outcomes and laid bare game mechanics (Bossom & Dunning, 2016: 109). We are witnessing a rebirth of short term interactive marketing experiences, art installations, interactive devices applied to health and/or indie games and play installations. Some of these experiments are taking advantage of the strong feeling of presence you can get when using VR Head Mounted Displays like Oculus Rift or an HTC Vive system.

II. Mainstream Culture (consoles) and VR devices and techniques

In the first two decades of the 21st century various types of consoles were made with different goals. Wii (Nintendo, 2006) inserted the human body movement into the game space, using *wiimote* and *nunchuck* as peripheral devices, extensions of their on physical body, players could engage in a mirror like relationship with their avatars. The previous consoles' static bodies became immersed into the gaming environment. It worked well for some kind of game typologies, sports and body related interfaces, but not for all gaming experiences like puzzles, first person shooters or sand boxes, to mention just few examples.

Previously, Playstation I, II and III (Sony, 1994) wanted to detail the image of the body with accuracy and pixel rigor to enhance the feeling of consistency and presence. Motion capture systems and software helped insert the realistic movement into games and animations but sometimes was less consistent with the artistic aims of the product and Computer Generated Imagery (CGI) would be more appropriated for aesthetical purposes (Gouveia *et al*., 2008; Gouveia, 2010). A "real" faked world imagery, with a strong and interesting plot or story, a cognitively demanding environment, would be enough to create a sense of multiple channels of sensory information (Madigan, 2010; 2015) but the *proprioceptive,* our senses coherent moves according to external stimulus, increased the feeling of consistent action and reaction (Gouveia, 2010).

Nintendo Wii enhanced game characteristics leading to spatial presence. Schematic movements are activated but the sense of agency and the transfer of agency to the virtual space may be a severe amputation which the digital games propagate. The *proprioception*, the sense of knowing one's position in space involves a combination of *somatosensory* perception in which we, as human beings, detect 3D objects by touch (eye-hand coordination, hand position, body movement, visual effects, sound design, conformation, etc.). Since force is necessary for real life but seems to be dispensed in games, the *proprioceptive* and *somatosensory* stimulus stops being symptomatic of this physical goals. There is a dichotomy, for example, in the Wii game box: "acting upon other agents and being acted upon – the active and tense acts of hitting someone virtually benefits to some extend from the ability to actually make punching motions, but the patient-relations involved in boxing match must be left to the audiovisual feedback and since this is comparatively sparse when hitting or blocking in Wii Boxing, the game does not do a very good job of fostering ownership of the virtual body in that situation" (Gregersen, A. & Grodal, T., 2009: 77). And the authors warn: "In other words, players can dance, swordfight, and fish the nights away in the comfort of their living room, but they still get no hugs or kisses" (Ibid., 81).

According to Jamie Madigan, "characteristics of games that facilitate immersion can be grouped into two general categories: those that create a rich mental model of the game environment and those that create consistency between the things in that environment." (Madigan, online, 2010). Consistent action is a key factor to enhance immersion. Kinect system for Xbox 360 (Microsoft, 2010) continues the same trend of inserting the player body into the game space used in previous gaming technologies. It also contributed to merge experimental game design and play installations (indie game play) and mainstream entertainment products (triple A games). Although Kinect system wasn't to well received among hardcore players it shaped a new trend in indie installations and gaming. The same can happen with VR technologies such as Oculus Rift or similar.

VR merged with game consoles and engines made gaming more inclusive. Casual games increased the number of players who can afford to play and gave them more chances to be able to participate in short game sessions and different types of playability (Juul, 2010). Games became available everywhere (tablets, smart phones, personal computers) and to everybody (different ages and genders, ethnicities and tastes, etc.). We can consider that the feeling of being inside the game or the VR space can generate empathy with real people or game characters. We can use VR technologies and gaming devices to affect other people lives and environments. Chris Milk in his TED Talk named "How Virtual Reality can create the ultimate empathy machine" (2015) considers that VR can change and affect the lives of millions of people. (cf. Watercutterin, online: 2015a)

VR can be instrumental to insert participants into experimental documentaries and films where they are integrated into the "other" life. This field is just about to begin. Watercutterin considers, the immediacy of the 360-degree VR view gives the film a poignancy that a news report simply can't. This technology is being used to immerse interactive participants into human dramas, Ebola disease, in *Waves of Grace,* or *Clouds Over Sidra*, a VR experience about a young Syrian refugee in Jordan. As Watercutterin states, "it's a powerful message even when read on paper, but when heard while standing amongst the orphans themselves and the graves of some of the more than 4,800 lives Ebola

has claimed in Liberia, it's downright heartbreaking." (Watercutterin, online: 2015b) The sense of being there with these victims is a powerful tool to create awareness and empathy. Game play devices and VR technologies can be instrumental to help real world problems and to catch new audiences.

III. Story, Texture, Force Feedback, Level Design, Mapping and Architectural Coherence

The haptic experience is connected with our skin surface and in a game we receive force feedback, motion stimulation and vibration. (Bogost, 2008) According to Ian Bogost, in a *Gamasutra* article about the use of texture in digital games, "in the era of 3D computer graphics, texture is a term frequently used in technical talk about video games. Textures are the graphical skins laid atop 3D models so they appear to have surface detail. Texturing techniques like bump mapping and normal mapping use two-dimensional image data to perturb the lighting patterns applied to objects by 3D rendering algorithms to make them appear to have a surface texture that is not actually present in the 3D model itself. These simulate the appearance, but not the behavior or sensation of texture. This is nothing new; The Fine Arts have often done similar. Unlike paintings games are not static scenes or objects - they are interactive models of experiences. To simulate the behavior, rather than just the appearance of texture, games have to use more than visual effects." (Bogost, online, 2008)

Bogost considers that texture in digital games goes far beyond visual effects and that sound design and simulated properties of the physical world (visuals, sounds, coherent movements, etc.) can increase the immersive feeling of texture. Bogost's statement is consistent with Jamie Madigan's concept of *multiple channels of sensory information*, which "means simply that the more senses you assault and the more those senses work in tandem, the better. A bird flying overhead is good. Hearing it screech as it does so is better. 3D may also play a role here, and we can all agree that smell-o-vision will herald in a new era of spatial presence" (Madigan, online: 2010; 2015).

Touch is an undeniable factor of gameplay, argues Bogost, and it will be appropriate to force feedback because if "the player still does not *feel* the texture of the road or the brush of the grasses when he plays, but only the cold plastic of the controller" (Bogost, online: 2008) she/he might leave the game experience. The author continues "unlike painting and sculpture (which forbid touch) and music (which cannot accommodate it), video games *require* user participation. (…) Tactile computer interfaces, or haptics, became a consumer industry by the early 1990s, with companies like Immersion developing cheaper, simpler sensors and motors that allowed such devices to be integrated into objects other than the expensive, awkward gloves and vests of dedicated virtual reality labs." (Ibid., 2008)

In this scenario, following Bogost, Nintendo 64 *Rumble Pak* add-on appeared and that's why, "we usually call haptic feedback in video games "rumble." Rumble allows games to create tactile sensations in addition to visual and aural ones. Cars can now seem to bump with the changing texture of asphalt, gravel, dirt. Technically, rumble in contemporary game systems is more or less all alike: motors spin one or more unevenly molded weights in a housing within the body of a controller. But despite the simplicity of rumble, its effects are quite varied: the pulse of a heartbeat signifies health and instils fear in *Silent Hill*; a

tackle in *Madden NFL* registers physically as well as visually; the tremor of a gunshot in *Call of Duty* alerts the player to unseen dangers from behind or above; the vibration of the steering wheel in *Gran Turismo* communicates the force of cornering around a hairpin at speed. The subtle signal of a motor signals the cursor entering a button in the *Wii sports* menu screen; a jolt to the hand in *MVP Baseball* alerts the player to an opponent stealing base; a spin of the rumble pack in *The Legend of Zelda: The Ocarina of Time* signifies the loose feel beneath Link's feet when a treasure is buried beneath the ground he stands upon." (Ibid., 2008)

For Bogost, *Rumble* increases immersion, makes players feel part of the game and orients them with consistent feedback through the ludic space. For game designer and scholar Ernest Adams "many modern controllers include a vibration feature, which you can use to provide sensory feedback (often called *rumble*) about games events. Although rumble is not technically an audio element, the player can usually hear it as well as feel it." (Adams, 2010: 231). *Rumble* creates a *synesthesic* effect, when you stimulate one sensory or cognitive pathway, the audio element, it connects with touch and visuals, and you experience sensations in various senses.

A coherent level design can also contribute to the sense of presence in game worlds. For game designers like Jesse Schell, "all a level designer does is arrange the architecture, props, and challenges in a game in ways that are fun and interesting - that is, making sure there is the right level of challenge, the right amount of reward, the right amount of meaningful choice, and all the other things that make a good game." (Schell, 2008: 343) Game development requires the creation of rich spaces that make us feel immersed in maps that involve locales, stages or missions. Cultural contexts and surroundings influence everything on the screen. Dan Taylor, who has been in the game industry for over 15 years, considered, in 2013, that good level design is based in ten basic principles: i. Fun to navigate; ii. Does not rely on words to tell the story; iii. Tells the player what to do, but not how to do it; iv. Constantly teaches the player something new; v. Surprising; vi. Empowers the player; vii. Allows the player to control the difficulty; viii. Efficient; ix. Creates emotion; x. Driven by your game's mechanics. According to Taylor, "videogames are driven by interaction, (…) so stage design should be considered as a 'gameplay delivery system'. That means bringing together artists, stage designers and programmers to work towards the same goal – interdisciplinary communication is vital for success." (Taylor, online: 2013)

Games can give players new patterns to research and resolve within the game environment, new places to explore and navigate. Jon Brouchoud considers that "the use of hierarchy in architecture is also an important and incredibly useful tool in game design. An architectural experience where all design elements carry the same visual weight isn't as meaningful or organized as when some elements are differentiated through scale, color, texture, shape, etc.. By contrasting *rhythm* with *hierarchy,* the player can enhance the game's wayfinding strategy by making it easier for the player to 'read' a building to help remember their relative position in space and to understand where important elements of gameplay can be found." (Brouchoud, online: 2013) And the author continues, "urban design, and the way building exteriors work together to shape outdoor space, can also play a role in the design of your game. (…) Placing a monument or statue at the end of a visual axis can help orient the player, and make it easier to remember where the player is located in relation to the rest

of the level." (Ibid., online: 2013) A clear visual map and some clear props to orient the player can be very important to create design consistency and to keep the participant immersed within the game environment. Level design can find inspiration in architectural approaches to orient the player in her/his journey (cf. Totten, 2014).

Phillip Robinson, from the Museum of Gaming Research Center in UK, writes, in the abstract of his draft paper titled "Designing games for Virtual Reality: A Valiant Example" that "Virtual Reality games need to be designed with the particular requirements of immersive gaming in mind and they need to play to the strengths of immersion whilst dealing with the unique issues that Virtual Reality games can create. One of the unavoidable problems with current hardware (2015) is simulator sickness and whilst new hardware will bring inherent improvements good game design now is actually more important and this foundation will be built upon when consumer devices are available (…)." (Robinson, online: 2015)

Story, texture, force feedback, level design, mapping and architectural coherence can contribute to the feeling of immersion in game spaces. Is it possible that the use of Oculus Rift or similar HMDs can jeopardize this sensation by imposing too much proximity in our sensorial apparatus? Besides Oculus Rift, owned by Facebook, other companies, like Sony, Valve, Samsung, Microsoft or Google, are creating similar devices these days. VR technologies will become part of our future gaming experience. Virtual reality is everywhere again, states Brenda Laurel, clarifying what VR is, i. e., i. a complete surround environment; ii. affordances for depth perception and motion parallax; iii. spatializhed audio, not just stereo; iv. affordances for tracking the participant's direction of motion distinct from the direction of gaze; v. the participant's sensorium as the camera; vi. natural gesture and movement; vii. affordances for narrative construction; viii. the principle of action." (Laurel, 2016: online)

Although "great technical improvements", argues Laurel, "are making great progress; e. g., frame rate, visual convergence, 3D modeling, and fine-tuned body tracking through video or other means. My intent is to describe in specific terms the formal and structural aspects of a particular form that was and is called Virtual Reality. I also want to warn younger folks of the consequences of stretching a name too thin. Back in the 1990s, that's exactly what happened - and the form, along with discoveries of those who created it - largely disappeared. Let's be mindful of that this time around." (Ibid., 2016: online)

IV. Oculus Rift VR Experiences and the impact of VR

Two Oculus Rift prototypes were made available for purchase as "development kits" (DK1, in 2012; DK2 in 2014). This was an opportunity for game developers and producers to explore and design game products oriented for Oculus Rift in its release date. At Noroff University College, in Norway, we had the chance of working with this technology and to engage students in some experimental projects using one of these prototypes. Our aim was to use an integrated arts-based research methodology, following the previously quoted article of Darren O'Donnell, where we merge knowledge production and dissemination with a participatory strategy: "knowledge analysis that happens naturally in an embodied way through participation. This integration of production and dissemination, plus the addition of the analysis phase—typically missing from art-based methods (usually

occurring with the application of non-artistic methods)—puts socially-based art works in a decisively strong position." (O'Donnell, online, 2015)

Raymond Hansen, a bachelor student in Interactive Media at Noroff University College, presented a final thesis research focused on the possibility of creating Appealing Architectural Visualizations using 3D animations made on Maya Software, Oculus Rift development kit and the game engine Unreal Engine 4. This student found that the biggest obstacle against VR experience is motion sickness. He reported, on his final thesis, that several people were complaining about getting sick within minutes of using the Oculus Rift, but some people don't react at all. The student found himself sick, nauseated for almost six hours, after testing Oculus Rift during 30 minutes (Hansen, 2015: 29). This research is consistent with our own tests with colleagues and students at the Faculty of Interactive Media (Games and Animation) at Noroff University College.

Raymond Hansen also found that both the resolution and the ergonomics of Oculus Rift have to be increased. According to this student, "The currently available Development Kit (DK2) feels kind of heavy, and after a few minutes of usage, sweat does build up, because of the intensity of the experience, and that is not that appealing." (Hansen, 2015: 30).

The Oculus Rift website promises "the magic of presence" where "The Rift's advanced display technology combined with its precise, low-latency constellation tracking system enables the sensation of presence – the feeling as though you're actually there. The magic of presence changes everything. You've never experienced immersion like this." (Oculus VR website, 2015) For Oculus VR, "seeing is believing" and "The Rift uses state of the art displays and optics designed specifically for VR. Its high refresh rate and low-persistence display work together with its custom optics system to provide incredible visual fidelity and an immersive, wide field of view." With an "Advanced and refined design, from the moment you pick up the Rift, you'll feel and see the attention to detail that went into its design and construction. Customizable, comfortable, adaptable, and beautiful, the Rift is technology and design as remarkable as the experiences it enables" (Ibid., 2015). And the company is also "introducing Oculus Touch, a new pair of tracked controllers that let you take your VR games and experiences further than ever before" (Ibid., 2015).

According to Hansen, "experiencing Virtual Reality with the Oculus Rift is really immersive. The brain is actually fooled to believe what we see is real, but that is also part of the problem. If the brain is "sensing"" that we are moving in a virtual world, while we're sitting still, it's easy to become motion sick – which is the biggest problem with virtual reality devices today. The motion sickness [sensation is not a pleasant one]. The resolution is also too low, as each OLED display only has a resolution of 960 x 1080 per eye. It's just not enough for a smooth experience, but Oculus has already done something with this with the Crescent Bay version [more recent versions]. People who have tried it reported that the resolution has been increased, but Oculus themselves has not released any official information on what the resolution in Crescent Bay is, and the resolution will probably increase again in the upcoming consumer version." (Hansen, 2015: 26).

The impact of virtual reality devices on human behavior is still a concern for researchers. According to the article "Long-term effects of virtual reality use need more research, say scientists", from Nicola Davis, there is plenty of work to be done. Virtual

reality systems can be used in a host of therapeutic situations, from helping those living with post traumatic stress disorder to those suffering from depression, but we need to consider that maybe this technology could have detrimental effects and it is better to stop using the headset if you feel unwell. Good advises could be don't use this technologies for more than 30 minutes and make sure someone is keeping an eye on you.

V. Vertigo play *(Ilinx)*

Oculus Rift VR experiences look like thematic parks or installations which deal with our perceptual apparatus. French game scholar, Roger Callois, in his attempt to classify game typologies called these strong sensations or vertigo experiences *Ilinx*. *Ilinx* is the Greek word for spin, twist, from which derives the Greek word for dizziness (vertigo / ilingos). *Ilinx* is disorder that takes an organic or psychological form. A sense of brutality and intensity capable of troubling human beings. The industrial revolution was lavish in machine construction and powerful devices and vertigo becomes a kind of game / play (Callois, 1961: 24-25). Sometimes these devices make us feel dizzy, let us jump into imaginary worlds, other times, the cinematic atmosphere can make us travel to real worlds, like in the above mentioned VR experiences *Waves of Grace* about Ebola, or *Clouds Over Sidra*, about a young Syrian refugee in Jordan. The experience could be so intense that it is not bearable for too long. As Callois argues in his previously quoted book, *Man, Games and Play*, *Ilinx* is more play (*paidia*) than game (*ludus*).

At this stage we can now answer our research questions which were the following. Is it possible to combine game engines and virtual reality HMDs to enhance presence/immersion? Can these peripheral devices ruin the gaming experience? We consider that the use of VR devices such as the Oculus Rift can be appropriated in short term play experiences but that they can be a source of discomfort for long term gaming experiences where the player should focus in other components of game play. The intensity of VR experiences could eventually make the player lose focus of the story and the consistency of the game world can be ruined. The capacity to directly interact with the game world can deceive players with a sense of real agency but if the experience is not short it can leave participants with a sense of nausea or discomfort. Short sessions are also available in thematic parks to make sure people can recover from such a strong vertigo. Games belong to a different branch of meaningful experiences and even if they can be combined with play moments, for Oculus Rift or other VR technologies use, they will still need some breathing room to let players solve puzzles, accomplish missions, explore maps and stories. With or without the strong effects of VR, vertigo and *paidia,* for now games will keep their path through *ludus* experiences, with chance and competition, joining only simulation and *ilinx* if appropriated by their game design.

According to Phillip Robinson, in his previously quoted draft paper, "VR games need to be designed with the particular requirements of immersive gaming in mind and they need to play to the strengths of immersion whilst dealing with the unique issues that VR games create. One of the unavoidable problems with current hardware (2015) is simulator sickness and no matter how good a game is, if it makes players feel sick they are unlikely to embrace it. (Robinson, online: 2015)

Robinson considers that "the problem is that as the level of immersion that a VR game offer increases it has a negative effect on the player's brain. The immersive nature of VR allows players to become convinced that they are in motion and they begin to experience an increasing amount of sensory conflict." (Ibid.: 2015) This is consistent with Raymond Hansen's experiments and exemplifies how important it is to focus on game design and to research some technological effects to see if they are supporting our creative ideas instead of dominating them. The game design should be consistent and the game concept and art should be coherent with the game technological apparatus and the player feeling of agency. For Robinson, "improved hardware is on the way, the Vive headset and the commercial release of the Oculus Rift both have faster refresh rates and higher resolutions than current development hardware and this will lessen the effects of simulator sickness. Whilst new hardware will bring inherent improvements good game design is actually more important and here the game *Valiant* by "Offpeak Games" [3] has produced an experience worthy of examination." (Ibid.: 2015)

Following Phillip Robinson's and Raymond Hansen's research in using Oculus Rift for different purposes, i.e., to explore in a fun way architectural places or to play games, we can suggest that we need to take into account our body congruence with the game engine and external devices in harmony with game design decisions (characters, worlds, actions, reactions, textures, visual details, maps, sounds, among other factors) and player agency. As Robinson states, "simulator sickness is a natural response by our physiology and in the world of VR it is immersion that we are after. Immersion is key to the experience and convincing our brain that what it is seeing and experiencing is reality is the whole purpose; it is a trick and our bodies do not always respond well to being tricked. (Ibid.: 2015) To play with a purpose is a key factor to the feeling of agency and/or presence.

VI. Play with a Purpose (Indie Games and Marketing Strategies using VR technologies)

Christina Campodonico's article "Play with a Purpose" at the Argonaut online published last October (2015) shows a IndieCade 2014 show reel where we can find various interactive experiences with VR devices such as Oculus Rift. Indie games promote multiple disruptive and old school techniques as we stated elsewhere (Gouveia, 2013) and it's a territory open to experimentation. According to Campodonico, "IndieCade challenges such stereotypes about the world of gaming by celebrating independent games and game designers from all over the country and the world. From board games to scenarios set in virtual reality, IndieCade welcomes games of all stripes – as long as they might open your mind." (Campodonico, online: 2015) Innovated experiences such as those promoted by IndieCade can accommodate Virtual Reality devices in a creative perspective.

Marketing strategists can also integrate VR in their product promotion. Tracy Brady in "8 things you need to know before launching a virtual reality brand experience" states that "Virtual reality is fast becoming one of advertising's buzziest tactics, and technologies like Oculus Rift have made it possible to create rich, multisensory virtual experiences. Last year during the Word Cup, Coca-Cola held a virtual reality experience [created by Ydreams Brazil] for fans, giving them a peek into locker rooms in Brazil's Maracanã Stadium. HBO has also been an early adopter, replicating a massive wall of ice from its hit television series

"Game of Thrones." The wall of ice allows users to experience wind and floor shaking as they travel in a virtual elevator along the icy face." (Brady, online: 2015)

Tracy Brady considers that we should take into account eight things when we start design a VR experience. First, we should think about the all strategy and to adapt technology to the goals of the brand. Second, we have to watch out for motion sickness. Third, technology is key, "the tech experience is dependent upon having a processor powerful enough to support the experience from a graphical standpoint. For something like Trailscape [Merrell's "Trailscape," the immersive sensory experience debuted at Sundance Festival in 2015], the depth of the 3D environment and the speed at which the engine needed to react to human head/eye movements couldn't be supported by a consumer-grade computer and requires a custom-build CPU in order to run." (Ibid., 2015) Fourth, "expect the unexpected", debug the system. Fifth, "Go beyond the visual**:** For a truly immersive sensory experience, going beyond the visual means considering factors like sound design, tactile scenic components, and "4D" elements, such as vibration and artificial wind. These are huge factors in taking full advantage of users' senses, particularly for the exploration factor of Trailscape. Using a VR headset as part of an experience isn't news by itself anymore; it's now about context. In many ways, the hardware/tech story is more about the content and using VR headsets in ways that make sense for the medium and not just using the technology for its own sake." (Ibid., 2015) Sixth, "Optimize your location: The financial investment in something like this can be significant, and the number of people who can experience it is often low, so it's important to have a plan to get the installation in front of as many eyes as possible. (Ibid., 2015) Seventh, **"**Keep costs in mind: As costs add up, the number of active installations you can afford may have to be minimized (…)". Finally, "go for curb appeal: It's crucial to think about the "curb appeal" of the experience. If someone walks in off the street, what do they see? Does it look fun or impressive? Since a relatively low number of people will be able to participate, and explaining VR doesn't do it justice, it's important to keep in mind that sharing photos of the installation and your physical setup around it will be how most people will spread the word about what you're doing." (Ibid., 2015) For the above quoted author, "even though we're still in the early days of VR for marketing, it's easy and exciting to imagine its potential." (Ibid., 2015)

VII. Virtual Reality: a Player's Experience

This section describes the experiences of a longtime gaming enthusiast transitioning from 2D gaming to full, room scale VR on an HTC Vive system. During a 3-4 month period, this player has experimented with more than 30 applications, ranging from games to VR "experiences" and a VR chat community.

System. Numerous negative reports relating to motion sickness and general discomfort in VR made clear that a powerful hardware base is required for a smooth experience. A PC system was assembled with specs comfortably above minimum VR requirements (Core i7@4GHz with 32 Gb RAM and an NVIDIA GTX1070 graphics card). With this system powering the HTC Vive, the transition to VR was almost completely smooth. Very little to no discomfort was experienced in most applications and, more interestingly, that discomfort was overcome through habit in a few cases (see below). Very rarely was any kind of "stuttering" or frame dropping experienced while gaming, and that only when game

settings were pushed beyond reasonable levels. On the other hand, it is clear that developers need to address the locomotion problem very carefully, as some modes of locomotion can and will make most people experience discomfort to varying levels (and no hardware upgrade will fix that). It should be added that this system was used by over 20 other subjects so far, and almost nobody experienced motion sickness.

Initial impressions. For someone used to experiencing 3D worlds on a flat, 2D screen, the sheer scale and depth are striking. Large or near objects filling a large part of the field of view seem impossible large, tall or frightening close. The player suddenly feels like a tiny speck on landscapes extending to infinity. If feels like this is the way gaming should have been experienced all along… can one go back to peeking through a small 2D window into a 3D world..?

Limitations. After the initially shock and excitement wears off, one is of course aware of the major limitations of the current systems. Resolution is not very good, particularly compared to what we have learned to expect from current technology. 4K screens are slowly taking over and gaming on less tham full HD (1920x1080) resolution is unacceptable. It won't be long before all games will run with playable frame rates on 4K screens (next-generation NVidia cards will probably allow it). In this context, the 1200x1080 p/eye offered by the current HTC Vive (and Oculus Rift) model is subpar. When looking at static images (particularly distant objects) or trying to read text, this is particularly striking. The infamous "Screen door effect" (perceiving the empty space between pixels) is quite noticeable at times. The Fresnel-type lenses used by the Vive produce artifacts when looking straight at light sources and some distortion at the edge of the field of view. The weight of these shortcomings on the player experience depends to a large extent on how applications are designed. For now, VR developers need to avoid scenarios where these limitations are more apparent (e.g. documents with tiny fonts or small objects in the distance). In this player's experience, these problems are quickly forgotten in the best gaming experiences. Careful design of textures and a good rendering engine are also very important (this is best illustrated by the wonderful Valve's "The Lab", a showcase application with various mini games and experiences).

The tether cable connecting the HMD to the PC is another potential immersion-breaker – in games where spinning or turning around very often is required, the cable will quickly tangle around the player's feet.

Head tracking and room-scale. On the good side, head tracking on the Vive is extremely good. Thanks to the "Lighthouse" tracking system, the player can map an area for room-scale playing. With the HTC Vive, room-scale is not an afterthought, but something that's been working since release. How much you can do with room-scale VR depends greatly on the size of your playing area. In this player's experience, a 3x2m playing space is adequate for most gaming experiences, including action and sports games (e.g. "Eleven: Table Tennis VR"). On the other hand, seated or standing VR feels very restrictive after you have indulged in room-scale VR for a while. It is true that seated VR is the normal way of interacting for some games and applications (e.g. piloting a ship in "Elite Dangerous" or watching a movie in a VR home cinema with "Bigscreen"), but for the most part room-scale adds a tremendous sense of presence to the VR experience: crawling under a table to look for a lost coin in the escape room game "The Gleam" really makes you feel like you

are there! Games like “Holopoint” (archery/dodging), “Thrill of the Fight” (boxing) or “Eleven: Table Tennis VR” (ping pong) will provide a terrify workout, thanks to room-scale VR.

Interaction. If there’s one thing that can break immersion in VR, it’s an unnatural, clumsy or strained mode of interaction with the virtual space. Controller tracking must be very good, and an ample array of buttons must be present, but once more application development is very important in this respect - traditional game interfaces and menu systems do not work well for 3D interaction on the VR space. The best solutions try to integrate some of the interface features in the VR in a natural and intuitive way. In the adventure game “The Gallery: Call of the Starseed”, the player’s inventory is called up by reaching behind your back and pulling out a backpack, revealing its contents. Stowing an item naturally consists of dropping the item in the backpack (by reaching back and letting go of the item). In “Zombie Training Simulator” items are selected by shooting at them. Naturally, the physical design of the controller, its shape, weight, etc.… will define some aspects of the interaction that cannot be circumvented with clever programming.

Interestingly, the brain seems “eager” to believe in the virtual world, and it will concede a level of disagreement between vision and touch. In “Serious Sam; First Encontouter”, the wand-like shape of the controller and its weight disagree with the representation of a huge steel machine gun… and yet in a matter of minutes, if not seconds, the brain adjusts to the dissonant perception and the experience becomes full immersive. Haptic feedback appear very important in this respect – even the slightest vibration will be accepted like an interaction between the player virtual “self” and it’s environment. In “Eleven: Table Tennis VR”, a short controller vibration marks the moment the ball hits your virtual racket, and that suffices to keep timing and precision in the game. The visual depiction of controllers as hands is very helpful in creating immersion and making interaction easier (very important in adventures games like “The Gallery: Call of the Starseed” where you need to manipulate and combine objects in different ways). Some games, like “Raw Data”, try to actually build partial arm/body representation through inverse kinematics. However, this requires a lot of real-time computation and the results are less than perfect – the future clearly lies in whole-body tracking systems like the Perception Neuron, which have already made their appearance in some VR social applications (this player has seen a demo in AltspaceVR). Hand and finger gestures are another problem: they are difficult to recreate with button-based controllers, and this feels like a big limitation in social applications like “AltpsaceVR”, where voice and gesture are both integral part of the player-to-player interaction (many AltspaceVR members use the LeapMotion hand tracking device, but this a rudimentary solution supported only a by few applications and with limited modes of interaction). Motion tracked gloves like the Noiton Hi5 (supported by the HTC Vive) will clearly bring the player interaction experience to a new level.

Motion and VR legs. Moving in the VR space is one of the greatest challenges facing application developers. Room-scale playing limits the player to a small space, and moving outside that space will require some sort of locomotion, be it gliding, jumping, teleporting, etc… Conflicting visual and proprioceptive stimuli will easily give rise to motion sickness, some people being much more sensitive than others to this problem. In this player’s experience, sliding motions can induce motion sickness, particularly when one is not facing the direction of movement (first experience was ice skating in “AltspaceVR”, with instant

nausea that lasted over a day!). However, the problem can be greatly reduced with practice (it's called gaining "VR legs") up to a point where sliding can be done with very little discomfort (after 2 months in AltspaceVR, this mode of locomotion was perfectly tolerable). But no matter how "strong" your VR legs have become, some types of motion will still cause great discomfort: smooth spinning is a sure nausea-inducer (e.g. in the "Deus Ex: Mankind Divided™ - VR Experience"). Teleporting from place to place (e.g. "The Lab", "The Gallery", "Raw Data"…) is a locomotion mode that's well tolerated by most people, and as such is has been implemented in numerous games and applications. It can, however, break immersion and make for unrealistic game playing. Some developers devised clever ways to make the brain accept the weirdness of VR locomotion: in "Climbey", walking is enacted by moving the arms up and down in a marching motion, and this simply removes all discomfort.

Socializing in VR. VR is an extremely powerful media for social interaction, and there are already a number of open, free-to-play online VR communities. AltspaceVR is one of the most active and friendly of these communities, and the one this player has been part of for over 50h of play time. It is interesting to compare the experience of socializing in VR with the first text-based chats of the early 1990's. There is much the same level of excitement and thrill of discovery, and the sheer fun of being part of something new. However, there are important differences. In VR, your real self is less shielded, because you're using voice, and not text messages. Avatars are still quite primitive in AltspaceVR, but as they get better they will enable a wider range of emotions and perhaps be tied to better tracking of the "real" self. The sense of presence of other's avatars is enhanced by sound spatialization, making a conversation between 4 or 5 people very easy to follow. AltspaceVR contains a variety of rooms and environments where people can relax, watch movies or listen to music, play games (like chess, checkers, Cards Against Humanity, Dungeons and Dragons), or sculpt and paint together. While the Avatar representations are still crude, these experiences feel very real. Also, members have the possibility to create new content (rooms, games, objects) and have them added to standard set of available AltspaceVR experiences. This makes for a very dynamic world, full of enthusiasts and early adopters of the VR technologies, with a strong leaning towards development of new applications and virtual environments. There regular virtual conferences, broadcasts and gatherings to discuss applications development, the future of VR technology and more general social and cultural issues.

Best VR experiences. After testing over 30 VR applications, some experiences have clearly stood out as the most accomplished, entertaining, immersive or just fun. Being an old adept of "graphical adventure games" (e.g. Myst), this player's first full gaming experience was "The Gallery: Call of the Starseed". While relatively short compared to its PC counterparts, it was immensely entertaining, fun and visually stunning. Adventure gaming befits VR very well, and with room scale the search and manipulation of objects becomes very natural. Also, the developers knew how to create gaming challenges that really work for VR, e.g. trying to grab objects thrown by an NPC or getting hold of tools in a zero gravity environment. The sheer scale of the objects in the finally scenes is also stunning and something that couldn't be experienced in anything else than VR. In the domain of FPS (first person shooters), "Serious Sam VR" passes with distinction: a brutally effective, action packed and fun experience of shooting at all sorts of horrendous creatures with an

assortment of powerful weapons. Being able to use both hands to shoot at different targets makes the FPS experience much more fun, and the sense of presence and size of the opponents (specially the final bosses) is astonishing – at first, the experience is almost too brutal! Room-scale is very well suited for action and sports games, and "Eleven: Table Tennis VR" is a good example of this. It's an accurate ping pong simulation, to the point where one can bring their real world skills into the game, and hone them through practice. Everything feels extremely real and there is an array of opponents ranging for the noobish amateur to the world class player. In the most advanced levels the AI playing feels extremely realistic and almost impossibly hard to beat. This game also doubles as an excellent workout. "Climbey" is a 3D platform game where you climb precipitous walls and narrow ledges and make risky jumps. It may be VR, but the vertigo is very real. Also, it implements the "marching technique" for locomotion, an interesting circumvent for the sliding motion discomfort. Valve´s "The Lab" is a collection of small games and experiences, beautifully crafted and rendered… despite being relatively simply and short, these are among the best moments in VR with the HTC Vive. Google's "Google Earth VR" is also a beautifully crafted port of the popular Earth viewer to VR space. Whether walking on mountain ranges or cityscapes, it is a thoroughly enjoyable experience due to a very nicely designed interface and smooth player experience (but it requires a powerful PC system). Valve's "Destinations" is a collection of environments captured and ported to VR using photogrammetry techniques, showcasing the power of VR as a tool for virtual exploration of real environments. "Bigscreen" is an application for working with virtual computer screens in a VR environment, or projecting movies on a big virtual screen or home cinema. The experience of watching a movie on a virtual movie theater room using an HMD is actually rather spectacular, in spite of the relatively low resolution afforded by current HMDs.

VIII. CONCLUSION

According to our research VR technologies can increase the feeling of presence (immersion) in indie games and installations but it might jeopardize other long term gaming experiences. The design of these play environments need to take into account several factors like coherent texture, level design, consistent human machine interaction and map planning. Virtual Reality remains a vertigo (*ilinx*) territory, where users are so immersed in the digital environment that they can play with their own sensorial apparatus, but the all experience is so intense that it can ruin other game design attributes such as plot or story consistency, meaningful interaction and game play, game mechanics, among others. Besides technical effects for mainstream games VR technologies can enrich play experiences in indie installations, documentaries about reality and marketing strategies. Future research will probably solve the Oculus Rift Development Kit problems, like high-resolution imagery and reducing latency, but a lot more tests need to be made to better connect the Oculus with game engines and web browsers.

In Anna Burzlaff's text "Aaron Koblin on VR Storytelling" (2015) the artist states that what got him excited about VR applications and tools was the potential to change the way we communicate and think. For Koblin today we are only scratching the surface of this territory and we can achieve an unprecedented degree of intimacy even if "someone unfamiliar with VR might find unusual given the clunky headsets, wires, and other technical wizardry (…)." (Burzlaff, online, 2015) The visceral side of VR involves you in a

powerful relation with your senses where, says Koblin quoted in Burzlaff, "you can't look away, you're fully immersed and vulnerable and that's a powerful thing. (…) Powerful VR content "has the potential to connect its users to others and engage them in emotional experiences that may otherwise to be too far removed from their immediate environment. (…) The difference is that being a part of virtual reality is not an ephemeral experience between your imagination and the storyteller. It's actually a much more visceral presence and experience when you're a part of the environment. That means there are also greater opportunities and a plethora of challenges as well." (Ibid., 2015)

For Koblin quoted in Burzlaff, "The applications of VR are definitely not restricted to entertainment. Some of the most exciting potentials lie in medicine, where doctors can trail surgery in virtual environments, and psychology, where immersive therapy has already been successful in treating post-traumatic stress disorder in soldiers. It could also prove invaluable for brands." (Ibid., 2015) Indie games will also take advantage of this new field and new tools and techniques will be created to engage players and their senses all over the globe. VR technologies can increase the feeling of presence (immersion) but it might jeopardize engagement in some gaming experiences. Even though the powers of VR may not lie in hardcore gaming they might open bright new possibilities for exploration elsewhere, may it be medicine, art worlds, documentaries or indie playful installations. VR can be a truly meaningful experience as our player's experience testimony summarized in several sessions, e. g., *System, Initial impressions, Limitations, Head tracking and room-scale, Interaction, Motion and VR legs, Socializing in VR* and *Best VR experiences.*

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