



NARRATIVE LANGUAGE OF VIRTUAL REALITY

aimone bodini

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Narrative Language of Virtual Reality
Aimone Bodini

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Aimone Bodini



DEDICATION

*There will never be words to express how much
you mean to me: Elisabetta, Flavio, Edoardo,
Maria and Attilia.*

ABOUT THE AUTHOR

Aimone Bodini is a digital native who was brought up living and breathing images. Since his teen years, he has been cultivating his love for cinema and building a vision that encompasses all sorts of audio-visual forms and languages – as immediate to appreciate, as mysterious to understand under the hood. Fascinated by the seventh art, Aimone attends a film school, graduating with a Bachelor of Arts in Digital Filmmaking. Right at the end of his studies, Aimone is struck by a new technology, Virtual Reality, which he immediately recognizes as a novel medium with an incredible expressive potential. With his dissertation, developed during his cooperation with a VR company in the U.S. and upon which this book was built, he decided to undertake the first step in the unknown path of the narrative language of Virtual Reality, aiming to decode it. In spite of his inclination towards continuous research in VR, Aimone has been working on a broad spectrum of traditional video productions, believing that a deep knowledge of existing media and their characteristics is a key ingredient in the synthesis of the new medium of Virtual Reality.

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I. INTRODUCTION

Personally, I agree with W.R. Sherman and A.B. Craig, who state that:

"VR has been accused of being merely a technological novelty, something overly promoted by the press into a false sense of importance. While there is some truth to VR being hyped in the press, the authors believe that VR is a useful new medium, one that cannot be ignored."

(Sherman & Craig)¹

What fascinates me is that, unlike all other media invented so far (radio, television, and film), the medium of Virtual Reality does not need what is called the 'suspension of disbelief'.

In cinema, to feel the story as real ('mimesis'), you need to be dragged into it through the director's storytelling skills, in VR, there is no need of a mental effort and identification. In VR, to immerse the spectator into a new world, before a 'mental immersion', there is 'physical immersion'.

My interest in Virtual Reality is also due to the fact that, to improve the quality of VR experiences, it is necessary to observe the world with different eyes.

In fact, it is necessary to be capable of 'deconstructing' reality in order to understand its real mechanisms. Only through a deep and detailed analysis of reality, as it may seem paradoxical, we would be able to create better VR contents.

The multimedia artist Chris Milk, Co-Founder of 'Within' (once named 'Vrse') and Director of many VR experiences, exhibited his project 'Clouds over Sidra' during the 'World Economic Forum' at Davos (Switzerland) in 2015, showing to influential political figures what it's like to live in a refugee camp in Jordan.

"VR is a machine that makes us more human."

(Chris Milk, Founder & CEO of Within)²

When I saw 'Clouds over Sidra', or rather, when I lived that experience, I was invaded by powerful emotions. I was deeply involved both emotionally and physically, I was there and watched the world move on, it looked as if it wasn't pre-recorded but as if it was happening in real time.

My awareness on this topic, was (and is) much stronger than the one that any other media could give me.

That was the moment when I realized that VR potential was great and, for this reason, I decided to start my research: I wanted to decipher the mechanisms that make VR so powerful and compelling.

As I continued the research, however, I discovered that the "world" of Virtual Reality in truth was a "universe", I discovered a lot of related topics that I wanted to learn more and more, in order to understand VR better from every point of view.

I felt like a diver who, initially, is seeing only the mast of a sunken wreck and then is pushed by his hunger for knowledge and extreme curiosity to explore the whole ship.

But a wise diver knows that, at some point, he must return to the surface to take a breath, he must always be aware of his limits.

Since Virtual Reality is still a developing concept, we are at that stage I would call the "democratization of the discovery." Everyone having access to this technology could potentially contribute to its growth and progress. I, therefore, felt an urge to be involved with this project, trying to explore some of the aspects of this new and exciting technological breakthrough. The entertainment aspect of Virtual Reality, especially the way it allows storytelling, is what attracts me the most to this technology. That said, if you tell a story as though you would in the film, you would soon meet problems, which would raise doubts and queries. It seems that applying the general audio-visual 'rules' achieved whilst watching a film or any other audio-visual content is not possible. One must take into consideration new factors which require ample research focused on studying and synthesizing a new language, a language that is specific and adequate to VR technology. This book, therefore, aims to explore, with the entailed means and limitations, what are the 'semantic factors', the 'vocabulary', the 'techniques' that can elevate VR from just an advanced

technological product to a real communication means. To do this, it was necessary to keep in mind the language closest to that of VR, the cinematic one.

Thanks to the use of specific texts, alongside the knowledge in the appearance of audio-visual content acquired both through my academic career and through literature, it was possible to decipher part of the VR language, often comparing it to the one used in film. It was necessary to determine which "words" you could translate into Virtual Reality directly, the ones which needed adjustments and finally the words which ultimately could not be translated at all. In parallel to this translation, it was also crucial to pay close attention to all the features that made Virtual Reality a means of communication in its own right, those factors that characterized VR and gave it an identity of its own. It was further important to 'test' a large number of experiences to understand what these various creators of VR experiences did to convey certain emotions and meanings to their audience. In the same way, it's been extremely useful to watch them online and, when possible, to attend those VR-focused events and conferences where these creators expressed their thoughts and talked about the process of creating their VR experiences. Support from the U.S. studio 'Bully! Entertainment', where I've interned for some months, was essential. It allowed me to use all their equipment at the forefront of Virtual Reality and, at the same time, gave me the opportunity to analyze qualitatively VR experiences through the exchange of opinions and thoughts with professionals within the studio.

This research is divided into two main parts. Initially, the reader is given an introduction to the historical context of VR, briefly explaining the advancements in this technology to date, an overview on today's market and, lastly, a brief explanation on how human eyes work and how VR tricks our brain.

The second part focuses on the VR language and analyzes those techniques used to exploit the VR medium. This part starts introducing the main feature of VR, or the so-called sense of 'presence' explaining the meaning and requirements necessary to create it.

The relationship with characters in Virtual Reality must also be understood and is discussed throughout as it changes the relationship that they establish with the audience. It is different to that of mediums such as literature or cinema. Exploring how editing works in this field is also detrimental to understanding what can be translated from the cinematic field and where new ways must be devised in terms of

"cuttings" that VR allows. The technology specific to VR is also described, in terms of both the 3 and 6 degrees of freedom, as well as explanations on how it can be used creatively for narrative purposes from editing to interacting with the environment and characters.

The exploration of this newly discovered language that the world hides behind single details and this topic of research, required much broader and deeper research than what was initially thought. What has been explored here is a first step in decoding the narrative language of Virtual Reality, which just scraped the tip of the iceberg. This is an important step in encouraging other researchers and scholars to demystify this area. Overall, this research is proof that VR has a language of its own and demonstrates that the knowledge of this language is fundamental to create better and more compelling experiences.

II. METHODOLOGY

For research on a hot topic such as VR, a technology, and a medium that is still in its primary stages of development, choosing how to approach it, and which methodology to use, was fundamental. The risk of writing this book in a superficial and trivial way, without a precise focus, was high.

Only through a wise choice of methodological tools to use, I could perform research for a consistency worthy of a book.

II.1 Methodology adopted

Methodology I will use to develop and answer to my primary question is based on:

1. Personal test and critical analysis of VR contents
2. Personal communication with professionals already operating in the industry.
3. Literary review
4. Conference and event analysis

II.1.2 Personal test and critical analysis of VR contents

I tested VR games, VR narrative experiments and various VR experiences available on 'Oculus Store', 'Steam', 'Google Play', creators' websites, or during VR conferences and events. I also used different headsets to determine what were the technical differences between the different products (mobile VR – "true VR", rotational tracking - positional tracking, hand tracking - touch controllers...) and their different expressive potential.

II.1.3 Personal communication with professionals already operating in the industry

The second method that I used to improve my research was to get in touch with as many professionals as possible. I've interned, for a period of a few months in the studio 'Bully! Entertainment' while already operating in the VR industry and with many VR projects already accomplished.

The company of high-level professionals, cutting-edge equipment, and a productive workflow have allowed me to acquire the knowledge necessary to better develop my research.

The decision to combine the practical with the theoretical, for writing this book, was wise and well-balanced.

Because VR is a medium not yet in its 'adult' phase, a time frame where it is possible to imagine its potential and characteristics but with little clarity, a comparison and exchange of ideas with professionals was particularly fertile and effective to achieve the goal of this work.

II.1.4 Literary review

Born in the late '60s and particularly developed during the 90s, Virtual Reality was a popular research subject.

The majority of academic documents on VR have mostly used a scientific or ethical/philosophical approach and most of them are in English.

There are papers that seek to introduce readers to VR as 'cutting edge technology' and also as a 'new medium' such as 'Understanding Virtual Reality' by W.R. Sherman and Craig A.B., which I'll quote more than once.

There are numerous 'reports' about practical applications of VR in the medical field, especially on how the use of this technology can help patients suffering from PTSD (Post-Traumatic Stress Disorder). Other reports are academic research and papers, as this one, often written by Computer Science students, approaching VR more from a technical standpoint.

I have not found many books, papers or other documents discussing storytelling in Virtual Reality, and perhaps the motivation is simple. Logically speaking, content creation is subsequent to the affirmation of technology, and VR is always developing new hardware and software for it.

Only in recent years, we have seen the rise of studios, which have developed independently of both software and hardware companies interested in experiencing the new medium to tell stories, only now our technology is ready for creating VR content.

II.1.4.1 Online articles

Today, there are websites focused on Virtual Reality news which have existed for the past few years. The main ones are 'roadtovr.com', 'uploadvr.com', 'vrfocus.com', 'vrscout.com'. and 'virtualrealityreporter.com'. I will refer to these websites frequently during this book because they are an excellent source for finding information about the VR market, interviews with professionals and new remarkable VR content releases.

Even the online publishing platform 'medium.com' thanks to the articles and posts focused on VR content, has been an important resource during the research

and analysis phase. In fact, it allowed me to compare different opinions and points of view expressed by influential VR creators.

II.5 Conferences, speaker experience and community

If there is a lack of books and papers focused on storytelling in VR, other important sources of information, which can be considered like 'contemporary oral bibliographies', are all the conferences attended by leading VR representatives worldwide and in which they share their knowledge about the VR medium often looking back at their recently completed projects.

The targets of these events are mainly other professionals and they are designed to show the latest progress made in the recent months from a technical (hardware and software) standpoint but also from an economic, psychological and philosophical point of view.

So, in these events it is common to see in the programming, talks that concern the economic growth of the VR market on possible future applications in the medical, social or in the entertainment field. Of particular interest for my research are many of the talks that took place during the three different editions of the 'Oculus Connect', which have been made accessible on the video sharing platform YouTube by the same company Oculus.

Several times I'll make references to conferences where Saschka Unseld (previously Creative Director at Oculus Story Studio) analyzes his VR projects ('Lost', 'Henry' and 'Dear Angelica') developed in the last years with the 'Oculus Story Studio'.

Other important people I'll quote throughout this book are Michael Abrash (Chief Scientist at Oculus VR) and John Carmack (Chief Technical Officer at Oculus VR) that I will mention in the most technical sections of my book.

Other conferences that I'll analyze were held at events such as the 'VRLA EXPO', 'Develop Conference', 'World VR Forum', 'SVVR', 'Google I/O' and many others, I've also personally attended some VR events as a speaker ('World VR Forum',

'AR & VR World', 'Voxxed Days – Belgrade', 'Immersive Italy') getting in touch with other speakers and professionals. This knowledge exchange really helped me to expand my vision.

In addition, the connection with the online community occurred personally through email correspondence or even through social VR platforms such as the 'Altspace VR' app with professionals already working in the VR industry. This correspondence was also vital while I was writing this book.

II.2 Methodology limits

As the development of this new medium is still in progress, the limit resulting from my methodology may be due to the fact that technology and language go hand in hand and, for this reason, parts of my research may remain current only for a short time frame.

Our research is limited to testing VR experiences available at the time of writing this book and relating with professionals, who are still asking questions about how to properly use this new medium.

Therefore, soon, some words and techniques specific to the VR language could become obsolete or redefined because of technological progress that will find the most effective solutions to convey certain meanings and emotions.

However, this book is not going to become irrelevant in the near future. In fact, the real goal is to clearly define the key concepts of storytelling in Virtual Reality, which are those specific tools the VR medium can use to tell a story. The goal is, therefore, to analyze the basic VR mechanics, the 'linguistic roots' that are independent of technological progress.

II.3 How to read this book

This book examines and analyzes many VR experiences (most of them already released to the public) and, for this reason, it is suggested to the readers that they try the experiences themselves. This will be mentioned in the following chapters to thoroughly illustrate the author's observations.

PART ONE

Virtual Reality: What, When and How

1. WHAT IS VIRTUAL REALITY?

At the time of writing, among people all over the world there is much ambiguity and lack of clarity about what 'Virtual Reality' is.

Some compare it to those 'boxes' at amusement parks where the players sit in and can, among other things, feel the seats shake.

Some people confuse VR with 'AR' ('Augmented Reality'), which, instead, is merely an illusion in the real world of the implementation of two-dimensional or three-dimensional objects/graphics that can be displayed only by specific devices such as smartphones, tablets or special glasses (Microsoft's 'Hololens', 'Meta' and 'CastAR' just to name a few).

Or, there are those who, hearing the words 'Virtual Reality', immediately think of Wachowski brothers' "The Matrix", but they don't actually have an idea of what VR is in practice.

The professor of humanities and author of several books on VR, Michael Heim, describes it as *"an event or entity that is real in effect but not in fact"*.³

To explain this sentence, you need to think of VR as a medium that can give to a person the impression of being catapulted into another world, it seems that all the senses perceive this new world as real. It is like being in another dimension.

However, the best way to understand what VR is - is by experiencing it. The most effective way to undertake a VR experience is through the use of a 'headset', a sort of helmet with an installed display (HMD) that displays a two-dimensional or three-dimensional image.

"An HMD is like headphones for your eyes. Headphones give your ears artificial sounds, HMDs give your eyes artificial light."

(Takashi Shibata, author)⁴

2. HISTORICAL CONTEXT

2.1 Origins

"-But what is reality? - asked the gnomelike man."

(from *"Pygmalion's Spectacles"*)⁵

Stanley Grauman Weinbaum is an American writer born in Louisville, Kentucky. Weinbaum enrolled in the University of Wisconsin's Chemical Engineering program, but after some time, in 1923, he decides to interrupt his studies to become a writer.

Weinbaum has always been an avid reader of science fiction stories and in 1934, he decides to focus on this genre getting a big hit with 'A Martian Odyssey', a tale in which Weinbaum characterizes extraterrestrial life forms, aliens, in a very original and innovative way, so the professor and writer Isaac Asimov describes his work saying:

"[...] a perfect Campbellian science fiction story, before John W. Campbell. Indeed, Tweel may be the first creature in science fiction to fulfill Campbell's dictum, 'write me a creature who thinks as well as a man, or better than a man, but not like a man'."

(Isaac Asimov)⁶

Later on, in 1935, Weinbaum wrote a short story entitled 'Pygmalion's Spectacles', in which the protagonist, thanks to a special pair of glasses, is catapulted

into another reality where all the stimuli are perceived as real by all the senses. Basically, he wrote about a headset for Virtual Reality that we have today. Unfortunately, Weinbaum died of lung cancer in 1935.

Although he wrote a few sci-fi stories, his influence on posterity was huge, after him many authors wanted to tell about virtual worlds generated by computers and futuristic technologies.

However, in my opinion, there wasn't only a literary influence, Weinbaum, with his stories, creates dreams for the scientists of that generation, motivating them to make Virtual Reality, a dream, more and more real.

Between the 50s and 60s, Mort Heilig invented what may be considered the first "machine" for VR: the "Sensorama".

The 'Sensorama' looked like a 'big box' in which the viewer put his head inside, allowing him to see stereoscopic images, feel vibrations from his seat, smell odors and even feel a little breeze on his face to simulate the wind.

Then, in 1968, 'Sword of Damocles', the first "headset" for Virtual Reality⁷ invented by the stated scientist Ivan Sutherland, makes its appearance. This device was connected to a computer allowing stereoscopic vision and also a primordial 'rotational tracking' technology that allowed a 360-degree view of the virtual world.

"Sensory feedback is an ingredient essential to Virtual Reality. The VR system provides direct sensory feedback to the participants based on their physical position."

(Sherman & Craig)¹

In addition, the fact that it was a helmet and not a box was considered revolutionary for its time because it allowed the person to move more freely.

In these years the American Department of Defense (USAF) also showed interest in Virtual Reality because they saw a useful application for it: training their soldiers in VR to be ready during military operations in real life.

Professor Thomas A. Furness (Ph.D. Engineering and Applied Science), during his 23 years of service (1966 - 1989) at the USAF, has focused his efforts to create real cockpit interfaces in Virtual Reality with the goal to train USAF pilots.⁸

In 1984 Jaron Lainer founded the 'VPL Research' that can boast of being the first company, in partnership with the toy company 'Mattel', bringing to market a consumer VR device as the 'Data Glove', allowing gamers to interact with the virtual world thanks to optical fibers wired into it. While not popular, the 'Data Glove' (renamed 'Power Glove' from 'Mattel') was purchasable for \$75.⁹

2.2 '90s wave'

In 1991 Sega announced the 'Sega VR-1', an HMD with an LCD screen, stereo headphones and a sensor capable of detecting the inertia created by the movement of the head to create a sort of 'head tracking'.

The 'Sega VR-1' was never released on the market because according to the CEO, Tom Kalinske, this headset was too realistic and could easily cause 'motion sickness' and headaches.¹⁰

Between the 1st of July, 1994 and the 8th of September, 1995, at the 'EPCOT Center' in Orlando, Florida, the "Walt Disney Imagineering" in partnership with the 'University of Virginia' created an amusement park ride based on the animated film 'Aladdin' in which visitors could get on a flying carpet and fly in Virtual Reality. This amusement park ride was made to investigate how the medium of VR could lend itself to storytelling. The ride was experienced by a total of 45,000 people from a wide variety of demographics, asking them to fill out a survey about it after the experience.¹¹

This experiment can be considered the first step aimed to investigate the relationship between storytelling and Virtual Reality.

The effervescence for VR of those years, where people were expecting to soon see VR devices at an affordable price on the consumer market, also influenced the stories brought to life on the big screen by the film industry. Among the most famous

films, there were 'Total Recall' (1990), 'Arcade' (1993), 'Johnny Mnemonic' (1995), 'Strange Days' (1995), 'eXistenZ' (1999), 'Virtuosity' (1995) and 'The Matrix' (1999).

An HMD was released in 1995 by the Japanese company 'Nintendo', the 'Virtual Boy', a game-oriented device. Its display was monochrome (red), as it was the only way to keep the price affordable, and was based on the optical effect of parallax, trying to give back a false third dimension.

The 'Virtual Boy' wasn't capable of tracking head movement.

The 'hype' of the '90s faded quickly after many VR devices, including those listed above, betrayed the expectations, both because they were not affordable and because they didn't convey the impression enough to be immersed in a virtual environment. The technology was not yet ready to plunge into the consumer market and VR went back to the lab, for a better research and development phase.

2.3 Today

The most important contemporary revolution regarding the world of Virtual Reality occurred thanks to the young Californian Palmer Luckey, who, in 2010, developed the first prototype of the 'Oculus Rift', an HMD with rotational tracking and capable of displaying 2D images. In addition, this Oculus version, allowed to have a field of view of about 90°, a feature very innovative for that time.

Later, Luckey got in touch with John Carmack, the famous developer and creator behind revolutionary video games like 'Doom' (1993) and 'Quake' (1996). In June 2012, the two founded the company 'OculusVR'.

The 1st of August 2012, Luckey launches a campaign on the crowdfunding platform 'Kickstarter' to finance his 'Oculus Developers Kit 1':

"I will not make a penny of profit off this project, the goal is to pay for the costs of parts, manufacturing, shipping, and credit card / Kickstarter fees with about \$10 left over for a celebratory pizza and beer."

(Palmer Luckey, Founder of Oculus VR)¹²

With a goal of \$250,000, in just three days, the project received more than a million dollars.

At only \$350, the DK1 offered the performance far superior to all the headsets that had been seen in the past, but, there were still some areas for improvement such as the display resolution and the 'positional tracking' implementation.

In 2014 a second model, the 'Oculus DK 2' was released with an improved resolution (from 800 x 600 pixels per eye to 960 x 1080 pixels) and the 'positional tracking' implementation for the player's head in a modest volumetric space.

Also in 2014, 'Facebook' acquired 'Oculus' for more than \$2 billion, and the CEO, Mark Zuckerberg, explained how:

"We're going to focus on helping Oculus build out their product and develop partnerships to support more games. Oculus will continue operating independently within Facebook to achieve this."

(Mark Zuckerberg, Chairman and CEO of Facebook)¹³

Meanwhile, many other startups were born. Some of them wanted to integrate the Oculus Rift headset with their hardware systems, making the experience more immersive in the virtual environment, improving the sense of 'presence'. Among these companies, 'Virtuix Omni', since 2013, focuses its efforts developing platforms that allow omnidirectional movement in the virtual environment.¹⁴

Company 'Leap Motion' is, instead, another startup that wants to let the user, through a device with a 'hand tracking', to use his or her own hands in the virtual environment, making possible an interaction with it.

Also in 2014, the biggest studios and entertainment companies, began to make their moves financing VR contents: 'Fox Studios', 'Universal', 'National Geographic', 'CNN', 'ABC' and 'DreamWorks' came into play.

On the 7th of November, 2015, 'The New York Times' sent more than one million 'Google Cardboards' to all their subscribers of the paper version and was also a sponsor of VR documentaries, such as 'The Displaced', created by 'Within'¹⁵.

In March 2015 HTC decided to bet on Virtual Reality by clutching to an agreement with Steam and announcing the release of their own 'Vive' device, also equipped with controllers and a remarkable positional tracking. The release date, originally scheduled for December 2015, has been postponed to April 2016.

On the 20th of November, 2015, the 'Samsung - Gear VR' was released, which, in partnership with Oculus, for an affordable price, offered numerous VR experiences of great quality, considering that it is a headset for mobile VR.

Mobile VR

Technological progress in recent years has meant that mobile devices such as smartphones become more and more efficient 'mini-computers' that can support VR contents for both 360° videos and VR games.

Devices like the 'Oculus DK2' and the 'Vive' are able to give back a level of "presence" far superior to that granted by smartphones. Nonetheless, it is important to keep in mind that these headsets also require a computer with high performance and many wires, not making the experience very comfortable.

Smartphones, however, despite not having a fast processor or a complex 'sensory feedback system', have two important features.

The first one is due to their wide distribution on the market already, the second is that smartphones allow a VR experience just adding (for a few dollars) a device such as Google Cardboard.

"The magic of a completely portable and wireless VR headset is easy to underestimate until you have experienced it. We don't have the raw horsepower of a high-end gaming PC (yet), but there are valuable compensations that make it a very interesting trade-off, and many developers will thrive on the platform, especially as it improves at the rapid pace of the mobile ecosystem."

(John Carmack)¹⁶

3. MARKET OVERVIEW

Since the time that the social network 'Facebook' acquired 'Oculus' in March 2014 for the staggering amount of \$2 billion, there was what much online news specialized in VR like to the 'California gold rush' of the nineteenth century:

"Since the famous crowdfunding campaign Facebook has acquired Oculus Rift for \$2 billion and all the big tech companies brewing up their own consumer headsets to put on the market."

(Christopher Kenessey of Huffington Post)¹⁷

This feverish race to secure leadership in the emerging market of Virtual Reality gave birth to hundreds of startups both focused on the manufacturing and on VR content creation.

Investors see in this new 'wave' of Virtual Reality a concrete chance for this technology to finally be established on the consumer market. Unlike the first 'wave' of the '90s, this time, it seems that the level of technology (hardware & software) achieved is ready to be promoted and distributed on a large scale.

The current market, however, is a little bit confusing, with so many players and so many prototypes, both hardware, and software. It is very difficult to take a detailed picture of what is going on all around the world because the scenario is always changing, every month there are new funds, startups, hardware, software, platforms and other news related to the VR ecosystem.

That said, I can only outline in broad terms the players involved in creating VR experiences which will be mentioned during this book.

When designing a VR experience, it is critical to choose the hardware that will be used to experience that content, each technology allows for different storytelling potential. In this regard, it is worth to mention 'Google' and its 'Cardboard',

'Samsung' and its 'Gear VR', 'Facebook' and its 'Oculus Rift', 'HTC' and its 'Vive'. Most contents produced by creators are designed to be experienced with these headsets, but each day we see new players entering the market. It is also important to emphasize how not every manufacturer is interested in taking part in the mainstream market. Starbreeze and Acer, for instance, developed a very high-end headset called 'StarVR' aiming to be the leading solutions provider of B2B Virtual Reality services.

The hardware and software required to produce VR experiences may change depending on the type of content that is going to get produced. In the case of interactive or pre-rendered CGI experiences, what is needed is a computer with high performance (hardware) and (software) as: 'Autodesk Maya', '3ds Max Zbrush', 'Cinema 4D' or 'Blender' along with graphic engines as 'Unity', 'Unreal Engine', or 'Cryengine' (software).

For creating 360° videos, it is necessary to cover the 360° space with multiple cameras (associated with wide-angle lenses in order to have a wider FOV) and then to merge the footage of each camera and to obtain an equirectangular image (a representation of latitude and longitude of a sphere using the Cartesian coordinate system).

The main issue when producing 360° videos today is due to the parallax (difference in alignment) between cameras. This difference creates seams and stitching lines visible in the output files. Many companies and filmmakers are experimenting with different camera designs in order to reduce this physical issue as much as possible. 'GoPro' launched its rig 'Omni' which mounts 6 synced 'GoPro cameras', 'Nokia', its 'all-in-one' system 'Ozo', same for 'Jaunt' and its 'Jaunt ONE (J1-24G)', 'Samsung (Gear360)', 'Kodak (SP360)' and 'Ricoh (Theta S)' decided to enter in the consumer market with cheaper cameras. Companies as 'Within' and 'Felix & Paul' developed high-end proprietary solutions, both on hardware and software, allowing them to create 360° videos of very high quality.

In addition to these cameras, many others have been announced and should be released in the near future, enriching the 360° video capture ecosystem.

The most common software programs used to stitch the footage together are: 'Autopano Video', 'VideoStitch Studio', 'PTgui Pro', 'Mistika VR' and 'Cara VR' (a

plugin for Nuke). Also, there is other software specifically designed for merging OZO's and Jaunt's footage ('OZO Creator' and 'Jaunt Cloud').

Other software as: 'After Effect', 'Photoshop', 'Autopano Giga', 'Mettle SkyBox Suite' is used to improve the post-production process.

The relevant companies involved in the production of VR contents in this book are:

- **Companies using mostly CGI and/or graphic engines:** 'Oculus Story Studio' (which now has been shut down), 'The Virtual Reality Company', 'Baobab Studios', 'Penrose Studios', 'CCP Games', 'Telltale Games', 'Epic Games', 'DICE', 'Google Spotlight Stories', 'Playful', 'The Body VR', 'Bully! Entertainment', 'Kite & Lightning', 'Emblematic Group', 'Reel FX', 'Reload Studios', 'Survios', 'Starbreeze Studio', 'nDreams', 'Crytek', 'Framestore VR Studio', 'Innerspace VR'.
- **Companies using mostly 360° cameras and VFX:** 'Within', 'Félix & Paul', 'Jaunt', 'NextVR', 'Happy Finish', 'Immersive Media', 'WeMakeVR', 'WEVR', 'Okio-Studio'.

4. BRIEF PHYSIOLOGICAL EXPLANATION ON HOW HUMAN EYES WORK

To better understand how Virtual Reality works, it is extremely important to understand how the human eyes work and what are the mechanisms that VR uses to give the impression of being catapulted into another world.

Without going too much into it, due to the limit of my anatomical and physiological knowledge and because it would go beyond the objective of my research, in the next lines I will explain which are the main 'tricks' that are used by the HMD (head-mounted display) to 'deceive' our visual perception.

4.1 Stereoscopy

Humans are provided with a binocular vision which allows them to perceive the three-dimensionality of the environment surrounding them. This three-dimensionality is not more than the synthesis of different images that single eyes at a distance of about 6,5 centimeters (*'Interpupillary Distance'* or *'IPD'*) from one another transmit those images to the brain which reworks them.

To create a stereoscopic vision, VR displays two images slightly offset representing the same subject to the spectator. Stereoscopy has been discovered and used by Sir Charles Wheatstone since 1832. It was not more than two images slightly different, combined with a display with mirrors and prisms, a tool named just *'stereoscope'*.

Over the years of technological progress, we switched from drawings to digital images displayed on LCD or OLED displays mounted on a headset, very close to human eyes to cover a large field of view (FOV).

To view images on the display correctly and without straining the eyes, a pair of lenses is interposed between the display and the eyes.

It is important to underline how some VR experiences are not provided with stereoscopic vision (those live-action 360° videos produced with non-stereoscopic cameras) and the images displayed are identical not allowing to perceive a sense of depth.

Despite what *'VR purists'* might point out, I believe that even a non-stereoscopic content produced with a 360° camera can be considered Virtual Reality because the virtual environment where the viewer is put into is perceived as real by him or her. For this reason, for the whole length of this book, I'll refer to stereoscopic CGI interactive contents, stereoscopic CGI 360° videos, stereoscopic 360° videos and non-stereoscopic 360° videos simply as *'VR experiences'*.

4.2 Field of view (FOV)

The field of view is that portion of space that our eyes allow us to observe. The horizontal visual field of a human is about 180° but the 'range' where we can decipher the letters is only 20°, the one in which we can distinguish the symbols is 40°, and the one in which we can recognize colours is 60°.

Moreover, it is important to distinguish between 'binocular' vision, the vision both eyes can see, and the 'monocular' vision, which, in fact, is granted to one or to the other eye.

Another big difference regarding the field of view is between 'central' and 'peripheral' vision.

The 'central' vision allows me to recognize precisely what I'm looking at (shapes, colours, letters) while the 'peripheral' vision does not allow to have a defined vision of objects we see, as they are located at the ends of our visual field.

Now it is understandable that to look at images in a newspaper or on television is drastically different from that of a 'head-mounted display' because in the first two cases the FOV used is just a small part of what we could use (anatomically), so it is possible to focus on a precise point.

Today, in most of the headsets, horizontal FOV ranges from 90° to 100° even if we can find unique examples such as the 'StarVR' headset with 210°.

It's necessary to keep in mind this characteristic when we are creating contents for Virtual Reality, as Joe Ludwig did, transpositioning a classic PC video game like 'Team Fortress 2' to True VR¹⁸ or even Alex Chu, when he was developing a 'User Interface' (UI) for the app 'Milk VR' for Samsung Gear VR.¹⁹ I've found their approach very wise and if you are interested, I suggest you consult the 'Reference' section at the end this book.

PART TWO

VR Storytelling: Language and Vocabulary

5. LANGUAGE ANALYSIS

5.0 Premises

Before explaining what are those elements that create the VR language, it's needed to make some premises to facilitate the readers' understanding of the following paragraphs.

5.0.1 Language and Technology

As I stated earlier, especially for this research and its focus, technology and language go hand in hand, they are inseparable and influence each other.

This bond is not new to the media. Let's try analyzing the film medium with which there are immediate effective similarities for understanding.

The first film shots in the early twentieth century were static, still and immovable. This was due to the fact that cameras, at the time, were large and heavy boxes that could not be moved easily by a person, therefore it was decided to place the camera on a tripod that was held firm and motionless.

In the 50's / 60's, with the introduction of 16 mm cameras far lighter than 35 mm, there was a great evolution of film language: filming with the 'handheld camera' had become the symbol of those years, in particular, French 'Nouvelle Vogue's' camera movements represented a 'point break' with the cinema of the past, characterized by images always 'linear' and 'fluid.'

From the first works with fixed cameras by Lumière Brothers and Méliès to the handheld shot by French directors like Truffaut and Godard, there was a gradual transition and a technological progress of course, but I brought an extreme example to make the relation between technology and language more evident. The language

used by pioneers of cinema had a vocabulary with fewer words than that one owned by Truffaut and Godard to express themselves in movies.

Today we can experience VR in very varied and different ways (standing or seated or in other positions, 3DoF or 6DoF, pre-rendered or real-time, interactive or passive, interacting with hand controllers or with the gaze based selection, head-tracking/ room-scale tracking/ 'hangar-scale' tracking, solo experience/social experience, in your room or in a specific event/exhibition and so on...).

For this reason, a macro-division into groups which differ by the type of technology used is necessary:

1) 360° Video (1° Immersion Level)

Examples of this are the videos filmed with 360° cameras (or through the use of several cameras positioned in such a manner as to cover a 360° vision, and merging the different footages with specific software). These contents can be seen on a 2D monitor, using the classic 'click and drag' mouse movement, or using a smartphone and exploiting its gyroscopic technology. Even better is to plug the smartphone into a VR mobile headset (like the 'Google Cardboard') in order to improve the overall experience.

The main features of this group are:

- Lack of positional tracking (6DoF).
- Low interactivity (spectators can just decide where to look at. There are very few interactive 360° videos).
- Creating a 360° video of medium-quality is cheaper, easier and faster than contents created with graphic engines.

- Real world recording.
- Moderate immersion level.

2) VR experience created with graphic engines (II° Immersion Level)

Examples of this are those VR experiences for mobile VR, more similar to video games than videos and movies, created with 3D computer graphic software along with graphic engines.

The main features of this group are:

- 'Gaze-based' interaction (gazing at a specific point for a few seconds to interact with it, is the most common interaction). Interaction also with a magnetic trigger, touch, trackpad (Gear VR) or analogic joystick and other similar devices (e.g. Gear VR gamepad).
- Lack of positional tracking (6DoF).
- Good sense of depth thanks to stereoscopic vision.
- 60Hz (smartphone maximum refresh rate at the moment) is enough to guarantee a smooth static experience, but if the viewer is moving his head quickly, the refresh rate should be higher.
- Creating this kind of VR experiences requires both technical resources (graphic engines, graphic software, hardware) and qualified professionals.
- Possibility to create both fictitious worlds and plausible real worlds.
- Good immersion level.

3) VR experience created with graphic engines and having positional tracking (III° Immersion Level)

Examples of this are many video games and experiences created with 3D computer graphic software along with graphic engines.

These experiences need specific headsets and a high-end computer. This is what is called by many '*true VR*'.

The main features of this group are:

- Great interactivity thanks to positional tracking (Valve's 'Lighthouse' sensors, Oculus' 'Constellation Tracking', 'OSVR Tracker Viewer'...) Interaction also with an analogic joystick and other similar devices ('XBOX controller', 'Oculus touch', 'Vive controllers', 'Vive Tracker'...). Thanks to specific tracker sensors it is possible to move in a small volumetric space (for instance, HTC Vive allows to move freely in a 15 x 15 ft. space).
- A remarkable sense of depth (thanks to stereoscopy and 6DoF).
- Creating VR experiences of this kind requires high technical resources (software and hardware) and high qualified professionals.
- Possibility to create worlds of all kinds, both fictional and real.
- Remarkable immersion level.

This research will analyze all the three groups because a VR experience with more physical immersion (III° group) is not always more interesting or worthier of analysis than another VR experience with a minor physical immersion level (I° and II° group) but with a better storytelling approach.

An experience that allows a great physical immersion, is able to trick the brain very well, but it is also true that in addition to the 'physical immersion', it is possible to have a 'mental immersion' which is not only determined by the use of immersive technologies. 'Mental immersion' is especially provided by the quality of the contents proposed and by their ability of engaging the viewer of fascinating him and shaking his feelings.

Moreover, Maureen Fan makes an important consideration regarding VR technologies available today and in the future, with the following statement:

"Different audiences will want different levels of interaction, not everyone will want to strap into a headset, tethered to a computer, and interact deeply with an experience when they get home from work. Sometimes, people will just want to be entertained. Others will welcome that heavy interactivity and could spend hours at a time in the virtual world."

(Maureen Fan, CEO of Baobab Studios)²⁰

What she says is very true and it's important to keep in mind when thinking and developing a VR product, because inevitably that VR product is placed on the market, where, today, there is strong 'targetization'.

Tom Heat (Software Engineer at Oculus VR)²¹ and Michael Abrash during 'Oculus Connect' conferences listed which, according to them, are technical requirements to create a VR experience belonging to the third group.

Here is a synthesis of this:

- Head tracking: realism of head movements (If I move my head from right to left of about 50 cm in the virtual environment, I must move from the same distance, not 1 meter or 10 centimeters. It is necessary for a high movement fidelity.)
- Stereoscopy: through the use of two slightly different images for each eye.
- The consistency of proportions.
- 6 degrees of freedom (Translation XYZ combined with three different rotations on the same axis).
- Wide field of view (80 degrees or more).
- Appropriate resolution (1080p or higher).
- 'Low pixels persistence' (3ms or less): avoid latency.

- 'Refresh rate' > 60 Hz (95 Hz is optimal): need 'fluidity', avoid double images, avoid 'motion blur'.
- Display where the pixels are lighted simultaneously.
- Optical Calibration.
- Strong tracking technology - translation must be millimetric accurate, orientation must have a tolerance of up to a ¼ degree, ability to move in a space of about 1.5 m.

5.0.2 Presence

What is real? From a scientific point of view, we consider real everything we perceive through our senses, Abrash explains how reality is nothing more than the sum of all the stimuli that our brain processes in perception and then, in reality.

"We have learned that the key to making the experience unique and compelling is convincing perceptual system that operates at low-level, well below conscious awareness that they are perceiving reality. Since by definition you are not aware of the relevant system, it's hard to understand what they are and why they matter."

(Michael Abrash)²²

Presence is the psychological perception of 'being' and 'existing' in the virtual world. This is achieved primarily through the creation of an illusory third dimension (thanks to the stereoscopic vision) thanks to the rotational and positional tracking and all those hardware components that are intended to create all those stimuli that we are used to perceiving in reality.

"Low-level processing signals form your senses of the world if VR provides inputs that simulate the low-level processors properly you feel like you are actually someplace."

(Michael Abrash)²³

Through correspondence with Mike Alger via email, however, we concluded that to get the sense of 'presence' only hardware technology is not enough. Contents are extremely important. Looking at the cinematic medium, over the last 120 years it has created a language of its own to make the viewing of the experience more immersive, more compelling:

"If you draw the user in through editing structure, shot composition, controlled palettes, smart writing, believable acting, etc., then you can make them cry, laugh, or jump."

(Mike Alger, VR Designer at Google)²⁴

To better explain what is meant by the sense of 'presence', Alger gave me this example: if a stone was thrown at the viewer in Virtual Reality, his instinct led him to avoid that object.

Despite being an illusion, his brain reacts as if it were a real event.

The instinct is, explains Abrash, an unconscious stimulus, one of the many 'low-level' processes that occur in the brain and one that we do not realize.²¹

Only with knowledge of the micro-unconscious would it be possible to create highly engaging VR experiences, and, for this reason, to better explore the VR medium, professionals from many fields are needed, not just developers, 3D artists and electronic engineers but also anthropologists, psychologists, neuroscientists, architects, philosophers and many others.

"Virtual reality, is an event or entity that is real in effect but not in fact."

(Heim, 1993)

After testing different VR experiences, I have noticed that one of the 'tricks' I've seen applied to increase this sense of 'presence', is to recreate a three-dimensional body from the neck down.

In this way, with a proper use of proportions, the user can see his chest covered with a steel armour as in 'Battle of Avengers Tower', produced by 'Framestore VR'. The next step is to display to the user - his own face, thanks to reflective surfaces that precisely reflect the character in which the player is identifying himself.

Also in 'Battle of Avengers Tower', when looking out of the window of a skyscraper, the player notices that his reflection and his movements in real life are consistent with those made in VR (in this experience, when the player rotates his head left and right).

Similarly, this also happens in the video game 'Dead Secret' developed by 'Robot Invaders', where there are many mirrors allowing the player to identify himself or herself with a journalist who is investigating the crime scene in a haunted house. The use of mirrors has an interesting narrative purpose, because, sometimes, when the player looks at the mirror, a 'monster' behind him appears, making the experience even more frightening.

During the '90s the well-known game designer and professor Ernest W. Adams began to study those possibilities granted by 'interactive storytelling' and he asked himself how the player immerses himself or herself in the virtual world like the video game one.²⁵ As I've already explained, this immersion is due to both: hardware components ('tactical immersion') and to the experience itself ('strategic immersion' and 'narrative immersion').

Tactical Immersion: Interaction with the virtual world

Extremely important when being immersed in the virtual world, is the use of 'tactical input' which allows the player to receive a feedback of his actions in the game, in 'real life', starting from the simple 'mouse click' action.

Today, with developing input, it is possible to recreate 'natural gestures' such as hand tracking devices (a famous example is the 'Leap Motion' device).

In the future, I see as a next step the possibility to let the player move in a volumetric space and tracking his body constantly (not just 'head-tracking', I'm talking about something similar to the 'motion capture' technology, capable to track your whole body).

The last step could be to have a sensory feedback from the virtual world, through electric impulses for instance, when interacting with an object.

Strategic Immersion

It is more of a mental immersion associated with the game's mechanics and to the strategy needed to progress and reach the goal of the game. The highest level of 'strategic immersion' is in the puzzle games because they require a high 'problem solving' skill.

Narrative Immersion: grab the player into the story

This kind of immersion is created when the player/spectator starts to empathize with the characters when he starts to care about the story and how it ends. This 'empathy process' is the same as the cinematic one. To create 'narrative immersion', it's necessary to have a great storyteller and for this reason, many game studios tend to hire movie screenwriters and not just game designers.

A game that makes a great use of these three different types of immersion is 'I Expect You To Die' created by 'Shell Games', because it merges 'tactical immersion' (using motion tracked controllers), 'strategic immersion' (it is an escape-the-room puzzle game) and 'narrative immersion' (you are a secret agent with a mission to accomplish). 'IEYTD' is a very well-made experience and I'll pick it up later for a more detailed analysis.

5.0.3 'Presence' vs Storytelling

While Creating the first narrative experiences creators such as Unseld noticed that spectators act in a different way in comparison to the ones they have seen seated at the cinema.

Being catapulted into a 360° world, allowing the viewer to look wherever he wants, raised a dilemma: *"is it possible to tell a story to the spectator and, at the same time, to allow him to look where he wants?"*

In fact, it seems like these two things are in conflict with one another. Unseld says that during his first test of his first VR short, 'Lost', people, pardon the pun, lost the narration since the beginning because they were too distracted by the surrounding environment. The possibility to look around and feel the sense of 'presence', put the story on a lower level.

This interactivity, this capability by the viewer to look around raised a question: in VR, people tend to easily and quickly forget the story.

"Interactivity is a problem. I go to the cinema to see a film created by a good storyteller, I go there because he got an amazing skill in storytelling, I can't continue the painting of someone else."

(Saschka Unseld)²⁶

Thus 'Presence vs Storytelling' dilemma was born, dilemma I guess will be the main topic in the next years for the 'theorists of narrative in Virtual Reality'.

To analyze this problem, the 'Oculus Story Studio' creators decided to make a step back asking themselves: *"Can you tell stories in VR?"*.

Two different schools of thought were formed.

The first one thinks that our brain is able to elaborate only a limited number of stimuli and that in VR there is a competition by story and presence, viewer focus is divided into two parts and it is easy to lose the story first. For this reason, the first group thinks that it is not possible to tell a story in VR.

The second group, instead, thinks that to tell a story in VR, it is necessary to recreate what in movies is the 'fourth wall': the only way to pay attention to the story is being influential on the story itself, the characters don't have to recognize the viewer's presence, they have to ignore it.

Using the 'fourth wall', it is possible to recreate what at the 'Oculus Story Studio' they call 'Swayze Effect':

"[...]describes the sensation of having no tangible relationship with your surroundings despite feeling present in the world. Much like the experiences and struggles of Sam Wheat, the protagonist in 'Ghost', 1990 hit crime-romance film starring Patrick Swayze. Basically, it's the feeling of yelling "I'm here! I'm here!" when no one or nothing else around seems to acknowledge it."

(Matt Burdette, Lead Environment Artist of 'Henry' and 'Lost')²⁷

I personally think that it is possible to tell a story in Virtual Reality despite the fact that it may appear problematic and difficult.

The most important thing to do in order to approach VR storytelling, in my opinion, is to rethink the way we usually tell stories since we are not just interpreting the story through a medium, with VR we are living the story personally through the medium.

For this reason, we should ask ourselves: which stories can be told in VR? Not the same we told with other media (or at least, not in the same way) and that's why it appears so different and destabilizing for traditional storytellers.

VR storytelling is a completely unknown path which, nonetheless, allows us to tell stories never told before.

5.1 Vocabulary

"There are often misunderstandings among researchers regarding what is meant by a particular term."

(Sherman & Craig)¹

This section will be dedicated to the listing and explanation of all the 'words', 'terms' and 'techniques', adopting the methodology I have identified and explained in the previous pages, which I believe are the first steps to the codification of the VR language.

Every term has an analysis of different length depending on its importance and my analyzing capacity of that particular term. When possible, I will refer to VR experiences already created to better explain the meaning of that specific technique.

More than once, I will also provide my personal imagining short concepts ideated by myself to better explain the potential of a specific technique.

Often, in the next paragraphs, cinematic and audio-visual techniques will be analyzed to explain if these techniques are:

- replicable also in this new medium
- need to be adapted for VR
- unusable for the VR medium

"Storytelling in new tech usually starts by imitating old. Early movies started by imitating theatre."

(Joseph Gordon Levitt, actor)²⁸

5.1.1 Tracking

Rotational tracking ('3-DOF')

Rotational tracking is one of the main features of VR and it is a unique characteristic with great potential, proper of this medium.

Exploiting the gyroscopic technology both for VR mobile and for True VR, it is possible to rotate the neck and look all around the 360° image displayed on the HMD as all the rotations made in real life have an effect in the virtual world.

The centenary concept (painting, photography, cinema) of frame is gone, the frame is broken and it's no longer a limit. In VR, there is a 360° vision that changes depending on where the viewer is looking at. This is due to the communication between gyroscopic technology and software, capable of detecting different movements and giving back different images, different portions of the 360° space.

'Rotational tracking' is based on what Mechanics calls 'the three-degrees-of-freedom system'.

The software is also able to detect 'how long' the viewer is looking for something in particular and can react in a specific way.

When I was writing the GDD (*Game Design Document*) of a horror VR experience of mine named 'The Bridge' and made in Unity, I thought to exploit the tracking technology and improving the A.I. making it react when the viewer is acting in a certain way.

If the player is not looking where he should, for instance, if he's looking down at the ground more than a few seconds, the A.I. would react and would start talking, saying something like this:

"Stop looking down, your nightmare is not on the ground"

(The Bridge - GDD)

Tracking all the head movements would also make the software react depending on a sort of 'sequence' of movements. Right, left, right, left could be a sequence to trigger a certain event:

"Why are you looking on your left and on your right? This is not the place you can find something bright."

(The Bridge - GDD)

This false 'AI-consciousness' would improve the sense of presence a lot because the viewer would realize that his actions in real life have an effect in the virtual world and even the story would be influenced by him or her.

Another extremely creative and functional way to use the rotational tracking is shown in the experience for Oculus Rift 'Sight Line: The Chair' which, in addition, to amazing the player with what he sees, has a purpose - to solve one of the biggest questions in VR: editing.

This experience will be analyzed better in the paragraph 'Transitions'.

Head tracking & other tracking systems ('6-DOF')

Head tracking is that technology that allows for the software to detect head position and rotation, it is a mix of rotational tracking and positional tracking based on what Mechanics calls 'a six-degrees-of-freedom system'.

Being able to use the head tracking allows a higher interaction and improves the sense of presence in a VR experience.

Once again, a 'case study' is the game developed by 'Shell Games' named 'I Expect You To Die' which, at a certain point during the game, requires the player to

avoid a laser beam, slightly moving his or her head. The laser beam is a type of retinal scanner, but the player doesn't have the credentials needed and is forced to avoid it.

It is clear how 'Shell Games' game designers implemented the head tracking in the story in a wise and creative way.

Often times, we see increasingly sophisticated tracking systems on the market. From the hand-tracking offered by 'Leap Motion' to physical devices as the 'Vive Tracker', in the future we will probably be able to faithfully track the entire body. It will be the creators' duty to make experiences exploiting this advanced technology as has been done in 'I Expect You To Die'.

5.1.2 Field of view ('FOV')

Unlike a 2D TV or a PC monitor, an HMD ('head-mounted display'), covers a much wider field of view.

Visual range required to observe the whole scene with an HMD is more similar to the vision we have in reality, where many elements of the surrounding world are located at the edges, that portion of our FOV called 'peripheral view'.

This VR feature should be kept in mind when creating contents, attention the viewer pays at those elements in the centre, is different from that one he pays at the edges.

Brad Herman (Head of 'DreamLab' at 'Dreamworks') said that, when analyzing people's attitude while they were experiencing the VR game 'How to Train Your Dragon 2', the audience, at the time, tended to look more ahead than around themselves, and, for this reason, he suggested to place all the main events and actions in the front.²⁹

Personally, I also consider interesting and worth exploring the area behind the viewer, what Alger names "zone of curiosity".

In the VR experience 'Sisters', creators decided to play many times with the space behind the player to surprise and terrorize him, in fact, a monster/ghost appears behind him more than once.

They also decided to take advantage of the peripheral vision as storytelling tools. In fact, during the experience you sit on a sofa in a living room, in front of you there is a TV without signal, displaying the typical noise, but if you try to look around, when the TV is on your peripheral view, you have the impression that you see a face inside the TV screen, and then you try to focus back on the TV and the face is gone. I found this technique very creative to scare the viewer even more.

Also "6x9" uses peripheral vision for a similar effect, in fact, in the experience people are inside a solitary cell and creators decided to make them feel like they had hallucinations so the viewers would better empathize with people living in solitary confinement for a long time.

"There is a difference between Cinema, television and VR. In Cinema and television, I can look away from the screen, but I decide to look at it. It's a decision. Why books involve us so much? because we decide to focus on them, we are open to being involved emotionally. I need to actively read. VR is very invasive and I think we need to be aware of that. The most interesting thing about VR is that you want someone to get in, but not just to look around, lean forward and to be curious to look around, you want to get someone to explore and get that kind of feeling."

(Saschka Unseld)³⁰

'Drive the attention'

When a film director portrays something on a bidimensional screen, he or she knows exactly what the audience will see, and it is rare that they will miss a single action.

The space where the scene takes place is limited by the frame, the field of view used by the viewer to look at the screen is definitely less than his maximum FOV (the anatomical one).

Keeping this in mind, the director has total control of what the audience will see, thanks to this fact, he or she can build a narration where all the actions are related to the previous and following ones.

In VR, there is no total control of the viewer's attention, it is no more 'absolute' than the cinematic one. The creator/director still decides where to put the camera and the viewer's point of view, but a new level of freedom is allowed to the viewer: he can decide where to look in the 360° space.

It might seem a simple action, but it changes deeply the way a story is told with an audiovisual medium.

As I've explained in the paragraph 'Presence vs Storytelling' many creators are asking if it is possible to tell a story in VR even without the absolute control of the viewer's attention. On the other hand, other creators started to wonder which tools in VR contents should be used to 'drive' the viewer's attention, both from the old techniques already used in movies and new tools, proper of the VR medium.

Old tools

- **Colour:** use colours to distinguish and underline a particular object from the others.
- **Dimensions:** as colour, different dimensions help to differentiate an object from the others.
- **Lighting:** lighting a certain part of the space or a specific object to emphasize it, was likewise used during the cinema 'golden-age' in Hollywood with 'spotlights' to put in evidence the actors in the shot and, of course, this technique is still used in today's movies. The most emblematic VR experience using lighting to drive user attention is given by Google Spotlight's 'Buggy Night' that uses a flashlight beam not only to light specific portions of the scene, but also as a storytelling tool.

- **Human presence:** each image that has the presence of a person, but also more generally, of a living being, makes this person a 'point of interest' the viewer will be attracted by. 'POI' as the VR Filmmaker Jessica Brillhart defined.³¹

VR tools

- **Audio:** if the viewer hears the sound of glass falling down and breaking, instinctively, he tends to turn in the direction of the sound source. In VR, the sense of space granted is not just visual, but also auditive and, for this reason, the direction of a particular sound can easily drive a viewer's attention.
- **HUD (heads-up display):** informative elements of various kinds are already used in traditional media to focus attention on a particular part of the picture, but in VR these elements are even more important to inform the viewer and to direct his or her gaze to a particular area of space. Also, to not break the immersion, in my opinion, the best thing to do is to put these pieces of information in a manner within the diegetic space. In the VR video game, 'I Expect You To Die', there is no HUD whatsoever, all the information the player needs to know is reported on pieces of diegetic postcards. In this way, a high level of immersion is maintained.
- **Dividing space:** at the L.A. based company 'Mindshow', they think that a solution to this problem could be to implement dashed boundary lines in the 360° space, dividing the space into different areas (primary, secondary, tertiary...) indicating where the main actions are taking place ("*control but not constrain*" is their motto).³²
- **Character gaze:** when a virtual character looks at something in particular, we tend to look in the same direction and we also tend to react as he did shortly before, character's expression is preparatory to our emotions, this is due to the empathy created with him or her. This technique could be translated as the 'eyeline match cut' in cinema. When a character is looking at something, in the next shot it is shown what he was looking at, it's a sort of first person point of

view. Hitchcock's 'Rear Window'-uses this technique many times for the whole duration of the movie.

But now let's take two examples of VR experiences.

In 'Colosse', at some point the main character discovers a cave and looks up like he's observing something. After seeing the character looking up, the viewer tends to look up too: on the cave's walls, there are some paintings.

Also in 'Asteroids!', produced by Baobab Studios, the characters' gaze helps us to look in the 'right' direction, where events and actions happen. We are inside a spaceship with a big glass wall, a sort of cockpit with monitors, controls and a docking port.

Depending on where the characters are looking at, the viewer tends to look at the same portion of the space without missing important actions.

- **Movement:** human eye is attracted to moving elements, in particular, if there is just one of them inside the field of view, the viewer tends to focus his or her attention on it:

"Visual selection is given based on the importance of the objects in the visual field. Some objects are innately more important. For example, moving objects are essential for survival; therefore, they naturally have a higher priority than stationary objects."

(K. Chen & H.J. Choi)³³

Also in a traditional video, our eyes are attracted by an object moving within the frame, but in VR it acquires even more importance because they lead the viewer to look all around and to move his neck. If with the cinematic medium camera operators were used to follow the movement of a character panning or tilting the camera, now we replicate that movement with our neck.

In the experience, 'Invasion!', also produced by 'Baobab Studios', creators decided to use both lighting and objects' movements to drive the viewer's attention. In fact, at the start of the experience, the viewer is floating in the space with the planet.

The Earth is in front of him. It is the only POI in the scene and for this reason should attract the viewer's attention.

At some point, on the far left of the viewer's FOV (peripheral vision), a flashing light appears and draws his attention: it is an extra-terrestrial spaceship that comes towards him and moves all around his head, attracting his attention.

Also in the experience 'Dear Angelica', produced by 'Oculus Story Studio', the viewer's attention is attracted and fascinated by the dance of sinuous lines that create words and figures (Jessica is writing a letter to her mother Angelica, an actress who played astronauts and superheroes). At some point in the narration, when Angelica is fighting a dragon, the experience becomes full of vivid colours and the drawings are vigorously animated: the viewer is no longer able to follow the movement of a specific line but is now immersed in a 'whirl of graphic events'. Even if he's not focused on a particular portion of the space, this chaotic moment works well for conveying a 'crescendo', a 'climax'.

Since May 2016, Facebook introduced two new tools for publishers to better control and understand the audience's behaviour when watching 360° videos.³⁴

Thanks to the 'Guide' function, publishers can select those points of interest they want people to see. In this way, those viewing the 360° video will be redirected automatically to these POI as the video plays.

The second tool is a 'Heatmap', a visual insights tool that shows which portions of a 360° video's field of view the audience is spending the most time watching.

If the first tool is forcing viewers to look where the creators want him to look at, the second one is just an analysis tool in order to let creators understand what is in their

360° video experience, it is considered interesting by the viewers, and it is a tool to better understand their tendencies.

The 'Heatmap' is not something new, in fact, it has been used for years for web analytics and for the advertising campaign, showing how powerful it is for designing and arranging contents inside the frame.

Another company that is working on people's behaviour when they are experiencing VR, is the studio Aldin Dynamics. In May 2016 they released the game "Waltz of the Wizard" giving people the feeling of having magic powers and incredible things.

The game was released on Steam and the audience response was very positive: more than 100,000 played the game and it is currently the highest-rated VR app on Steam.

To ensure that game mechanics were functioning as intended, Aldin developed also a large-scale analytics and visualization tool named 'Ghostline'.

This software can show data on player's physical locomotion, buttons presses, head movement and many others; "Ghostline" had a vital role in prototyping "Waltz of the Wizard's" level design and gameplay.

"The smallest of details can make or break an experience. For this reason, it is absolutely vital to pay careful attention to the user experience and ensure that your content is having the exact impact that you envision."

(Aldin Dynamics)³⁵

Also notable is the effort of 'ZeroLight', a VR company operating in the automotive industry. 'ZeroLight' had developed a specific software named 'Wisdom VR', a real-time Virtual Reality analytics platform capable to record the movements and interactions people do when they are in the experience: which part of the car they pay more attention to, which car's door they open more often, how they are moving around the car, what kind of customization they do.³⁶

However, after explaining some tools and techniques on how to drive a viewer's attention, an obvious question arises: if I am creating a 360° experience for the VR medium, that has among its fundamental features the one of letting the viewer to look all around in a 360° space, why am I trying to control and drive his attention? This question may seem like a paradox and therefore it is difficult to give it an answer, especially today, as VR is both technically and semantically in its infancy.

Certainly, creators have to take care and design not just a portion, but the whole 360° space and make it interesting and functional to their story.

5.1.3 Composition

Chris Milk also believes that if in the rectangular frame we have always thought of a two-dimensional composition, to organize the frame in Virtual Reality we must think spatially, "it is not a composition of the frame, it is a composition of presence"³⁹.

A good result in this regard, also obtained by Milk and Gabo Arora (co-director), with the VR documentary 'Clouds Over Sidra', a story about the life of a little Syrian girl in Zaatari refugee camp in Jordan.

In the final scene, directors decided to position the 360° camera and, therefore, the viewer, where the children are gradually accumulated until they form a circle all around him or her: wherever he or she looks, the viewer is surrounded by these smiles of joy that only children can make, even during the most dramatic situations.

This 'all around composition' is something new for an audio-visual medium, but it is not for a medium as theatre. In fact, in theatre the position ('composition') of actors on the stage has always been a key element when designing a play. Theatre directors have always thought in a '360°' way and probably also VR directors should become used to this way of thinking.

Once again, a new medium always rests on previous media's bases.

Robyn Miller, co-creator of the videogame 'Myst' (released in 1993 was one of the first games aiming to realistically immerse the player into another world), underlines how, while experiencing VR, he is intrigued by how creators have built the scene on the opposite side of the POI or where the creator is trying to direct the viewer's attention, the 'curiosity zone'. Doing so, Miller notices how few creators design something for that area and most of the time it is not exploited in any way.

In order to make the composition in a 360° space more interesting, Jessica Brillhart, in her project 'Resonance', decided to place a young girl playing the violin in her room, defining her as the main 'point of interest', she's in the front of the viewer. On the opposite side, behind the viewer, the parents are observing the young girl practicing.

The structure of this spatial composition enriches the scene from a storytelling point of view, it underlines the relationship among the characters. When the viewer turns back and observes the reaction of the child's parents, he or she can feel their emotions depending on how they react: Are they happy seeing their daughter playing the violin? Do they support her? Or do they disapprove of her choice?

The semantic function of parents within this composition might be compared to the one of a cinematic 'reaction shot' when, for instance, two characters are talking to each other and the director edits the shot of the actor who's listening to the other actor in order to let the viewer see the reaction.

5.1.4 Editing

It might seem obvious but a premise is needed. The way we cut a video, a movie, a commercial or a music video can't be done in VR, or, to be precise, all the editing techniques must be adjusted for this new medium.

Adaptation time

One of the reasons why it is not recommended to cut in the 'traditional way', is due to the fact that in a VR world the quick change of the environment is perceived as invasive and disturbing by the viewer. Also, every time the space changes we

should give the user enough time to look around to realize where he is, avoiding incessant cuts. I call it 'adaptation time'.

During the development of the VR experience 'Lost,' 'Oculus Story Studio' decided to favour long takes, giving to the viewer all the time he or she needs to explore the environment. Once he will be ready, he can listen to the story. That said, this seems like fast and quick editing, like the one adopted in any action movie, it is not that good in VR, but as with the cinematic language, many rules can be broken and, for this reason, I do not rule out that something like that could be done in the future. Anyways, today I don't think that continuously teleporting the viewer from one place to another is a comfortable and effective way to tell the story.

Localization of key events/ Points of interests

Another concern when editing a VR experience is to maintain the position of key events and points of interest unchanged, preventing the viewer to continuously look around and confusing him or her with where to look: the next scene should always have the main action positioned at the same point of the previous one, moreover, if cuts are numerous and quick. After I have already formulated my hypothesis I discovered that another filmmaker, Georgy Molodtsov, had devised this editing technique for his project 'VRability':

*"The cut is — the protagonist in the wider shot ends up in the same location in the shot, allowing the viewer to retain story continuity"*³⁷.

Also, Jessica Brillhart found out that an efficient way to edit in VR is to cut in order to match the user's attention and to make the experience more comfortable and less disorienting. In other words, she tried to explain her 'extending to engagement' ('like opening a portal that she can fall through naturally.') and 'responding to engagement' ('like grabbing the visitor by the hand and pulling her into the next world.') technique.³⁸

Linearity

Once filmmaker Alfred Hitchcock said *"cinema is life with the boring parts cut"*³⁹ to describe the function of editing: help the story progression by eliminating the boring parts not useful to the narration.

Nowadays, audiovisual contents, movies, and narrative videos have numerous ellipses, flashbacks, jump cuts, flash-forwards and many other cuts which we no longer notice even though they have come to be part of the audiovisual language we know and are accustomed to. But, with the VR medium, things are a little bit different.

VR gives back to its audience a sense of presence of being in a specific place, perceived as real. But, the 'physical dimension' is just one aspect of reality. In fact, if VR wants to emulate reality entirely, I think that it must also have a 'temporal dimension' equal to the one experienced in real life: a linear time.

"In our lives as human beings, time is linear. In most storytelling, medium time is non-linear, we jump ahead, even in a book."

(Kim Libreri, CTO at Epic Games)⁴⁰

Many VR experiences I have tested, have long takes to reduce cuts and breaking the temporal linearity as much as possible. The 'film time' duration is the same for the 'story time'.

However, I am aware of what Hitchcock said and I believe that creators should find a way to cut out the boring parts of the narration without, apparently, breaking the time linearity. Having time shifts, is allowed if done in a creative and smart way. I will go deeper into this topic in the section named 'Transition'.

Split screen and cross cutting

The affirmation of 'cross-cutting' began with D.W. Griffith that already used this technique in 1909 to tell the events that occurred at the same time but in different places. The technique of cross-cutting became the most common in the era of contemporary cinema.

But, there are also examples of films where the frame is divided into two or more sections ('split screen'), which can be used to represent two simultaneous actions but at different places as well. For instance, one of the first scenes of 'Kill Bill'

(2003) is a portrait with a split screen where one of the antagonists played by Daryl Hannah is preparing to make a lethal injection to Uma Thurman, at that time, in a coma on a hospital bed. The viewer has full knowledge of what is happening in that moment and he knows that the two scenes are destined to converge. The fact that time is ticking in the same way for both scenes, conveys even more tension and stress to the viewer.

Thinking about the 'split screen' in Virtual Reality seems like the viewer might have the gift of ubiquity, he could be in two different contexts at the same time.

The doubts that may arise concern the audio aspect. Having two different worlds, for example, one in front and one behind, which soundscape should the viewer perceive? Would he hear an overlapping of the two audio tracks?

Once again, the 'Within' team in their project 'New Wave' devised a particularly effective trick. 'New Wave' shows two young lovers speaking through a voice-over, a kind of interior monologue that tells their stream of consciousness. But these are just thoughts, thoughts that only the viewer is able to listen to, in fact, depending on where he is focusing his gaze, he is able to perceive the different thoughts of one or the other character.

It is a sort of 'dynamic' and 'interactive' track, once again granted by the rotational tracking technology. The experience detects where the viewer is looking at and reacts accordingly. This might be a good solution to solve the audio problem in a VR split screen experience.

Always, keeping the cinematic language in mind, maybe we could say that the cinematic 'cross-cutting' technique might have a translation in VR with a sort of 'split screen'. As all the hypothesis I'm doing, it would be interesting to experiment it in practice and to see how the viewer would react.

Transitions

This sub-chapter on transitions analyzes and suggests creative ideas to flawlessly move from one scene to another in Virtual Reality.

- **'Cloud cut':** always in Molodtsov's project, 'VRability' uses what he calls 'cloud cut', a directional cross transition as if there were clouds gradually covering the space above the viewer. Despite being a transition imported directly from the film world, the result is fluid and acceptable by the viewer (because he or she knows this language well). Even more than during the editing of classic audiovisual contents, Molodtsov is keen to stress how: *"The editing is determined not only by how you combine the already filmed material, but largely on how you decide to combine it before you start shooting"*³⁶.

The same technique is also used in another 'Within' project, a music video for U2 called 'Song for Someone'. In this experience, the viewer moves among different places of the world in a very smooth way, thanks to this technique.

- **Diegetic transitions:** deriving from cinema, 'diegetic transitions' are those transitions that use visuals related to the story in a creative way. To clarify with an example, just think of this situation: the main character is in a completely dark tunnel, he sees a strong light in the distance, at the tunnel's end. He decides to proceed in that direction and as he approaches it, the light becomes more and more intense and it is at this time that it is possible to make a diegetic transition to white. It is possible to use the same technique fading to black, for example, after a blackout, or again, a character can throw a blanket over the viewer to obstruct his or her vision surrounding and then, pick it off and put the viewer in a new scene. The scene just described comes from the 360° music video 'Booty Man' by Redfoo.
- A character could also cast a smoke grenade towards the viewer blocking his view because of smoke formed around him or, as it is possible to experience in the 'Mr. Robot' 360° video, a character can blow the smoke from a joint at you. These diegetic transitions can also remember the technique of 'foreground wipe' but be aware that in VR, there is 360° to occlude, fist directed to the camera (like in action movies) is not enough, what's needed is a trick capable of obstructing a 360° space.
- **Blink cut:** Brad Herman (previously Head of 'Dreamworks Dreamlab') suggests replicating a blink to fade to black for a few frames, in this way it is possible to 'cut' the scene. Brad explains how a few black frames can trick a viewer's brain, it will seem an unconscious blink and would be possible to cut without breaking

the 'continuity' of what the viewer was watching.⁴¹ Nevertheless, Maxwell Planck (previously Technology Director at 'Oculus Story Studio') wants to underline how this technique works only in scenes with a lack of light and information, where black is predominant.⁴²

- **Interactive transition/Rotational tracking transition:** Testing the experience 'Sight Line: The Chair', I discovered an extremely smart and creative way to change the space around the viewer, to make him jump from scene to scene in a very fluid and surprising way. Thanks to the rotational tracking technology, the software knows where the viewer is looking at in a specific time and can change the environment that is not within his field of view. The motto of the creator of the experience, Tomáš 'Frooxius' Mariančík, is *"Seeing is believing. Not seeing is change"*.⁴³ During the experience, many environments are changed: if, at first, I'm in a flowery meadow, at some point, behind me, the environment has become a city I turn around and see that I am actually on the sidewalk now, I turn to the initial position and what I see is no longer the initial green lawn, but the continuation of the sidewalk in the opposite direction. This technique is interesting because it takes full advantage of one of the characteristics proper of the VR medium, the rotational tracking, and grants a fluid and surprising progression through the story.
- **Interactive transition/whip pan transition:** also derived film, 'whip pan transition' is often used by directors like Paul Thomas Anderson to make a cut but without breaking, apparently in the continuity of the scene, the viewer can be transported into a new setting or time. Similarly, in VR, it would be possible to use this technique, with some adjustments. One tip to keep in mind, to avoid the 'motion sickness', is that the transition should not be controlled by the software, but, instead, by the viewer himself. He's the one who decides when to change the scene by moving his head quickly and using the technology of rotational tracking. In movies, this technique works because a quick pan gives enough 'motion blur' to the image to make it unrecognizable and allowing to cut in this moment. In VR, the high frame rate could always make the image recognizable and if there is a 'cut', the viewer might find it distracting. It would be interesting to experiment.
- **Match cut:** Often in movies, it is also used to mount two different shots that have, however, on a visual level, a similarity, an analogy. The most famous,

perhaps, is the combination of shots made in Kubrick's film '2001: A Space Odyssey,' in which the director correlates a bone, used by the primate as a first tool of war, to a spaceship, symbol of a sophisticated technological achievement, performing temporal ellipsis of millions of years in an extremely smooth and effective way. Avoiding disturbing the viewer in a rude and drastic way, keeping a visual relationship when changing two scenes, might work. An application of this technique in a VR experience is found in 'Catatonic' directed by Guy Shelmerdine and produced by 'Within'. At the end of the experience, 'Catatonic' alternates two different scenes, but, which have the same environment and the same point of view in a room, with different characters. If in scene 'A', we are in an operating room and we have a doctor in front of us, in scene 'B' we are always in the operating room, but with other people around us. POV, lighting and everything else is equal to scene 'A'. The 'cut' between scene 'A' and scene 'B' is not too disturbing from a visual point of view.

In 'World Tour', Jessica Brillhart studied in detail how to edit this experience and more than once used a 'match cut' (she calls it 'engagement edit' or 'spatial engagement') to smoothly jump from one scene to another: if the viewer is looking outside the side window of an aerial lift, in the next scene he or she will see another object visually similar to the window's frame, in this case, a box stall.

5.1.5 Relationship with characters

Since the beginning of time, the stories have always told the deeds of characters to which the audience could empathize and identify with.

A major feature of VR is that the viewer is in a virtual world, in a different space than the one in which a narrative takes place in.

It is, therefore, clear how the relationship between the characters is different than that of those within a movie or a book. Also, as Noah Nelson says, perhaps the play is the one that comes closest to this type of situation, but the difference is that usually, a play takes place in front of the audience on a stage while VR surrounds the viewer with 360°.

"Let's stay with this idea about how far apart you can place the actors. Because the key thing about staging a theatrical piece — and let's be clear that VR cinema is a hell of a lot more like putting on a stage show than it is shooting a film — is creating dramatic tension in physical space between actors."

(Noah Nelson, reporter & producer)⁴⁴

Empathy

Most of the time the stories tell about a character, the protagonist, who is in charge of the values and themes of the story itself. The first one to codify this, analyzing, in particular, the tragedy and epic, was Aristotle with his 'Poetics'. The main character is the hero of the whole affair, who, is a character with whom the audience empathizes and creates a bond that grows stronger during the story progression.

From Aristotle to the present day, the skeleton of the story has not changed too much, literature and cinema retain this structure, and probably also VR. But with some variations.

"A book works through a monologue, you read what a character thinks, in a film you understand a character through his actions and in VR, I think you understand the story more through how you feel in the situation."

(Saschka Unseld)⁴⁵

"You can make a character much more compelling [...] In VR the character looks at you. I'm in the same room, I feel the empathy, Henry is right next to you, in the same space, it is not prerecorded, Henry performs like he's real, is he doing that because I'm here? I care for him."

(Palmer Luckey)⁴⁶

With a sense of 'presence' so strong, the characters in front of us seem to exist for real. The affect we feel for them becomes stronger because they are perceived as real. It almost seems like the characters are not actors, but as if they are in front of us

living their life, it seems like there is no acting and, for this reason, the relationship that the viewer has with them is much more intimate and natural.

Lajeunesse believes that to create a connection with the character in Virtual Reality, the use of stereoscopy is essential: *"(VR) creates a sense of intimacy between the viewer and the subject"* improving what he calls *"relational quality"*⁴⁷.

But to better understand how to create empathy between the viewer and the characters, what are the mechanics of this emotional process, it's necessary to analyze a characteristic of VR: the virtual space and how the characters are placed within it.

Proximity

In a three-dimensional world, like the one recreated by the VR, and with the characters inside of it, the distance between the viewer and these characters matters as in real life.

The anthropologist Edward T. Hall as a result of his study coined the term 'proxemics' to define the discipline studying the gestures and behaviour, the nonverbal communication, within space.

Hall has identified that people tend to position themselves at a certain distance one from the other, depending on the interpersonal relationship that they have. Here below, you can see Edward T. Hall's personal reaction bubbles:

- 0 - 18 inch → Intimate distance
- 1.5 - 4.5 feet → Personal distance
- 4 - 12 feet → Social distance
- 12 or more feet → Public distance

Keeping in mind what is theorized by Hall, in VR, we can distinguish "passive proxemics" from "active proxemics".

Passive proxemics

A clear example of "passive proxemics" is given by the VR experience "Henry - Trailer", let's analyze it.

The experience begins with Henry, a hedgehog, facing the viewer. When Henry realizes the stranger's presence, he steps forward to meet the viewer. The hedgehog is friendly and joyful, at this time it is easier for the viewer to empathize with him, the animal is his or her friend and this is also due to the close distance between the two.

Shortly, after the narrator of the story tells how, because of the sharp spines, Henry has no friends, and the hedgehog, remembering this fact, steps back and becomes sad, suddenly the viewer feels sorry for Henry, now far away from the initial position.

Another experience where the distance with the character is important to tell the story and convey certain emotions is 'Colosse'.

In 'Colosse' we are seeing a hunter who is trying to pierce a crab with his spear, when, suddenly, we hear a thud coming towards us (these are the steps of a rock giant, of a 'Colosse' exactly).

The hunter is scared and comes towards us, as if he is seeking shelter, now we get a feeling of fear, the same way the hunter is feeling. This action reminds me of a frightened child running towards a parent, looking for safety.

Passive proxemics also improve the sense of presence of the viewer in the virtual world, in particular if he is recognized by the virtual characters as part of their world and interacts with him as in 'Henry'.

Another application of 'proximity' that I would propose is the following. I am tied to a chair and I cannot move, I see that a figure comes out of the shadows. He is holding a knife with a sharp blade in his right hand. He is my executioner. Each step he takes toward me terrifies me more and more, I feel helpless, my fate is sealed.

This is a good example for the reader to better understand how one should exploit the space in VR to value the story.

Cinema and photography, in their first decades, coded different types of shots to organize the frame in relation to the human body.

Different shots convey different meanings and emotions to the viewer: a close up is very different from a long shot that is different from a full shot. Organizing the shot is one of the basics of the cinematic language, but, as I've already explained, in VR, instead of the 'frame' there is a 360° space.

Therefore, one wonders whether it is possible to organize shots in VR and if it would be possible to have something like, for example, a 'close-up'?

With a video camera, it is possible to recreate a close-up through the combination of distance to the subject and lenses used, you can stay a few meters from the subject but use a telephoto lens to get the shot just of the actor's face.

In VR, not being able to exploit various types of lenses and focal length, you can only change the position of the point of view.

To translate a cinematic close-up to a VR close-up, then, I suggest to pay particular attention to the distance between the viewer and the characters, always remembering what is written above from Hall about interpersonal areas: a short distance from the character could have the same meaning as a close-up in the film, it would create greater intimacy with it and a consequent sense of empathy; a distance instead would get the opposite effect and you might observe the character in the distance, immersed in the environment, just as if it was a long shot.

'Waves of Grace', produced by Within and directed by Chris Milk and Gabo Arora, tells the story of Deontee Davis an Ebola survivor who uses her immunity to care for orphaned children in her village. Most of the time, the characters are positioned very close to the viewer and, in this way, he or she can clearly see their facial expressions and understand their feelings.

Passive proxemics works in the opposite way if the nature of the virtual characters is different. If they are perceived as 'bad characters' (as enemies or antagonists), the further they are positioned – the safer we would be. On the other hand, if they get too close, we would feel in danger, uncomfortable, afraid.

So, to convey the right feelings, when using passive proxemics, it is important to consider the position/distance of the characters within the space and their nature.

Active proxemics

'Active proxemics' are different, as this time, it is the user who decides to relate with the virtual character, moving away or getting closer to him or her.

However, this movement, this interaction decided by the viewer, is possible only in those 6DOF experiences created with graphic engines as 'Unity' or 'Unreal Engine' that can react to the viewer's position change, triggering and activating different reactions of the virtual characters.

A clear example is given by the game 'Lucky's Tale', developed by 'Playful', where, thanks to a gamepad, the player controls a virtual character, a little fox named Lucky. 'Lucky's Tale' has been designed exclusively for the 'Oculus Rift' and creators decided to exploit this specific headset feature, provided with head-tracking, in an innovative and engaging way.

In fact, every time the player gets closer to Lucky to observe him better, the little fox reacts to the player's movements and greets him or her by waving his hand.

So, this time, contrary to what happens with 'active proxemics', it is the user that triggers a reaction of the virtual character, depending on the distance he is keeping from him. In this case, it is up to the user to decide what kind of spatial relationship he or she would like to have with the character.

Communication with characters

Assuming that the author's experience of VR grants me the sense of 'presence' lets me have a role within a story and to be recognized by the other characters, it is only natural to wonder how we can interact with them.

Even before the speech part, the first interaction we have with another person / living being is the visual contact. The moment we cross our eyes with someone else, we are already communicating. Our expression, our posture, the direction of our gaze has a meaning, expresses something. Once again, we must keep in mind that during the VR experience we are always monitored by the software and that it can react in various ways to our behaviour.

Imagine being at a banquet in Ancient Greece and having a storyteller, a 'rhapsode' (etymologically 'sewer of songs'), in front of us narrating the 'Iliad' or the 'Odyssey', in fact, the Homeric poems, before being transcribed, had been handed down orally for centuries.

If we consider certain parts of the story boring, we could have disinterested attitudes: we continually look around, we are attracted by an apple on the table, we look everywhere but not in the eye of the storyteller... And so, the story can react. The storyteller can change the density of the story trying to attract our attention again with a quicker narrative, omitting the unimportant parts and encouraging the most crucial ones.

Eye contact

Thanks to the head-tracking technology (6DOF), virtual characters can make an eye contact, looking at the viewer's eyes and following any of its movements in space. This visual connection between the viewer and the character creates a very strong relationship and serves as a privileged communication tool to convey emotions: "Eyes are windows to the soul" says an old proverb. 'Henry' is probably the most emblematic example to prove the effectiveness of 'eye contact'.

But 'eye contact' is not a privilege of only those experiences created with graphic engines and capable to track head movement. Of course, head-tracking allows a more engaging eye contact, but there are also many 360° videos where characters notice the viewer and look at him. In VR, 'eye contact' with other characters helps a lot to validate the visitor's existence inside the experience and doing so, engages him even more.

5.1.6 Point of view ('POV')

The first movies by Lumière brothers were outstanding for the time because they showed exotic places like Egypt to the European people. With their film 'The Pyramids' (1897), they showed people a far-away place that most people have never visited.

Any VR experience, because of its very nature, can teleport the viewer into a different place giving him a specific point of view that may be different depending on the goal and creativity of creators. Similarly, to what Lumière brothers did, VR can let people see and visit areas and lands in a more immersive way, that otherwise would not be possible to experience. But, as it will be explained in the next lines, VR is not just about teleporting people to other places, in fact VR goes even further and lets you experience the world with different 'eyes.'

Physical Point of View to achieve presence

Until this moment, this book, has always emphasized one of the main features of VR, which gives full freedom to the viewer, allowing him to decide 'where to look', but now I want to remind you that the 'place where' the point of view is positioned is still decided by the director and creators of a VR story.

Felix Lajeunesse (Co - Founder of 'Felix & Paul Studios') believes that when you place the point of view, it is fundamental to think like it's not the camera that is being placed, but a person, a living subject. This attitude, according to Lajeunesse, is the correct one and gives the viewer a sense of realism "[...] *it feels right*"⁴⁸.

Of equal importance to the spatial positioning (axis 'X' and 'Y'), is also to always keep in mind the camera height ('Z' axis), the POV's height.

Most of the time VR filmmakers, when shooting a 360° video, position the camera at the same height of a person's head in order to give a better sense of presence and realness, but other creators purposely altered the height to better fit the story.

In "Miyubi" (produced by 'Félix & Paul Studios' and selected at "Sundance Film Festival 2017"), people experience the story from the point of view of a tiny Japanese

toy robot and for this reason the camera is positioned in a way that its height is lower than the one of a human.

Also, note that most of the time VR is experienced while standing or sitting.

'Catatonic' is a VR experience, produced by 'Within', where the viewer is a patient admitted to a mental hospital. Director Guy Shelmerdine decided to put the patient on a virtual wheelchair and, if you are to sit on a normal chair, the sense of 'presence' will be greatly increased as the position of the viewer in reality corresponded with that one in VR.

Director Randal Kleiser decided to go even further. In fact, when I've attended 'World VR Forum 2016', I've tried his 360° short-film "Defrost" on a real wheelchair because the story was about a person that just woke up from her frozen state after thirty years. Thanks also to that physical immersion with that point of view, my connection with the story was great.

And again, the height of the point of view is essential not to break the sense of 'presence', it must be adapted to the viewer's height.

If it is a VR experience for children, I think it would be better to encourage this point of view, on the contrary if it is, mainly, an adult experience, it should take an adult height. But, as I'll explain better in the next chapter 'Scale & Proportions', it is also possible to alter the perception of our height (without breaking the sense of 'presence') modifying the scale of the virtual environment.

As previously introduced, among the VR experiences produced today, there are also some that allow the viewer to have a 'virtual body', just to give a greater sense of realism and 'presence'. Experiences such as 'Apollo 11' realizes the dream of many 'wannabe' astronauts and allow the viewer to wear a spacesuit, others such as the aforementioned experience 'Battle for the Avengers Tower' adorn the audience in an armour of the superhero Iron Man.

While there is no true interaction with your virtual body, this ploy contributes largely to enhance the sense of 'presence' during a virtual experience.

One thing to consider though, is that when giving the viewer a virtual body, you decide to make it real within the narrative, achieving the opposite of the 'Swayze Effect' (see 'Storytelling vs. Presence').

Physical Point of View to achieve empathy

Another specific feature of VR is that of letting people play the part of someone else, being teleported into his or her world, into his or her everyday life and, and in doing so, building empathy with him or her. One of the most emblematic examples is due to the already mentioned 'Clouds Over Sidra', directed by Chris Milk and Gabo Arora and produced by Within. The main goal of this experience was to raise awareness among influential politicians attending the World Economic Forum in Davos, in 2015, letting them experience and get in touch with a daily life perceived as far, far away, but that actually affects the lives of millions of people. Thanks to the sense of presence granted by VR, people are catapulted into the Zaatari refugee camp in Jordan, living for about ten minutes, the daily life that a 12-year-old girl has to face.

As the story continues, narrated by the word of the little girl named Sidra, the viewer tends to create a relationship, a bond, with her and with the people living in the same situation. The viewer is led to take action to contrast this emergency.

In order to prove the power of this experience, it has been distributed, to the first seven thousand people who saw 'Clouds Over Sidra' in Canada, a handbook (or 'vademeccum') of 5 points on 'what do to' concretely to help Syrian refugees. The 95% expressed how they now feel more empathy for Syrian refugees, the 87% said that they are now motivated into taking actions, but the most stunning fact is that the 73% of people actually took action on at least one of the five points listed in the handbook.⁴⁹

"By leveraging breakthrough technologies, such as virtual reality, we can create solidarity with those who are normally excluded and overlooked, amplifying their voices and explaining their situations."

(Gabo Arora, Creative Director & Senior Advisor at the UN)

Visual Point of View to achieve empathy

Another very beautiful idea is to let the viewer experience the life of someone else in the same way this person sees (or 'hears') the world; VR is able to show us that there are many possible states of being in our world and different ways to perceive it.

'Notes on Blindness' wants you to empathize with a blind person in a way that wouldn't be possible without using the VR medium. The concept behind this experience is to let you 'see' the world as a blind person does. Creators decided to design the environment adopting the 'point cloud' technique that proves to be effective in giving the idea to the viewer of how a blind person perceives the world around him. Even more importance is given to the audio part of the experience because when a sense as sight is lost, other senses become more and more sensitive. The main goal was to make people empathize through an alteration of senses such as sight and hearing, creating a sort of synesthesia in order to represent visually what one hears.

Another experience that uses visuals in a creative way to describe a different perception of the world by a person is '6x9', a VR experience created by 'The Guardian' that this time aims to use visuals not to describe a physical difficulty but a mental difficulty. In fact, the experience teleports the viewer into a 6x9 feet solitary confinement cell where people often develop a mental illness and psychic alteration.

For this reason, the viewer starts to hear voices, to see writings and crack on the walls, to have a distorted vision of the world around him. Without experiencing this physical and, especially, this visual point of view, normal people wouldn't be able to get a little taste of what solitary confinement is.

Dynamic Point of View

However, the point of view does not mean that it should remain fixed, it can change at the behest of the creators or the same viewer. An example is 'Super Turbo Atomic Ninja Rabbit' in which the viewer, through a 'based gaze' system, can select and identify with a different character than the current one.

POV changing is definitely a path to explore, but, personally, I have doubts about it because, as well as a reader of novels, the viewer usually identifies with one character, with which he builds a relationship of empathy and attachment for the duration of the whole story.

But again, I'll try to give an example where the changing POV can be smart and useful for a narrative purpose. Imagine a VR experience or a VR video-game in which the viewer is an alien being, a parasite that needs a host organism to reach its goal. To progress through the story, this alien needs to transform into a person because to achieve certain objectives, he needs to have possession of a body with other abilities or powers. In this case, changing the POV, would enhance the story and would be a proper use of the VR medium.

God's Point of view

I have always talked about the first-person point of view, but one should also keep in mind that it is possible to place the viewer in third person, as in the experiences 'Mythos of World Axis', 'Lucky's Tale' or 'Herobound Gladiators' where the player is a kind of puppeteer, or 'god', who observes and controls the scene from above. What I've mentioned above are VR games, but I think that it would be also very interesting to experience a story (an episode of 'The Smurfs' for instance) from this point of view.

5.1.7 Scale & Proportions

In Virtual Reality, it is easy to alter a viewer's perception of scale and proportions. A remarkable example is 'Titans of Space', an experience that allows people to live a journey through the universe, playing with the scale, comparing planets and stars of different sizes.

From a more narrative standpoint, 'Colosse' is notable because it uses the scale with great awareness.

During the experience, we are immersed in a 'low poly' style arctic scenario and we see the main character hunting a little crab. In this moment, all our attention is on the small animal: it is a helpless being in front of the skilled hunter.

But at some point, a loud thud behind us scares away the crab and stops the hunting: if until now we looked down, now we have to raise our head and look up because there is a rock giant above us, a 'colossus' who frightens the hunter.

The great creator's mastery is to have been able to play with the scale and moreover to have introduced the crab and the colossus one after the other creating a contrast during the story.

If the creator's goal is to make VR experiences more and more realistic, Unreal crew states:

"The best thing to do about the scale of the objects in your VR world is to mimic reality as closely as you can. Making objects bigger or smaller than their real-world counterparts could lead to confusion or Simulation Sickness."

(Unreal Engine)⁵⁰

For this reason, even for 'The Bridge' development, I thought fundamental to emphasize about the proportion and scale of the objects in the experience, I needed to choose their sizes and measurements based on real measurements.

But, at the same time, it is also true that, being able to alter scale and dimensions in VR, it would be possible to catapult the viewer into microscopic worlds, which, on the contrary, make him feel like a giant. This is a unique potential granted by VR that might be used and exploited.

'The Body VR' is a series of experiences that allow people to visit and see, from the inside of the human body, some physiological processes: from the red blood cells in the blood vessels to the amazing path of the kinesin protein on the microtubules inside the cytoplasm. This experience is great because, besides the high-end technical realization and the entertainment offered, it allows people to see and experience a world that was only imaginable. On a conceptual level, 'The Body VR' may be considered a VR adaptation of the famous Asimov's novel 'Fantastic Voyage' and for this reason, it is worth to try.

Certainly, it is entertaining, but it also proves how VR can be game-changing in the education field.

5.1.8 Sense of depth

Thanks to stereoscopy, VR grants to exploit the sense of depth in the virtual environment and, accordingly, also the sense of 'presence'.

In addition to stereoscopy, it is possible to look at the past and to identify which are those techniques and tools that could help in recreating a sense of depth in a bidimensional space.

The most trivial are the ones which portrait the elements with different sizes: the smaller the element represented, the more it gives the impression of being away; likewise, the greater it is in size – the closer it looks.

Another trick, is to create, when possible, an 'aerial perspective'.

In the real world, the atmospheric dust (fog, smog, dust...) decrease the visibility of background elements, obfuscate them, decrease their contrast and make their colours greyer like. A remarkable VR game that uses the 'aerial perspective' is 'Windland' which, catapulting us into a low-poly world, conveys to us - a great sense of depth, also thanks to this technique.

Overlapping one element over another defines a hierarchy of the distance between the viewer and these elements; it's a technique used widely, but in VR it is even more powerful. The VR experience 'Neuro', conveys to the viewer a great sense of depth thanks to this overlapping technique, overlapping multiple levels. During this experience, we are inside the brain of a person and we can see many neurons, positioned at different distances and heights all around us. When one of them occludes, we can perceive a sense of depth with the other, improved also by a slow and linear camera movement (a sort of dolly) that creates a 'parallax effect' when we look at the neurons.

5.1.9 Audio

VR, being an 'audio-visual' medium is made also by sound elements not negligible as well as fundamental to communicate something. If the image from 2D became three dimensional, even the audio acquires a spatiality within the virtual environment.

Actually, this '3D audio', is already used at the cinemas to 'surround' audience from an acoustic standpoint. The most famous technology is the 'Dolby Digital Surround' which is designed to give an acoustic spatiality to the screened image.

In VR, the concept is the same: give a precise location to the audio sources.

To create the sense of 'presence' it is also necessary to use tracking, giving the impression to the viewer, even turning his or her head, so he or she would always hear sounds in the same location, like in the real world.

The study of sound perception in real life is the topic of research for Brian Hook (Audio Engineer at Oculus VR). Hook underlines how sound can improve the perception of distance, dimension and movement of an object.⁵¹

As analyzed during the paragraph 'Drive the attention', sound can have a decisive role in locating the key events of the scene and can considerably affect the viewer's attention: if he perceives a sound behind himself, he tends to turn his head and to look behind.

This would be different in the case where creators insert a soundtrack inside the experience. Hook says that it would be better to not locate the soundtrack in a particular part of the space in order to keep it extra-diegetic.

5.1.10 To explore

In this paragraph, I decided to write some thoughts of various kinds that would be analyzed better, but I think that could be an interesting 'start point', an inspiration, for the next books/papers/research about the VR language.

Composition

Although I've tried to briefly analyze how to create a 'frame composition' in a two-dimensional space and tried to translate it into a 360° space, I think there is still a lot to explore.

Maybe, both the role of a director/ cinematographer in a 360° video, and the one of a 3D artist is not enough anymore, he or she should be helped by scenographers, architects and interior designers to manage the three-dimensional space, a combined effort is required.

On screen – Off screen

How is it possible to play with what's on screen and what's off screen? But, more important, to still exist 'off-screen'? Personally, I think that in VR we got what I call a 'temporary off-screen', because human' FOV is less than 360° and, somehow, we still have a 'frame', but this is a 'frame' we break every time we turn our head, allowing to see all the space surroundings.

Text

Even the implementation of text is worth to study, because in VR, reading, seems at the moment very difficult and tiring both from a technical perspective (HMD and smartphones' display resolution and density is not high enough) and for the enjoyment of the experience.

Chris Pruett tried to go deep into it and, creating his VR game 'Dead Secret', he concluded that, at the moment, the best thing to do is to reduce the text as much as possible, to use a bigger font dimension than usual and to insert it into the game in a diegetic way.

Things are different when the experience is not a game but a storytelling experience: should we keep using subtitles? I believe that subtitles are very distracting and break the immersion: in real life, we don't see letters floating in the air when someone is talking.

Camera movements

In VR, moving the viewer's POV creates what is called 'motion sickness' causing nausea and vomiting. Why?

"The answer is known as the "toxicology hypothesis". Certain poisons (from some mushrooms, for example) can disrupt the neurology of the brain such that the input from the little hairs in our inner ear (which detect acceleration and rotation) do not align with the input from our visual system. These poisons must have been a significant problem sometime in our evolutionary past, because wise old nature has programmed our brains to vomit when this happens, thus saving our lives. The problem is that poisons are not the only way to cause this disconnect -- reading in the car, riding the Tilt-a-Whirl, and engaging in certain VR experiences can do the same thing."

(Jesse Schell, CEO of Schell Games)⁵²

So, all those virtuosity camera movements we are used to seeing in movies seem like they are not replicable in a VR experience. For this reason, is it necessary to think if it is even possible to move the camera, and, if so, how to do it? Maybe, in VR, is the viewer the 'maker' of these camera movements? Is it necessary to adopt omnidirectional treadmill like the 'Virtuix's Omni' system? But omnidirectional treadmill can work only with CGI experiences.

When I was attending the 'VR & AR World 2016', I had a chat with Nitzan Shenar (Founder and CTO at 'Inception'), we talked about camera movements in 360° videos. He explained to me how camera movements might be tolerable for the viewer if creators keep the following rules:

- Moving the camera at a constant pace
- Keeping the movement in exactly the same direction (without making turns or going over bumps)
- Putting the viewer within some kind of cockpit or stable reference object

VR experiences such as 'Pearl' (the first VR film to be nominated for an Oscar) or 'Sonar' (selected in many festivals including: Cannes, Sundance and TIFF) uses a 'reference frame' in order to make the VR experience more comfortable while moving in the space. Let's focus on 'Pearl'. The experience is set inside a car named Pearl and tells the story of a father and his daughter through the years. Creators, led by director

Patrick Osborne, who, not only used Pearl as a static reference object to avoid motion sickness when the car is moving, but also used the car as a storytelling tool. This creative and brilliant combination of technique and storytelling gives birth to compelling experiences.

Shenar also told me that they are working on an interactive solution for video where the user can actively decide to move from one place to another on the same timeline (and without buffering). That is possible thanks to the 'teleporting' technique which in the gaming environment is also considered to be the best way to move around in VR.⁵³

Other creators decided to act in a different way, placing the player in a static position (seated or standing) and creating a very dense virtual environment. In 'I Expect You To Die' the player can interact with many objects all around him and, depending on how he uses them, is able to proceed in the story. This very dense environment makes the experience fun and never boring.

It seems like there are different schools of thought on camera movements at the time of writing, only time will give the answer.

Touch Orbit Interaction

Being capable of exploiting the few inputs available with a VR headset would improve both the experience mechanics and the immersion level.

To simulate 'positional tracking' with VR mobile devices, Eugene Chung (CEO & Film Director at 'Penrose Studio'), invented what he calls 'touch orbit interaction', an action that allows the viewer to move freely around a pivot just using the Gear VR's trackpad as the only input and to look all around a specific object, in the case of the experience 'The Rose and I' at a little planet.⁵⁴

This idea allows us to feel a very good sense of 'presence' even with a mobile VR headset and it is the proof that even with limited inputs and technology, thanks to creativity, it is possible to achieve very innovative ways of creating and experiencing VR.

'Freeze frame' in VR

After testing the VR experience 'The Hunger Games', I started to wonder how the cinematic 'freeze frame' would be translated into a virtual world, maybe, it would become a sort of sculptural museum where characters are still.

The characters inside this experience, many times, are depicted before or after a specific action reminding me of the Greek sculptor Myron, and, in particular, his masterpiece 'Discobolus'. Myron was the first one to represent the human body during a physical action. The 'Discobolus' conveyed a 'tension' because the position of his muscles stretched, just a moment before the discus was thrown.

More or less, in the same way, also, the movie 'The Matrix' recreated a sort of '3D freeze frame' which is called technically 'bullet effect'. The goal was the same: exploit the moment through the actor's action and add more tension to the scene.

Fourth Dimension

During 2014 'Oculus Connect', Unseld told about one of his VR concepts, a sort of 4th dimension experience.

The concept is to loop an experience where the viewer is immersed in a crowd, a lot of people are walking all around him (this setting reminds me of Hachikō Square in Tokyo). The viewer cannot in just a single 'take', look at the behaviour of each person and for this reason, each time when looping the experience, the viewer can live the same scene but focus on different characters.

In part, it is what Savannah College of Art & Design students did when creating the VR experience 'Say It With Music', a 360° video where people are teleported into a crowded restaurant during dinning time.

"The experience guides the audience through the interlocking stories of 36 different individuals. Each character has their own specific story to follow, making this an experience you'll want to enjoy over and over again"

(Kyle Melnick of VR Scout)⁵⁵

VR Split Screen

Dividing the space into two different parts (180° for each part) and, in doing so, having two different places, two different stories, would be interesting as well.

When thinking of which 360° video might take advantage of this technique, the idea of telling the story of an event showing two different effects in different places comes to my mind. This technique might be used to make people more aware of environmental and social emergencies showing the two sides of the same coin, how, for instance, actions of people living in Norway have an effect on people living in Madagascar or vice versa.

In the case of a VR game, it would be possible to connect these two worlds and to create a puzzle game similar to the 'Portal' game.

A split screen in VR allows the viewer to be present in two different places at the same time, giving him or her the power of 'bilocation'.

In the same way, it allows him or her to be present in the same place but in two different times, in two different historical eras.

5.2 Real-time storytelling

Among the VR experiences, I mentioned, there is one that particularly fascinated me: 'Colosse', ideated and created by an independent team.

One of the most interesting features is that the narration of the story happens in 'real time', or rather, depending on how the viewer acts, virtual environment, characters, and so the whole story reacts in different ways.

This is possible only through the use of two particular tools of VR.

The first one is the tracking technology implemented inside the headset that allows the software to know exactly where the viewer is looking at in a specific moment. The second one is the complicated 'event system' created by developers inside graphic engines like Unity or Unreal Engine.

If the viewer decides to look at a character or to look at the horizon in front of him ('event'), this behaviour will change the story.

This kind of narration is a choice made by creators, as 'Colosse' developers, Jason Storey and Nick Pittom explain: *"One of the main issues with VR narrative is the focus. A story can happen all around you and so it is easy to miss critical story elements."*

Also, Unseld expresses his opinion about the control of the story by the storyteller in VR:

"How could we make sure the viewer always looks in the correct direction? {...} We tried guiding the audience's view through audio cues {...} We also tried to design the set in a way that guides the viewer's gaze to the right areas. However, each time we implemented one of these dictatorial tools too heavy-handedly, the storytelling started to feel forced, staged, and artificial. Over time, we stepped away from this sort of thinking. To embrace VR as its own unique medium, we have to let go of our almighty control of what the audience sees. Instead of instantly

pushing the story onto the viewer, we take a step back for a while and let the viewer take part in discovering the story themselves."

(Saschka Unseld)⁵⁶

This way of thinking can be considered the opposite of what has always been done, it is the opposite of the traditional way of narration. Not having the complete control of viewer's attention, the storyteller has to act in a way to create a narration consequent to viewer's actions, he or she has to build the story based on where the viewer is looking at in a particular moment.

This is called 'real-time storytelling', and it is not limited to CGI experiences. For example, the VR experience mentioned in the 'Editing' chapter 'New Wave', it is a 360° video that, thanks to the rotational-tracking, lets the viewer choose who to listen to. Also in the VR experience 'Miyubi' produced by 'Félix & Paul Studios', the viewer can 'unlock' a hidden Easter egg keeping his gaze on specific objects for a certain amount of time and 'unlock' a special scene.

Another reason why narration in 'real time' might be interesting, is because it improves the sense of 'presence' and realism a lot.

To have a story that reacts to my little decisions, that contributes to create a more fluent experience and 'as I want', 'I want you to tell me the story as I want to hear it', 'tell me the story in this way', and so on and so forth. I'd suggest to the reader to try all the games (non-VR) created by Davey Wreden. In particular, 'The Stanley Parabol', where the story is based on the player's actions and will.

Also, Jason Storey (developer of 'Colosse') thinks the same and pushes beyond. Storey purposes to change the story depending on 'how long' the user is looking at something, on what interests him or her the most. Storey make this example: on one side, the viewer got some waterfalls, on the other he can see a big castle in the distance. If he keeps looking at the castle, that means that he is more interested in this object and wants to follow this path, he wants to look at it closer, he wants to see what's inside, who lives there.⁵⁷ Thanks to the tracking technology, all of this would be possible and would exploit a feature proper of the VR medium.

The consequences of the viewer's choices are well summarized by the Hollywoodian director Eric Darnell:

"The cool thing is when you can do that, but the viewer feels like it was all their choice. This medium puts the viewer in control and that gives us film creators endless new opportunities."

(Eric Darnell, CCO of Baobab Studios) ¹⁸

'Real-time storytelling', in addition to changing the plot, can also change the density and the duration of character's actions. As I've already explained in the paragraph 'communication with characters', a bored behaviour might give the input to accelerate the story progression, changing its density.

"If I seat next to a person that tells me a story, he watches me react, he sees that I don't understand something, that I'm bored. In VR, we have a singular audience we don't have to make a movie that works for everyone. In VR, you can change the density of things that happen based on the behaviour of that singular viewer."

(Saschka Unseld)⁵⁸

Real-time storytelling transforms a narration into an event-driven experience where you are allowed to proceed through the story at your own pace.

6. CONCLUSIONS AND FUTURE WORK

To find out if the techniques and narrative tools that I decoded, analyzed and designed are actually effective, I think that there is no better judge than the viewer himself or herself. The next step should drive more people to test those VR experiences which have been applied to these techniques adopting a scientific methodology, able to record and analyze reactions, tendencies and feelings of the viewers. A data collection to support in analyzing the audience's behaviour.

Whenever I had the opportunity to let 'VRgins' (a person who has never experienced Virtual Reality) test a VR experience, I asked him or her about what his or her impressions were and, most of the times, my assumptions proved to be correct. This comparison with people has been extremely helpful when analyzing VR experiences qualitatively and with specific scientific tools that would be even more accurate.

To continue this 'semantic' research, to consolidate more and more VR language, I think that it is fundamental to also study reality. For example, to code a language between the viewer and a fictional VR character, I believe that it's necessary to pay a lot of attention to how it happens in real communication, verbal and nonverbal, between two real people, how they interact with each other. It might seem easy, but actually, the hard part is when it is necessary to analyze those non-superficial aspects of this relationship when one needs to understand which are the 'micro-mechanisms', they don't even notice them (unconscious behaviour).

It's, for this reason, I believe, that to code a VR language, it is also necessary to include the effort of other professionals, such as: psychologists, neurologists, anthropologists, architects, designers and many others. If VR aims to recreate another world, fictitious or real doesn't matter, a collective effort is necessary. Mine is just a tiny step forward, a drop in the ocean of discovery.

"VR is a big bet. It is bold to accept the challenge. It is stupid to think of doing it alone."

(Aimone Bodini)

I also think that future books on VR will be able to go deeper on the single 'terms' and 'techniques' I've explained with this research because they still hide a lot of aspects and features.

If it took many years to codify the cinematic language and, in spite of this it continues to evolve itself, for VR we will need time as well.

However, the big difference with the cinematic medium is that today by comparison, the possibility to share opinions with other VR professionals and to reach new conclusions, definitely takes much less time.

As Unseld says, the first cinema pioneers were all around the world and did not have the opportunity to communicate with each other. Today we can share what we learn and inspire others, speeding up the creation of VR language. I hope that this book will also contribute to doing so.

However, VR techniques and the use of the VR language are not enough to create an engaging narrative. Virtual Reality, as any other medium, is just a tool to communicate a story, the medium serves the story: 'Story is King' they say at Pixar.

Story is the key element for the success of any narration. Once the story is found, it is up to the creators to identify which medium turns out to be the most effective way to tell that story, it is up to the creators to understand which medium has the specific features and characteristics to enhance it.

Thus, it is necessary to have detailed knowledge of the language used in various media types as well as VR, allowing for the understanding of when to use one rather than the other.

How many times we saw a film adaptation that was not as good as the book? There may be many reasons of course, but maybe the creators didn't translate properly the techniques the book used into the cinematic language or, maybe the book, was, with its expressive potential and features, already the best medium to tell that story.

Some experiences that have been analyzed, as the one of 'Clouds Over Sidra', have a great impact because, first and foremost, it is the story that's told to be astonishing; the decision of adopting the VR medium comes second, when creators were trying to understand which medium was the best to use, which one would have exploited this story. Teleporting people into a refugee camp has proved to be a wise choice for amplifying their emotions and feelings.

Even the story told in 'Notes on Blindness' was very strong before the use of a medium as the VR one. The story of theologian John Hull and the way he describes his gradual blindness through tape recordings, is heart breaking. Only secondly, creators, which initially wanted to create an audio project, found out that the best medium to use would have been VR and, doing so, thanks to unique VR visual and audio features, they were able to create a compelling and fascinating story.

"I feel like in 'Notes of Blindness', we really used the VR medium to strengthen that story, which remains the heart of the experience."

(Arnaud Colinart, director & producer)⁵⁹

But it is not just about discovering a new language, it is also about understanding this new medium; people will need time to understand that to become used to it.

Today we can compare ourselves with the public of the 6th January, 1896, when Lumière brothers screened '*L'Arrivée d'un train en gare de La Ciotat*' ('Arrival of a Train at La Ciotat', 1895).

Spectators that were watching the movie, being not used to cinematic medium, were frightened by the locomotive coming towards them as if it was going to crush them.

⁶⁰After 120 years, we are no more scared watching a movie with a train coming towards us because we now understand how cinematic language works.

I think that, in the same way, this will also happen with VR, our relationship with it will change as it becomes more of an 'adult'. But when will VR become an 'adult'?

When will it no longer be necessary to describe VR and its language, comparing it with that of other media, when VR will have its own identity as a medium?

During this research, more than once, I've used cinematic similitudes to better explain the VR language and from what I've written, it might seem that I consider VR the 'last medium', the best medium ever invented.

But that is not true. I also think that the cinematic medium will continue to exist, as theatre or painting still exist today. What is going to happen, in my humble opinion, is a transformation, an evolution of the cinematic medium.

If we look at the past, we can observe how during the '50s, TV's popularity stole a great part of the audience from movie theatres.

To survive this crisis, cinema had to develop new and different strategies to take back its audience, it had to change.

Thus, technologies like Cinerama, Technicolor, 3-D, and Cinemascope were introduced. In addition, it was necessary to change and diversify the stories screened. It was necessary to create contents for a specific target, doing the opposite of what television was doing, purposing generalist contents. Also, in those years, directors gained much more control over their movies and this led to the rise of great directors and authors as Martin Scorsese, Brian De Palma, Robert Altman, Woody Allen, Steven Spielberg, George Lucas and Francis Ford Coppola just to name a few.

Every new medium inevitably borrows grammar and language from other pre-existing media. Any new medium, in order to be understood, needs to translate, with some adjustments, the 'words' used by previous media. How J.D. Bolter R. Grusin would say with their neologism, it needs a 'Remediation' and that's why we see many creators designing their 'VR short film' as if they would design a traditional short film, that's why we see game designer creating a VR game with the same mechanics of a traditional PC/Consoles video game. Most of the time these experiences don't work, but that is fine, every medium found its way through empirical attempts.

Therefore, I believe that VR is going to influence the movie industry in the next years but I also believe that this new transformation required for the cinematic medium will be able to create a new kind of movies.

The last thought I want to express is that, in my opinion, we are much more prepared for VR than we think.

Since the birth of the 'world wide web', they came to create 'social platforms' such as the 'Forum', to which, within a few years the 'social networks', such as 'Facebook' and 'Twitter' were added.

If we think about it for a moment, it is what real people do to take part in the virtual community, creating a virtual profile to get in touch with other virtual profiles.

Of course, we are in front (and not inside) of a screen made up of pixels, but, I believe that we already know many of the mechanics that govern a virtual world.

Virtual Reality experienced with headsets or other devices, is just the next step, probably the largest done to date of a path that's already been taken a long time ago.

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