

# Virtual Reality as an Artistic Medium

A Study on Creative Projects Using Contemporary  
Head-Mounted Displays

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## Abstract

There has been a lack of discussion concerning virtual reality as an expressive medium. It is essential to emphasise the aesthetic dimension of virtual reality in order to develop the medium as a powerful artistic mode of expression. This thesis examines how head-mounted display-based virtual reality can be used for artistic expression, focussing on the aesthetic pleasures of the medium.

Pioneering first-generation VR artworks are reviewed through the scope of artistic exploration, and four key aesthetic pleasures in VR experience are proposed: immersion, agency, navigation, and transformation. The demonstration of VR aesthetics is investigated through the qualitative content analysis of four contemporary VR installations.

The study reveals following findings: (1) the coherence of a virtual environment is more crucial than a realistic representation of the physical world in inducing a sense of immersion; (2) the degree of agency is inverse in proportion to the degree of authorship in VR experiences; (3) placing constraints on participants' movements can bring about a strong emotional impact; and (4) the participant's attitude and behaviour changes according to the given identity in a virtual environment.

It is suggested that the capacity of virtual reality is not currently used to its full extent when it comes to artistic manifestation. It is therefore the responsibility of artists, developers, and researchers to establish the language of virtual reality as an artistic medium for the future production of VR experience.

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**Keywords** Virtual Reality, Artistic Medium, VR Art, VR Aesthetics

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# 1. Introduction

In August 2012, 19 year-old Palmer Luckey launched a Kickstarter crowdfunding campaign to sell approximately 100 pieces of Oculus Rift, “his own version of a clunky headset” (Schnipper, 2014). The campaign did not only surpass the goal, but also raised 2.4 million dollars from nearly 10,000 people, 974 percent more than intended (Purchase, 2013). Less than two years later, Facebook acquired Oculus for 2 billion dollars. Meanwhile, the biggest IT companies in the world—Google, Samsung, HTC & Valve, and Sony—have competitively undertaken the development of consumer versions of VR headsets. Virtual reality is back.

Virtual reality as a technology is nothing new. VR technologies have been employed for decades, and the concept of the VR system has been existed for even longer. However, virtual reality has long been considered impractical to mainstream users, mainly because of cumbersome headsets with low resolution and narrow field of view (Hutchison, 2007). The medium that was once believed to be a fantasy machine which would let us go anywhere and do anything imaginable (Bates, 1992) seemed to be forgotten by most of people. Then things changed: a number of advances in technology in recent years have brought the renaissance of virtual reality (Aronson-Rath, Milward, Owen, & Pitt, 2015).

Virtual reality as an aesthetic medium is still something relatively new. Although the technological side of virtual reality has evolved rapidly, the aesthetic side of the medium has remained in a nascent stage. Since the first working head-mounted display came out, the main interest of developers have been towards either the practical or the entertainment aspect of the medium. Things are not so much different in today’s second generation virtual reality production—the majority of virtual reality experiences have been designed without enough consideration regarding the aesthetic pleasures the medium could deliver to users.

This lack of attention has been shown in the academic circles as well. Over the past two decades, research in this field has been mainly focused on the technological aspect of the medium. In this regard, virtual reality has been considered as a medium for human-



computer interaction rather than for artistic expression, and very little research has been undertaken to explore the capacity of virtual reality as an artistic medium. Furthermore, not much study has been done analysing virtual reality experiences from an aesthetic perspective.

It matters to discuss the aesthetic dimension of virtual reality. Joseph Bates (1992) argues that “for virtual reality to achieve its promise as a rich and popular artistic form, [...] it will be necessary to explore well beyond the interface, to those issues of content and style that have made traditional media so powerful”. Janet H. Murray also illustrates the importance of the issue on the analogy of history of film in *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (1997). She claims that aggressive exploration and exploitation of its own expressive power is essential to transform a technology-oriented medium into an expressive medium, as film became the medium as we know it today from a mere recording technology (Murray, 1997, p. 66).

In order to address this problem, I explore virtual reality as an artistic medium which enables artists to create immersive expressive experiences. Through the study, I aim to provide an answer to the questions “What are the aesthetic pleasures virtual reality experiences offer?” and “How contemporary virtual reality artworks explore the aesthetic potential of the medium?”

I start the study by defining virtual reality and review the history of virtual reality based on the Gartner Hype Cycle. In next chapter, I examine pioneering virtual reality experiences which used the medium to create art in the first generation. The specific works I will discuss are *VIDEOPLACE* (1974) by Myron Krueger, *The Legible City* (1989) by Jeffrey Shaw, *Placeholder* (1992) by Brenda Laurel and Rachel Strickland, and *Osmose* (1995) by Char Davies. In addition, the aesthetics of virtual reality is proposed as a theoretical framework of the study. In the last part of the study, I provide qualitative content analysis on specific examples of contemporary virtual reality experiences, focussing on four titles: *SightLine: The Chair* (2014) by Tomáš “Frooxius” Mariančík, *FIREBIRD: La Péri* (2016) by Innerspace VR, *The Gallery: Call of the Starseed* (2016) by Cloudhead Games, and *Tilt Brush* (2016) by Google.

This thesis is limited to head-mounted display-based virtual reality experiences for several reasons. First, the VR headset is the contemporary thing that most of the present virtual reality production—both hardware and software—has been focussing on. Second, it offers the ultimate immersive experience by excluding sight from the physical world. Lastly, it has a higher accessibility to the public compared to other types of VR systems, such as CAVE (Cruz-Neira, Sandin, & DeFanti, 1993).

We are witnessing the emergence of a powerful artistic medium—virtual reality. As Lev Manovich (2001) tried to record and theorize the language of new media in its first decade, there is also a need to examine the early stage of virtual reality as an expressive medium “before it slips into invisibility” (p. 8). If virtual reality eventually evolves into “the ultimate empathy machine” as Chris Milk (founder and creative director of Vrse.work) argued in his 2015 TED Talk, there will be no doubt that this medium will be the art of the 21st century, as cinema was for the 20th.

## 2. Context

This chapter briefly looks into the background of virtual reality. First, the Reality–Virtuality Continuum is introduced. Next follow definitions of virtual reality and the brief history of virtual reality based on the Gartner Hype Cycle.

### 2.1. Reality-Virtuality (RV) Continuum

Milgram, Takemura, Utsumi, and Kishino (1995) introduced the Reality–Virtuality Continuum (shown in Figure 1) that describes “the relationship between Augmented Reality (AR) and a larger class of technologies which we refer to as ‘Mixed Reality’ (MR).”

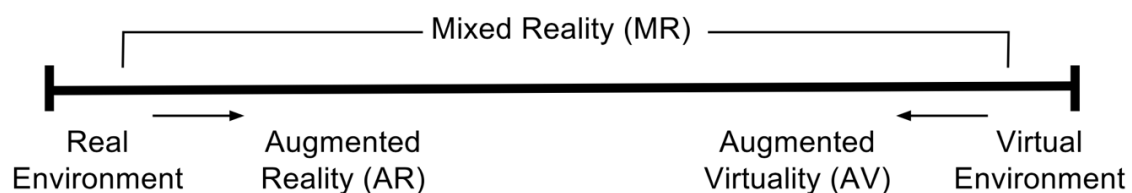


Figure 1: Reality–Virtuality (RV) Continuum.

As Figure 1 shows, the VR Environment is placed on one end of the continuum while the Real Environment is on the opposite side; everything in between is considered as Mixed Reality. The continuum indicates that the VR Environment is a completely synthetic world, unconstrained by the bounds of physical reality (Milgram et al., 1995).

## 2.2. Definitions of Virtual Reality

In 1989, Jaron Lanier, CEO of VPL, coined the term ‘virtual reality’ as an umbrella term for any virtual project that “typically refers to three-dimensional realities implemented with stereo viewing goggles and reality gloves” (Krueger, 1991, p. xiii). Because virtual reality has been considered as a relatively new medium, its definition is still unsettled. Researchers and users still have different points of view depending on their field of interest.

Jonathan Steuer (1992) points out that virtual reality has been “typically defined in terms of a particular collection of technological hardware, including computers, head-mounted displays, headphones, and motion-sensing gloves”. According to him, a device-driven definition is problematic in providing a conceptual framework or the theoretical dimensions of virtual reality. Therefore, he defines virtual reality in terms of human experience, without referring to any particular hardware system: “Virtual reality is defined as a real or simulated environment in which a perceiver experiences telepresence.”

William R. Sherman and Alan B. Craig (2003) have defined virtual reality by combining four key elements in experiencing the medium—a virtual world, immersion, sensory feedback (responding to user input), and interactivity:

Virtual reality is a medium composed of interactive computer simulations that sense the participant’s position and actions and replace or augment the feedback to one or more senses, giving the feeling of being mentally immersed or present in the simulation (a virtual world). (p. 13)

In this study, I follow both of the above definitions, which put more emphasis on the experiential dimension of virtual reality rather than technological dimension of it. As Steuer (1992) points out, a technology-based view on virtual reality could bring difficulties in understanding the full potentials and capacities of the medium.

## 2.3. Virtual Reality Hype Cycle

Sherman and Craig (2003) adopted the Gartner Hype Cycle (Figure 2) to examine the state of virtual reality (p. 438). The Gartner Hype Cycle is a graphic representation developed by Gartner Group, an American IT research and advisory company, to describe the path new technologies have followed over time. As seen in Figure 2, the cycle has five phases of development:

1. Technology Trigger
2. Peak of Inflated Expectations
3. Trough of Disillusionment
4. Slope of Enlightenment
5. Plateau of Productivity

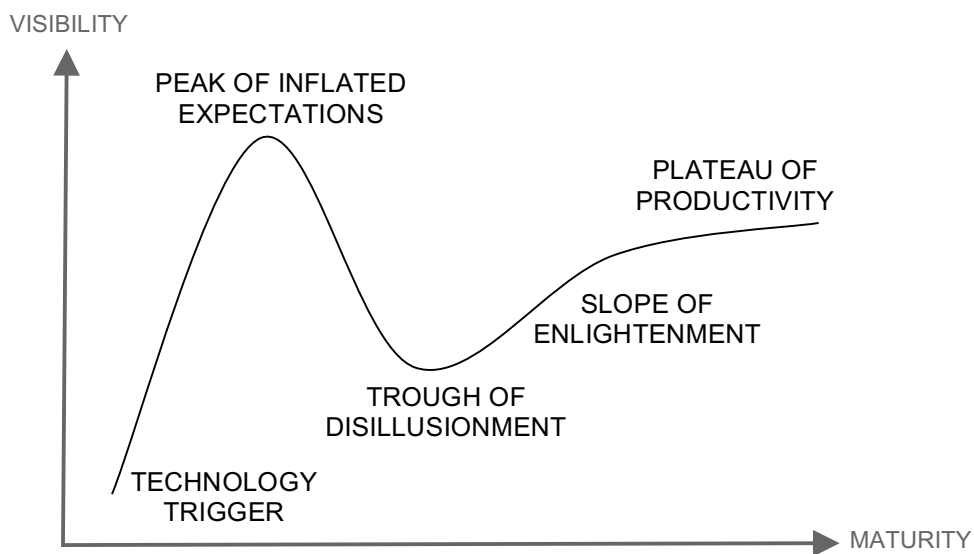


Figure 2: Gartner Hype Cycle.

In this section, I use the Gartner Hype Cycle as a framework to review the history of virtual reality from the perspective of evolution of the medium. However, the framework is modified since the medium shows different path after the fourth stage. This section does not cover the exhaustive history of VR, but does illustrate historical events related to the development of head-mounted displays and the creative use of virtual reality.

### 2.3.1. Before the Beginning

The root of virtual reality can be traced back to the 18th century when panoramic painting created an illusion by filling the viewer's entire field of vision (Grau, 2003, p. 5). Later, stereoscopes—the first 3D picture viewers—were introduced and View-Master stereoscope was invented in 1939, which was mainly used for virtual tourism (Virtual Reality Society, n.d.). With the advent of electronics and computer technology, virtual reality as we know it began to be realised from the beginning of the 20th century.

In 1929, Edward Link created the first flight simulator, *Link Trainer*, to train pilots in a stationary location (Sherman & Craig, 2003, pp. 24–25). In 1956, filmmaker Morton Heilig invented an arcade-style attraction which featured a stereoscopic 3D display, stereo speakers, a vibrating seat, fans, and scent producer (Robertson & Zelenko, 2014). Heilig conceived of his invention as “the ultimate film experience,” but it failed to achieve commercial success (Krueger, 1991, p. 66).

In 1965, Ivan E. Sutherland, “the father of computer graphics” (Krueger, 1991, p. 68), described the ‘ultimate display’ concept in which the user could interact with objects in virtual environment that was not bound by the laws of physical reality. Sutherland (1965) explained the concept as “a room within which the computer can control the existence of matter.” Later in 1968, Sutherland and his student Bob Sproull implemented a tracked stereoscopic head-mounted display, called *Sword of Damocles*, which was suspended from the ceiling and strapped to the viewer's head (Virtual Reality Society, n.d.).

Around the same time, an artist and programmer Myron Krueger developed a series of experiences which he termed ‘artificial reality’. This series of research projects led to the development of *VIDEOPLACE* (1974), in which untethered participants can interact with responsive computer-generated environments (Krueger, 1991). *VIDEOPLACE* is examined in detail as one of the pioneering artworks in the first generation of virtual reality in Chapter 3.

### 2.3.2. Technology Trigger

Although Sutherland's head-mounted display was lacking public attention, a number of researchers at the University of North Carolina at Chapel Hill, Wright Patterson Air Force Base, and NASA Ames Research Center—among others—continued developing related technologies (Sherman & Craig, 2003, p. 439). A vast amount of interest in virtual reality started arising among mass media in the late 1980s (Krueger, 1991, p. 73).

Along with continued research and increasing interest, the first phase of the Virtual Reality Hype Cycle is assigned to the year 1989. In that year, VPL Research Inc. enabled researchers to develop their own virtual reality experiences with affordable hardware on a commercial basis, including DataGlove and EyePhones (Sherman & Craig, 2003, p. 439; Krueger, 1991, p. 73). The term 'virtual reality' was coined by VPL founder Jaron Lanier in the same year (Krueger, 1991, p. xiii).

### 2.3.3. The First Peak of Inflated Expectations

Virtual reality reached its first peak of inflated expectations between 1992 and 1995, when unrealistic expectations and over-enthusiasm around virtual reality prevailed. In the interview with Frank Biocca in 1992, Lanier claimed that “approximately 2 years from now, there will be head-mounted home entertainment systems” (Lanier & Biocca, 1992). In addition, Nicholas Negroponte (the founder of MIT Media Lab) predicted in 1993, in *Wired Magazine*, that head-mounted displays would be ubiquitous by 1998 (as cited in Hutchison, 2007).

During those years, virtual reality was also a popular subject in other media, including films, books, magazines, and newsletters. *The Lawnmower Man* (1992) described the hype around virtual reality people believed could come true at that time. It was partially based on Jaron Lanier and his early laboratory days—he was played by Pierce Brosnan and real VPL equipment was used in the movie (Robertson & Zelenko, 2014). The film covered various topics in virtual reality including military use of VR, virtual learning, virtual sex, and virtual identity.

While the future promises of the medium were frequently discussed, people were not aware of how many years it would take to actually obtain that future. Overblown expectations led to disappointments, and the public interest in virtual reality began to decrease.

#### 2.3.4. Trough of Disillusionment

VPL Research Inc. went bankrupt in late 1992. Not long after, Brenda Laurel added a chapter to her book *Computers as Theatre* (1991) entitled “Post-Virtual Reality: After the Hype is Over,” implying that the bubble from the previous phase was about to implode. Between the years 1995 and 1998, the medium went through the trough of disillusionment stage. The VR headset market as a whole began to collapse, making it difficult to pursue virtual reality for art or research.

The medium failed to fill the gap between optimistic predictions and availability of current technology; the hardware was still too expensive to be affordable, and they had had several technical issues that mainstream users could not accept (Sherman & Craig, 2003, p. 440). After the World Wide Web became commonplace, virtual reality seemed to have faded from public consciousness (Robertson & Zelenko, 2014).

#### 2.3.5. Slope of Enlightenment

Even though virtual reality was considered as having evaporated after all the hype, some researchers had not given up the hope that it would regain its fame when sufficient technologies became available to support VR. Meanwhile, rapid advancement in computer technologies and 3D graphic capabilities had continued (Virtual Reality Society, n.d.).

A decade later in 2012, Palmer Luckey brought Oculus Rift to the world, a long-awaited reward for VR enthusiasts. Its unprecedented success on Kickstarter was a big issue among tech lovers and gamers, but it was relatively less known to the public until Facebook announced its 2 billion-dollar acquisition of Oculus in 2014 (Wagner, 2016).



### 2.3.6. The Second Peak of Inflated Expectations

Virtual reality has been in its second peak of inflated expectations since Oculus Rift burst onto the scene and its acquisition by Facebook. Rosy predictions of virtual reality have been appearing again in news coverages, with headlines reminiscent of the 90s when the first hype had reached its peak. Meanwhile, Oculus and HTC & Valve respectively released the first consumer version headsets in early 2016, while Sony's gaming virtual reality headset will be released in October 2016.

In the second generation of virtual reality, it has become much easier to access the medium thanks to the mainstream adoption of the smartphone. Google Cardboard, a DIY headset made of a simple, low-cost component, uses a smartphone as the headset's display. Samsung's Gear VR uses a compatible Samsung Galaxy device as a screen and the driving computer of the headset. Both products have increased the public's ability to gain a glimpse of the virtual reality experience.

### 2.3.7. After the Hype is Over

We do not know yet whether or not the second generation of virtual reality will go through another stage of disillusionment or continue moving towards the plateau of productivity. In order to reach the last phase of this cycle, the benefits of virtual reality need to be widely demonstrated and accepted. Additionally, the technology is required to reach a stable point. The final height of the plateau will vary according to whether virtual reality will be adopted by mainstream users, or if it will only benefit a niche market.

It is worth noting that the second generation of virtual reality has been striving to expand from gaming and entertainment contents. Oculus Story Studio has been producing virtual reality experiences, which focus on the storytelling aspects of VR. Various film festivals have started including VR titles as part of their programmes. In particular, in 2016 Sundance Film Festival created a separate category meant specifically for artistic virtual reality experiences. Furthermore, The New York Times has launched virtual reality

journalism project in collaboration with Google, distributing more than a million Google Cardboards to its subscribers (Silverstein, 2015).

Although the future of virtual reality is still unknown, the medium has inspired various artists as a powerful medium for creative expression. If we continue exploring the artistic capacity of the medium together with technological development, it will not be just a pipe dream to say that virtual reality will be one of the most powerful media in human history.

### 3. Pioneering Virtual Reality Artworks

In this Chapter, I review pioneering artworks which used virtual reality as an expressive medium: *VIDEOPLACE* (1974) by Myron Krueger, *The Legible City* (1989) by Jeffrey Shaw, *Placeholder* (1992) by Brenda Laurel and Rachel Strickland, and *Osmose* (1995) by Char Davies. The selected works were produced before the second peak of inflated expectations which made them as the first generation of virtual reality (see Chapter 2). The original intention of the authors behind these installations and the innovative use of the medium are the main focuses of each review.

#### 3.1. VIDEOPLACE (1974)

*I vowed to create an experience that would allow a person to go into a room and come out with their attitudes about computers changed.*

— Myron W. Krueger (as cited in Robertson & Zelenko, 2014)

*VIDEOPLACE* is an interactive installation which combines a participant's live video image with a computer graphic world, creating a "shared visual environment" (Krueger, 1991, p. 37). In *VIDEOPLACE*, a participant can interact with other participants in remote locations through a projected image of herself on a video screen. A single participant can also interact with graphic objects and creatures on a screen, which appear to react to the movements of the participant's image in real-time.

Contrary to the keyboard terminals which were the dominating interface of computing in the early 70s (Levin, 2006), Krueger wanted to demonstrate alternate modes of human-computer interaction. He believed that the entire human body should have a role in interaction with computers, and began to explore the idea of physical participation in a graphic world with his series of early works—*GLOWFLOW*, *METAPLAY*, and *PSYCHIC SPACE*—which he called *Responsive Environment*. It is an empty space in which a single participant's movements are perceived by the computer and responded to with visuals and sound. (Krueger, 1985)

During the exhibition of *METAPLAY*, Krueger and his colleague accidentally used two-way video links—one in a museum and the other in a computer center—for the discussion. Krueger found that conversation through graphic displays was exactly the same as it would have been had he been sitting together with his colleague in physical world. Soon after the incident, Krueger started experimenting with two-way interaction, leading to the concept of *VIDEOPLACE*. (Krueger, 1991, pp. 34–36)

The concept of *VIDEOPLACE* suggests a new paradigm in telecommunication (Figure 3). Krueger (1991) illustrated that “two-way telecommunication between two places creates a third place consisting of the information that is available to both communicating parties simultaneously” (p. 37). The idea of a third place led him to consider the properties of a real place and how they could be reconstructed or replaced in a computer-generated environment.

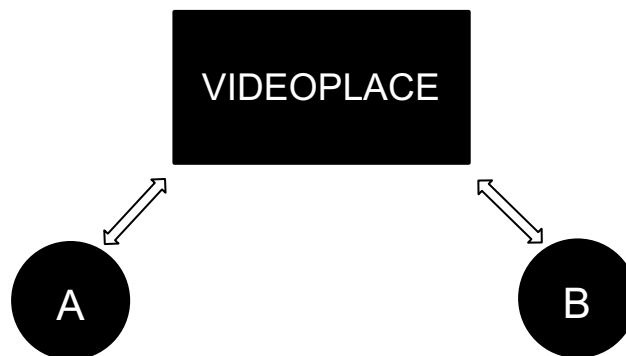


Figure 3: The *VIDEOPLACE* Concept.

In the *VIDEOPLACE* installation, the participant stands in front of a backlit wall and faces a video projection screen which displays her live image. The participant’s live image is situated in a graphic setting furnished with graphic objects and inhabited by graphic creatures to provide a sense of place. Then each participant’s video image is digitised, and their posture, shape, and gestural movements are analyzed. When the participant’s actions are interpreted by the specialized processors, the system decides how to react to the input. Depending on the participant’s behavior, the system can move an object, change that object’s color, move the participant’s image, or make a sound. Visual and auditory responses are generated accordingly. (Krueger, 1991, pp. 43–45)

Krueger believes that the installation should be actively explored to express the medium itself. Therefore, over 50 different compositions and interactions are offered in the *VIDEOPLACE* framework. One of the most popular interactions was *CRITTER*, a small creature with which the participant can play. Krueger (1985) described that his intention was “to produce the sensation of an intelligent and witty interaction between creature and the participant.” *CRITTER* chases the participant’s image around the screen, tries to climb up the participant’s silhouette, or dangles from the participant’s finger.

Some interactions allow participants to create art through bodily movement. Krueger (1991) described that “your body becomes a means of creating art” (p. 48). The participant can draw various type of lines and paths with their fingers, hands, and bodies (Figure 4). The idea of creating art in computer-generated environment through physical interaction is later employed in several virtual reality painting applications. Among others, Google’s *Tilt Brush* is examined in detail in Chapter 6 as one of creative virtual reality works in the second generation.

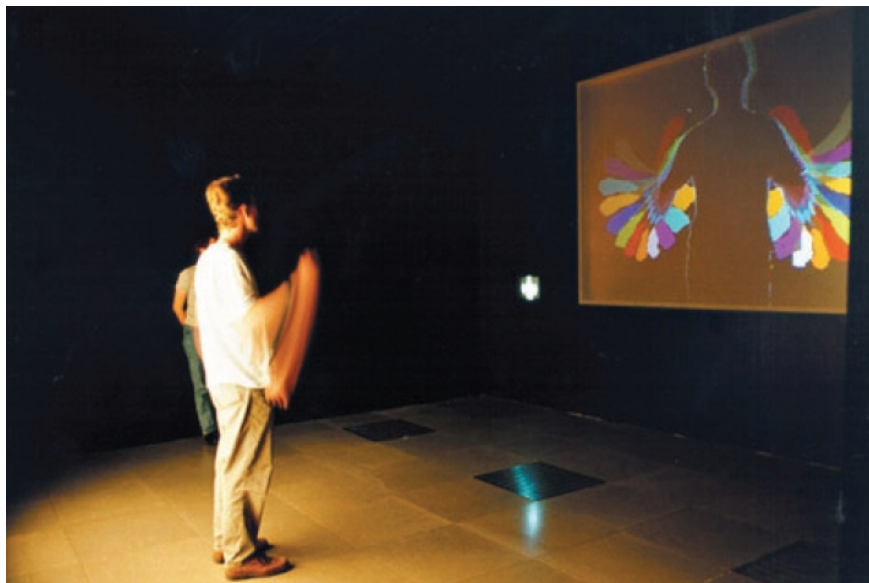


Figure 4: Creating art in *VIDEOPLACE*. The participant can create shapes through bodily interaction.

Simulated environments in *VIDEOPLACE* are not constrained by the laws of physics existing in the real world. A participant’s image will freely float on the screen, or might transform into a miniaturised version, enabling the participant to do things are not possible in reality. Krueger believes that participants would become aware of previously

unquestioned assumptions and expectations about the real world by interacting with a familiar reality that showed unfamiliar aspects (1991, pp. 37–38).

Later, Krueger (1991) coined the term ‘artificial reality’ to cover *VIDEOPLACE* and Ivan E. Sutherland’s head-mounted display technology. Artificial reality aims to provide full-body participation in computer generated environments, which the participant would recognise as real experience (p. xiii). Furthermore, he also claimed that artificial reality should be understood more as a new aesthetic medium like film than as a technology like computers (p. 84). *VIDEOPLACE* is a revolutionary artwork not only suggests the new perspective in human-machine interaction, but also offers timeless inspiration to virtual reality artworks.

### 3.2. The Legible City (1989)

*(In virtual reality) the viewer is no longer consumer in a mausoleum of objects, rather he/she is a traveller and discoverer in a latent space of audio visual information.*

— Jeffrey Shaw (1992)

*The Legible City* is an interactive installation where a single participant seated upon on a modified bike travels around virtual spaces. Each space is based on the ground plans of actual cities: Manhattan, Amsterdam, and Karlsruhe. However, buildings in physical space are replaced by 3D letters that form words and sentences along the sides of the streets. The participant’s view is shown on a large back-projected screen in front of the bike, and she can control the movement by pedalling and steering the handlebars.

Jeffrey Shaw had been working on various interactive installations focussing on the relationship between the participant and virtual space. For example, in his early work, *THE NARRATIVE LANDSCAPE* (1984), the participant explores images in a virtual 3D space by using a joystick. Each image is placed according to narrative relationship between images. Shaw had also been interested in virtual imaging mechanisms from early on in his work. In *VIEWPOINT* (1975) and *FUTURE?* (1976), he uses a stereographic viewing device which could be considered an antecedent of a head-mounted display. (Shaw, 1992)

In the first version of *The Legible City*, the ground plan is based on an area of Manhattan south of Central Park. Instead of being tied to the simulation of physical reality, the virtual space is made of 3D letters. Eight separate fictional storylines written by Dick Groeneveld constitute the whole visual architecture of virtual Manhattan. Shaw (1992) described the space as though “the city has been transformed into a kind of three dimensional book”. By choosing which paths to follow, the participant is able to reconstruct the text in her own way.

In later works of *The Legible City*, Amsterdam (1990) and Karlsruhe (1991) versions are introduced, in which every value of virtual space is derived from the existing physical space it replaces. All the letters are scaled in a way that the size of each letter matches the size of the actual buildings they replace. Therefore, the virtual cityscape still remains an architectural resemblance of actual cities. Manovich (2001) argues that through this mapping, *The Legible City* suggests alternative way of creating virtual spaces by taking a middle road between spaces that have nothing to do with actual physical spaces, and spaces that are closely modeled after existing physical structures (p. 260).



Figure 5: The installation setting of *The Legible City*.

In the installation of *The Legible City*, a single participant is placed on a stationary bicycle inside a dark room. As Figure 5 shows, the participant faces a large projected screen that displays the participant's view in virtual space, while a small LCD monitor on the handlebars of the bike shows the current position of the participant in a simple ground plan of each city. The movement in virtual space is controlled by the handlebars and pedals of the bicycle. Whenever the participant changes the direction or speed, the view on the screen changes accordingly.

Later, Shaw introduced a multi-user version of the installation, entitled *Distributed Legible City* (1998). In this installation, multiple participants in different physical locations cycle together in a shared virtual space. Each participant is represented as an animated cycling avatar in the virtual environment and participants can communicate with each other via headphones and microphones. By adding a social aspect, *Distributed Legible City* adds a new layer to the same virtual space in the original work.

As in *VIDEOPLACE*, *The Legible City* also explores the aesthetics of full-body interaction in computer generated environment. According to Manovich (2001), "*The Legible City* functions not only as a unique navigable virtual space of its own, but also as a comment on all the other navigable spaces" (p. 260). The installation carefully preserves the memory of the real city, encoding its deep structure in a new form. Overall, *The Legible City* successfully transplants the participant into the virtual environment by embedding a familiar, physical interaction into an unfamiliar, virtual interaction.

### 3.3. Placeholder (1992)

*The VR artist does not bathe the participant in content; she invites the participant to produce content by constructing meanings, to experience the pleasure of embodied imagination.*

— Brenda Laurel (1994)



*Placeholder* is a virtual reality experience that explores a new paradigm for interaction and narrative in virtual environments. In this installation, two participants with head-mounted displays transform into one of the ‘Critters’, a spiritual inhabitant in the environment. They can then explore several places as the critters and leave their marks on the space for other participants to discover. As Figure 6 shows, it is designed to be a shared experience for two simultaneous participants, and both can communicate with each other verbally through a microphone attached to the head-mounted display. (Laurel, Strickland, & Tow, 1994)



Figure 6: The installation setting of *Placeholder*.

The developers of *Placeholder* believed it was important to question conventions derived from other media or early experiments in VR interactions such as computer displays, teleoperations, or training simulators. For example, a window metaphor was commonly used to allow participants to move among different virtual spaces. However, the developers found the technique was too close to the visual language of computers, therefore they adopted the idea of active portals as a means of transporting participants to other worlds.

The authors of the installation also questioned VR interface conventions using formal, gestural language. For instance, it was customary to use ‘flying’ mode for moving in a virtual environment, which required a user to point the desired direction with two fingers. They identified the issue of these gestures having nothing to do with the desired activity of moving or flying, and resolved this issue by letting the participant fly by flapping their arms as a bird beats its wings. Their motto in developing *Placeholder* was “no interface,” allowing participants to interact with the system naturally without noticing any constraints placed on them.

The other main challenge in *Placeholder* was to design and implement virtual environments rich with narrative elements. The developers considered *Placeholder* as a set of places that could be experienced and marked through narrative activity. In order to maximize narrative potential of the medium, professional storytellers and improvisational theater groups engaged in the process of concept development. Narrative motifs inspired from cultural anthropology, mythology, and folklore were employed in two main features of the installation: ‘placemarks’ and ‘critters’.

Placemarks are fragments of a story about the environment in the form of oral storytelling. They are embedded in a virtual environment and activated when the participant approaches them close enough. The authors of the applications were also interested in the phenomenon of placemarking, assuming that it would bring a new insight about interactions to the virtual environment. In *Placeholder*, participants can leave their marks on virtual spaces by leaving ‘voicemarks’, participant’s voice message. The voicemark is then stored in a ‘voiceholder’, a movable virtual record/playback device that is played when a voiceholder is touched by participants.

Critters function as ‘smart costumes’ in the installation. When participants first enter the world of *Placeholder*, they don’t have a body (i.e., they have no avatar) except two blue dots representing both of their hands. In order to fully experience the world, participants need to acquire a body by embodying themselves into one of the critters: spider, snake, fish, or crow. The critter changes the way the participant looks, sounds, moves, and perceives the world. Each characteristic of perception and locomotion for the critter is based on the narrative motifs. For example, shiny things are visually highlighted for the crow participant, and the snake participant can see in the dark.

Smart costumes play an important role in the installation. According to Laurel (1994), “the ‘masquerade’ aspects of the smart costumes—replacing or obscuring one’s identity with an exotic persona, and also amplifying aspect of one’s own identity that are obscured by one’s ordinary persona—put people in a frame of mind that allowed them to *play*, often quite boldly and imaginatively” (p. 123). By successfully implementing smart costumes in the installation, the developers could prove their hypothesis of VR: namely, that the medium is more suitable as an active play space than a passive entertainment space.

*Placeholder* is also a performance piece, in that one of the characters is controlled by a human being in real-time—the character of ‘the Goddess’. The goddess is not represented visually, but only aurally through the voice of the performer. The developers originally conceived the character as a playmate and trickster in order to enrich the dramatic interaction between the participants and the world. The Goddess’ character varies according to the relations between participants. Sometimes she is a helper and friend, and sometimes she is a cupid and a tease.

Although *Placeholder* could not implement all the features and functions originally planned due to the time limits and technological issues, it showed the great potential and possibility of narrative interaction in virtual reality. The authors raised valuable questions in the appropriateness of conventions when designing narrative-oriented virtual reality experiences. In addition, they allowed participants to *play* in virtual environment by booting up their imaginations with various creative elements in the world of *Placeholder*. I am consistent with Sherman and Craig’s summary of the experience: “*Placeholder* is an artistic exploration about virtual reality, place, play, and self” (2003, p. 523).

### 3.4. Osmose (1995)

*In OSMOSE, I set out to create a work [...] which demonstrates the medium’s potential to enable us to experience our place in the world afresh, or to paraphrase Bachelard, to change space in order to change our Nature.*

— Char Davies (1998)

*Osmose* is an immersive virtual environment where an ‘immersant’ (Davies’ preferred term for participant) donning a head-mounted display and a motion capture vest can submerge and explore poetic world-spaces. One of the primary intentions of *Osmose* was to create a space that is “psychically innovating” and which reawakens a fundamental sense of “being-in-the-world” (Davies & Harrison, 1996). The installation has demonstrated that it is more than possible to express artistic visions through virtual reality.

As a formal painter, Davies had been seeking to create an enveloping luminous space to manifest archetypal aspects of Nature and dissolved the boundaries between interior and

exterior. This particular artistic vision led her from paintings to 3D computer graphics, since they enabled her to create a virtual 3D space on the other side of the picture plane. In order to communicate with the virtual environments she created, she began to work with virtual reality. (Davies, 1998)

Davies aimed to demonstrate alternative ways of representing a virtual space contrary to the photo-realistic, hard-edged, and polygonal style which was commonly used in existing 3D computer graphics. The result was a painterly, soft, and atmospheric environment consisting of translucent textures and flowing particles (Figure 7). The ‘soft’ aesthetic of *Osmose* is further supported through the use of slow cinematic dissolves between different worlds (Manovich, 2001, p. 261). Along with visuals in the space, spatialised sound filled the environment, responding to changes in an immersant’s location, direction, and speed in real-time. The sound was composed in a way that would support the contemplative nature of the installation, consisting of an ambiance of continuous, emotional sound.

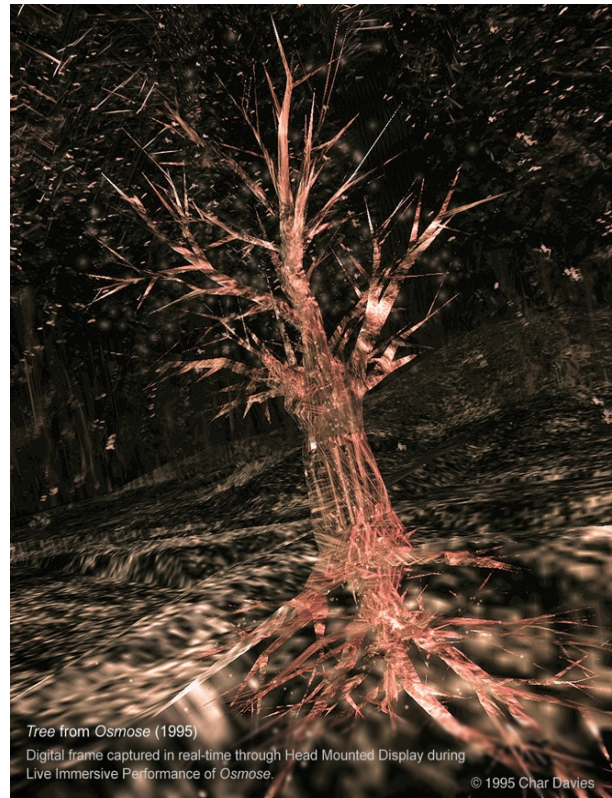


Figure 7: The visual representation in *Osmose*. It presents the atmospheric virtual environment by dissolving the boundaries between figure and ground.

Davies also questioned the convention of using handling devices in virtual reality experience such as a joystick or glove. She believed that if the interface is centered on the hand, it encourages the immersant to approach the world in terms of *doing* things rather than *being* in the world (Robertson & Zelenko, 2014). Another goal in designing the interface of *Osmose* was to facilitate an experience where the immersant feels centered in their physical bodies “in a way that is similar to the effect of practicing tai-chi or meditation” (Davies & Harrison, 1996).

As a result, an alternative technique was developed: a hands-free interface that relies on breathing and balance. The immersant is able to float upward and downward by breathing in and out. The direction can be changed by subtly altering the body's centre of balance. This technique was mainly inspired by Davies' own experience of the scuba diving practice of buoyancy control. Since there is no motion tracking for hands, the immersant is discouraged from manipulating objects during the experience. The interface of *Osmose* leads the immersant to enjoy being in the world, rather than trying to do things to it.

The installation was designed as a solitary, intimate experience, but it also offers a collective experience. While the immersant's experience takes place in a small private chamber, her journey in *Osmose* is shared with audiences in real-time through two projection screens in public place. One screen shows the immersant's view in the installation, and the other screen shows the shadow of the immersant's body silhouette. According to Manovich (2001), the immersant, like a ship captain, "occupies a visible and symbolically marked position, being responsible for the audience's aesthetic experience" (p. 261).

Although Davies expected immersants to have calm and meditative experiences in *Osmose*, many experienced unexpected sensations and emotions such as euphoria or a sense of loss, finding themselves weeping after the session. Erik Davis (1996) from *Wired Magazine* illustrated his experience in *Osmose*: "I feel at once immaterial and embodied, angelic and animal. I move like I do in lucid dreams, vaporous and invisible, and yet I'm constantly returning to the root of breath and balance."

Davies continued to further develop the artistic vision in *Osmose* and made another immersive virtual environment, *Ephémère* (1998). It shares the same visual concept and navigation methods. However, in the world of *Ephémère*, the immersant can experience the virtual world temporally as well. The installation is structured to represent the ephemerality of being, allowing the immersant to experience the transformation of landscape, earth, and body as time passes. (Davies, 2003)

*Osmose* has expanded the range of visual, aural, and interactive aesthetics of virtual reality environments. The title demonstrated an alternative use of immersive space, pushing the

boundaries of existing 3D tools. As the term *Osmose*—a biological process involving passage from one side of a membrane to another—implies, the installation allows the immersant to transcend the Cartesian split between mind and body, subject and object, ultimately reconnecting mind, body, and world.

## 4. The Aesthetics of Virtual Reality

In this chapter, I introduce the aesthetics of virtual reality, which are primarily based on the aesthetics of digital environment defined by Janet H. Murray (1997) in *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*. Although Murray examines the aesthetic pleasures of interactive digital media, I found it applies to the virtual reality experience as well. In addition to the original list—immersion, agency, and transformation—navigation is added to complement the unique characteristic of the medium. Murray illustrates why it matters to address the aesthetic issues:

Every expressive medium has its own unique patterns of desire; its own way of giving pleasure, of creating beauty, of capturing what we feel to be true about life; its own aesthetic. One of the functions of early artifacts is to awaken the public to these new desires, to create the demand for an intensification of the particular pleasures the medium has to offer. (p. 94)

### 4.1. Immersion

Richard Wagner, German composer and theatre director, used the term *Gesamtkunstwerk* (translated as ‘total artwork’) in his 1849 essay, *The Artwork of the Future*, to illustrate his ideal of building a theater that unifies all forms of art. His intent was to create an immersive experience where the spectator mentally transplants herself onto the stage through via multisensory stimulation. Wagner is not the only one who had a desire to maximise the suspension of disbelief—throughout the history of art, artists have tried to realise the similar desire by means of various forms of art including paintings, novels, and movies.

Now we can create a world more immersive than has ever been possible before with virtual reality. One of the most distinguishing characteristics of virtual reality is that it offers a fully-enveloping experience for the participant. When we put on a head-mounted display, we are completely surrounded by a virtual environment, excluding ourselves from physical

reality. All these sensory stimuli such as 3D stereoscopic view, spatialized sound, and haptic feedback enable us to be transplanted in another reality, ultimately leading us to be completely engaged in it.

#### 4.1.1. Immersion and Presence

Murray (1997) has defined immersion as “the sensation of being surrounded by a completely other reality, as different as water is from air, that takes over all of our attention, our whole perceptual apparatus” (p. 98). Murray further argues that “the experience of being transported to an elaborately simulated place is pleasurable in itself, regardless of the fantasy content” (p. 98).

However, a sense of *immersion* is often confused with a sense of *presence*, since there is not yet a universal agreement on definitions of both terms, nor a standard explication of the relationship between them. Therefore, immersion and presence have been appeared as interchangeable terms within VR literature. Sometimes, only immersion is used to embrace both terms, and other times the physical and mental dimensions of each are considered (McMahan, 2003; Sherman & Craig, 2003; Smith, Marsh, Duke, & Wright, 1998).

The term ‘presence’, short for ‘sense of presence’, is mainly used in technically-oriented research on scientific VR applications (McMahan, 2003). Thomas B. Sheridan (1992) has defined presence as “a sense of being physically present with visual, auditory or force displays generated by a computer.” Meanwhile, Steuer (1992) has defined the term as “the extent to which one feels present in the mediated environment, rather than in the immediate physical environment.”

In technically-oriented research, immersion is often regarded as an objective and technological aspect of virtual reality, while presence is a psychological factor and cognitive consequence of immersion (Schubert, Friedmann, & Regenbrecht, 1999; Slater & Wilbur, 1997; Steuer, 1992). Slater and Wilbur (1997) define immersion as “an objective and quantifiable description of what any particular system does provide” while



presence is “a state of consciousness, the (psychological) sense of being in the virtual environment.”

However, Witmer and Singer (1998) do not agree with Slater and Wilbur’s view. They argue that immersion is also a psychological and individual experience. According to them, immersion is “a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences.” However, they also consider immersion as one of the necessary conditions to induce presence.

Before defining the relationship between immersion and presence for this thesis, I want to make it clear that this thesis follows a qualitative and aesthetic approach rather than a quantitative and technical approach. Therefore, I do not agree with the technical perspective, which regards immersion as a subordinated factor of presence. In addition to that, measuring immersion quantitatively using technological factors is not the direction of this study. I am consistent with Murray’s description—a sensation of being completely enveloped in environment—and Wagner’s concept of *Gesamtkunstwerk*—transplanting the spectator upon the stage with all sensory dimension—when it comes to defining a sense of immersion. Therefore, I consider presence to be the same as immersion, preventing further confusion on both terms.

#### 4.1.2. Sense of Place in Virtual Environment

In virtual reality, it is essential to create an environment in which the participant can have “a sense of being there” (Steuer, 1992). Phil and Susan Turner (2006) have proposed that the sense of place could be considered as one of content factors in inducing a sense of immersion. They have suggested four components comprising sense of place:

- The physical characteristics of the environment;
- The affect and meanings including memories and associations, as well as connotations and denotations;
- The activities afforded by the place;
- The social interactions associated with the place.

However, they argue that technology might reproduce the actual places, but not a sense of being there. According to them, the experience of place is subjective in its nature since “place results from our experience of a space, our memories and emotional attachment to that space, and the meanings we attach to it.” Therefore, the sense of place is “an emergent property” that derives from the interaction between an individual and the environment. (Turner & Turner, 2006)

#### 4.1.3. Realism in Immersion

A realistic representation of a virtual environment plays an important role in inducing a sense of immersion. Lombard and Ditton (1997) divided realism into ‘social realism’ and ‘perceptual realism’. While social realism indicates the extent to which the social interaction in virtual environment is plausible, perceptual realism is related with how closely the virtual space depicts the non-mediated world in terms of sensory dimension. Some virtual environments can have a low degree of perceptual realism but a high degree of social realism and vice versa.

However, there exist contrary opinions about realistic virtual environment. One school argues that a virtual environment must be extremely realistic to offer an immersive experience. Astheimer et al. (1994) argue that anything indicating that you are not in the real world needs to be excluded (as cited in Sherman & Craig, 2003, p. 383). The other school includes magical properties as part of a virtual environment. For example, Slater and Usoh (1994) claim that “magical interaction”—actions which are not possible in everyday reality such as flying, scaling the environment, or teleportation—can influence a sense of immersion by helping the participant to be taken away to another world.

When we consider pioneering artworks in the first generation of virtual reality, total photorealism was not necessarily required to induce an immersive experience. For instance, *The Legible City* used 3D block letters to represent cityspaces and *Osmose* intentionally dissolved the boundary between figures and backgrounds of objects in the environment. According to Sherman and Craig (2003), the cartoonishness in virtual environment enabled

participants to enter a dream or fantasy state of mind where anything is possible while any flaw in a photorealistic world might reduce the sense of immersion (p. 383).

## 4.2. Agency

Murray (1997) claims that immersion in a participatory medium does not only indicate a pleasurable drowning, but also implies learning to swim, to do the things that the new environment offers (p. 99). She further argues that “The more realised the immersive environment, the more active we want to be within it” (p. 126). This leads to the second pleasure of virtual reality experience: agency.

### 4.2.1. Sense of Agency

Sense of agency, often referred to simply as ‘agency’, is the term originally derived from cognitive neuroscience theories. Gallagher (2000) defines sense of agency as “the sense that I am the one who is causing or generating an action. For example, the sense that I am the one who is causing something to move, or that I am the one who is generating a certain thought in my stream of consciousness.” In a similar vein, Jeannerod (2003) defines sense of agency as “the ability to recognize oneself as the agent of a behavior.”

Sense of agency has played a critical part in evaluating how people interact with technology as a focus research area in the field of human-computer interaction (Limerick, Coyle, & Moore, 2014). Shneiderman and Plaisant (2004) state in *The Seventh of Shneiderman’s Rules of Interface Design* that designers should endeavour to create interfaces that “support an internal locus of control,” since users “strongly desire the sense that they are in charge of the system and that the system responds to their actions” (as cited in Limerick, Coyle, & Moore, 2014).

#### 4.2.2. Levels of Agency

Murray has defined agency as “the satisfying power to take meaningful action and see the results of our decisions and choices” (p. 126). She points out that activity or participation alone is not agency. In order to have a high degree of agency, “the actions need to be highly autonomous, selected from a large range of possible choices, and wholly determine the course of the experience such as those in playing chess game” such as in a chess game (p. 128).

Marie-Laure Ryan (2005) illustrates four levels of interactivity in digital narrative texts. I adopt her theory to examine levels of agency in virtual reality experience:

Level 1. Peripheral Agency;

Level 2. Agency affecting the discourse and the presentation of the event;

Level 3. Agency creating variations in a partly preprogrammed system;

Level 4. Real-time generation.

In the first level, the virtual world has an interactive interface, but the participant’s action does not affect the events or the order of their presentation. For example, in a 360-degree film, although the participant can choose where to watch from surrounding view, the participant’s action does not affect the storyline. In the next level, widely known as ‘hypertext’, a collection of elements are interconnected by digital links, so that the participant can choose the next element by selecting one of the links.

In the third level, the participant plays the role of a character in the virtual world. The participant is given of freedom of action to some extent, but the purpose of the agency is to progress along a fixed narrative without changing the whole struction of the system. In the last level, stories are not determined beforehand, but rather, generated spontaneously based on the participant’s interaction with the system. The highest level of agency is consistent with Manovich (2001)’s *Open Interactivity*, where the elements and structure of the virtual world is modified in real time according to the participant’s action (p. 40).

### 4.2.3. Interaction Methods

In VR experience, the participant can attain a sense of agency through interaction with a virtual environment and the objects that occupy it. Mark Mine (1995) has illustrated three key methods in which most forms of interaction can be performed within a VR experience:

1. Direct user interface;
2. Physical controls;
3. Virtual controls.

‘Direct user interface’ is an intuitive and flexible method of interaction in which the participant interacts with objects just as she would in the real world. It is crucial for direct user interfaces to design natural, intuitive mappings between the participant’s actions and the resulting actions in the virtual world. In the physical controls method, real-world apparatus—buttons, dials, sliders, and steering wheels, etc.—are used to control the virtual world. The haptic feedback is provided to the participant through control devices, enhancing a sense of immersion and facilitating precise control. However, the physical method does not have a high flexibility. Virtual controls are those that interact with a virtual world via virtual objects that are computer-generated representations. Because the controls are virtual, it lacks of haptic feedback and the participant has general difficulty in interacting with virtual objects. (Mine, 1995)

### 4.2.4. Agency in Pioneering VR Artworks

In the *VIDEOPLACE* experience, the participants have countless ways of interacting with a system by using their whole body freely. Since the title offers direct user interface, it offers a natural and intuitive interaction to the participant. The virtual world is modified in real-time according to the participant’s body gestures and movement. *Legible City* uses the physical control method in which a bicycle is used as a device to interact with a virtual world. Although the virtual environment remains unchanged during the experience, the participant can freely navigate through the space by steering the bicycle.

In *Osmose* and *Placeholder*, whenever the participant turns her head, the view is adjusted accordingly through the head-mounted display. The participant is the one who controls the view of the environment, like in physical reality. While one is not allowed to manipulate the world and objects in *Osmose*, *Placeholder* offers participants a direct user interface method including grabbing the objects and approaching to them for activation. However, in the experience of *Osmose*, the participant can have a strong sense of controlling her own body—body ownership—by navigating the virtual world through her own breathing and turning the direction of the body. The virtual world in *Osmose* is a preprogrammed world, while the world is regenerated on the fly in *Placeholder*.

### 4.3. Navigation

Among interactions in VR experience, navigation is particularly well implemented in virtual reality since the medium already contains a space as a main property. Manovich (2001) claims navigable space as one of key forms of new media along with the database. According to him, movement through spaces is valuable in and of itself, serving the self-sufficient goal of exploration (p. 247). Murray (1997) also argues that the ability to navigate in virtual environment can be pleasurable in itself regardless of the content within (p. 129). The aesthetic pleasure which derives from the navigation of spaces is one of the essential elements in VR experiences.

#### 4.3.1. Types of Navigation Structure

According to Murray (1997), there are three types of navigational structure in virtual environments: the solvable maze, the tangled rhizome, and the journey. Each structure assigns a different role to the participant by providing a different type of pleasure through navigation.

In the case of the solvable maze, the participant takes a role as a heroic protagonist much like one in a classic fairytale narrative of danger and salvation. The maze structure combines a cognitive problem—finding the path—with an emotionally symbolic pattern—

facing what is frightening and unknown. Although the participant derives pleasure from unfolding experiences as she moves forward, she has limited options in the virtual environment: there is only one way to follow to find the way out.

In the tangled rhizome structure, the participant is free to wander around and explore to any direction within. It is unheroic and solutionless without any end point or way out. In this structure, the participant becomes *flâneur* (introduced in Charles Baudelaire's 1863 essay, *The Painter of Modern Life*) who is an anonymous observer, navigating through the space of a crowd without any specific goal or place to go. According to Manovich (2001), "the virtual flâneur is happiest on the move, clicking from one object to another, traversing room after room, level after level, data volume after data volume" (p. 274).

The journey structure unites problem-solving with the active process of navigation in the virtual environment. It follows a universal archetype which dates back to oral storytelling: setting out in solitary from home to find one's fortune. One of the lasting appeals of the journey structure is derived from the pleasure of unfolding solutions to seemingly impossible situations. In this structure, VR experience is organized around the voyage of the participant.

#### 4.3.2. Travel Techniques

Travel is the motor component of navigation: i.e., how the participant moves through space (or time). In virtual reality, there are endless ways of travelling through the virtual environment. Bowman, Kruijff, LaViola Jr, & Poupyrev (2004) describe travel techniques through six common metaphors (p. 191):

1. Physical locomotion;
2. Steering;
3. Route-planning;
4. Target-based;
5. Manual manipulation;
6. Scaling.

Physical locomotion techniques mimic a natural method of locomotion in the physical world (e.g. walking). No extra interface is required other than the tracking of the participant's body position and rendering the world accordingly, which are basic requirements of a virtual environment. However, the scope of participant movement is limited within the range of the tracking device. With steering techniques, the participant constantly specifies either the absolute or relative direction of travel (e.g. gaze-direction, pointing, torso-direction, etc.). They are generally easy to understand and provide the highest level of control for the participant.

Route planning techniques allow the participant to indicate a path or route through their virtual environment, then transport themselves along the path. Although the participant has a limited control over the motion, it enables them to move more precisely by reviewing, refining, or editing the path before its execution. Target-based techniques are used when the participant is concerned only with the endpoint of travel. Even though the participant is willing to give up control of the motion to the system, it is always recommended to offer continuous movement from the starting point to the endpoint.

Manual manipulation techniques can be effective in situations where both travel and object manipulation are frequent and scattered during VR experience. These techniques use hand-based object manipulation to modify the viewpoint instead of a virtual object. Lastly, travel-by-scaling techniques allow the participant to change the scale of the world so that available tracking range and physical space can represent a space of any size. These techniques may cause the participant motion sickness or discomfort, and the participant's movement may not be precise in scaled world. (Bowman et al., 2004)

### 4.3.3. Wayfinding Aids

Wayfinding is the cognitive element of navigation—how the participant knows where she is located and defines a path through an environment to the desired direction. Many different types of information—either from natural or artificial cues—help us to perform wayfinding. Therefore, an interface for navigating through a virtual world often offers



tools to aid in the process of wayfinding. Sherman and Craig (2003) have proposed commonly used real- and virtual-world aids to improve wayfinding (p. 336):

- Path following: a path or trail embedded in a virtual environment;
- Maps: a graphical representation of a virtual space;
- Landmarks: a specific object in a virtual world that is static and easy to locate;
- Memorable place names: places assigned with a memorable names;
- Breadcrumbs: leaving any form of trail markers that are retraceable later;
- Compass: any form of an orientation indicator in a virtual environment;
- Instrument guidance: a variety of navigation aids using visual and sonic cues;
- Exocentric view: a temporary shift in viewpoint to the global context;
- Coordinate display and orthogonal grid structure: presenting location information as text with a grid (e.g. Cartesian system);
- Constrained travel: Placing restrictions on the participant's travel.

According to Sherman and Craig (2003), it is recommended to implement a wayfinding system that accommodates different preferences or includes multiple cues, since individuals use different strategies to develop a cognitive map of their environment (p. 335).

#### 4.4. Transformation

In American television series *Star Trek*, the spaceship crew transformed into fictional characters in the computer simulated environment called the 'holodeck'. The crew could express hidden desires and their true self by freeing themselves from formal persona in real world. As in the holodeck, the participants can become a different being—not necessarily limited to human beings—in VR experience. In *Placeholder* (see Section 3.3), for instance, the participant can transform themselves into mythical creatures through the 'smart costume'. Brenda Laurel (1994), co-director of *Placeholder*, claims that replacing one's ordinary persona with an exotic persona let participants play with a bold imagination in a virtual environment. Transformational experience in a virtual environment is one of main aesthetic pleasures the medium offers to participants.

#### 4.4.1. Self in Virtual Reality

In her 1994 essay, *Constructions and Reconstruction of Self in Virtual Reality: Playing in the MUDs (Multi-User Dungeon)*, Sherry Turkle examines how multiplayer game experience influences one's identity. According to her, MUDs function as "identity workshops" where players present themselves as a character which can be as close or as far away from their real self and an opportunity is given to play with one's identity and to try out new ones. Therefore, the self is not only decentered, but also multiplied without limit in a virtual world.

After observing how players project themselves to a character in a virtual environment, Turkle found that the medium allows players "to explore a social context as well as to reflect on its own nature and powers." Furthermore, she claims virtual reality as an "exemplary evocative object" which provokes thoughts about the self and the real world which we have taken for granted. She believes that virtual reality will raise old questions in new contexts and offer fresh resolutions in constructing and reconstructing identity. (Turkle, 1994)

#### 4.4.2. Enactment in Virtual Reality

In VR experience, we enact stories rather than merely witnessing them (Murray, 1997, p. 170). The participant experiences events as 'personal experiences' because the participant is the center of the virtual world and things are happening to her, right here and right now. Murray points out that the strong emotional impact of enactment within an immersive environment has been employed effectively in psychotherapy. More specifically, psychologists have treated phobic patients by enabling them to practice coping behaviors within simulated environments.

However, she also claims that there might be a side effect of the transformational power of enacted experiences. For instance, enactment in VR may strengthen violent or antisocial behaviors. Since the medium offers an immersive virtual environment where the participant can project their inner fantasies and desires regardless of morality, the participant might be encouraged to subsequently carry out the same behavior in the real

world. Murray has suggested including violent or antisocial material in VR experiences rather than excluding them, but to also offer participants with a wide range of other options in which they can see different consequences.

#### 4.4.3. Immersive Journalism

Journalists have also noticed the impact of enacted narrative, applying virtual reality to newscasting. De la Peña et al. (2010) introduced the concept of immersive journalism, which is “the production of news in a form in which people can gain first-person experiences of the events of situation described in news stories.” In experiencing immersive journalism, the participant is represented as a digital avatar in a virtual environment, and enact recreated scenarios based on the news story.

In Nonny de la Peña’s early work, *Hunger in Los Angeles* (2012), the participants don a head-mounted display portraying a scenario situated inside the long queue for getting free food from the church. Suddenly, an old man in front of the participant falls down from a heart attack. While the man writhes in agony on the ground, some people call for help, but others take that incident as a chance to cut in line. While the simple 3D computer animation is used for visual representation, the sound recorded from a real event is used to enhance realism in the virtual environment. After the experience, the participants have shown a strong emotional response which they might not have to news coverage in television or newspaper.

According to De la Peña et al. (2010), virtual reality systems are uniquely suited for immersive journalism by transferring participants to a place where a credible action is taking place that they perceive as really happening, the term for this phenomena being ‘response-as-if-real’ (RAIR). They believed that participants’ emotional involvement in current events could be elevated through first-person experience of enactment, ultimately leading them to understand the news “in a way that is otherwise impossible, without really being there.”

## 5. Research Material and Methods

In this chapter, I introduce sources of my research material and the selected VR projects for the analysis. Next follow the research approach of this study and the brief illustration of how I conducted a systematic observation on each work.

### 5.1. Research Material

#### 5.1.1. Sources

In order to select materials for analysis, I looked through virtual reality installations from several different sources. First, I reviewed 50 virtual reality projects shown in Sundance Film Festival from 2012 to 2016. This consisted of 35 projects in 2016, 11 projects in 2015, 3 projects in 2014, and 1 project in 2012. Sundance Film Festival has been a well-known public venue that presents narrative-driven virtual reality titles. This is particularly prominent now that the festival has created a separate section in 2016 meant specifically for artistic virtual reality experiences.

In addition to that, I checked 23 titles selected in Kaleidoscope VR Festival (those also presented in Sundance Film Festival are excluded from counting). Kaleidoscope VR Festival launched in 2015 to promote virtual reality artworks created by independent developers. Lastly, I looked through virtual reality titles in Steam, the biggest online platform of video game distribution developed by Valve Corporation. The company has been producing HTC Vive—a virtual reality headset—in partnership with HTC.

Unfortunately, not all the titles were available for direct experience. Some installations required specific equipment which were not accessible to public (such as *Real Virtuality: Immersive Explorers* (2016) by Sylvain Chagué & Caecilia Charbonnier, *In the Eyes of Animal* (2016) by Barnaby Steel & Robin McNicholas, and *The Leviathan Project* (2016) by Alex McDowell & Bradley Newman). And some did not release their work to the public after the festival. I have tried out most of the available titles, and for those I could not have a direct experience with, I reviewed them through secondary sources such as

online articles, playthrough videos, and interviews with developers. The list of virtual reality installations I studied is attached in the Appendix.

### 5.1.2. Selecting Works for the Analysis

After going through the virtual reality projects mentioned above, I have selected four works for analysis. The pieces were chosen as to represent a wide range of virtual reality experiences. Each title offers a distinct experience, while all use virtual reality as an artistic medium. The most important criteria in selecting research materials was how well the aesthetics of virtual reality was expressed through the work.

I chose to analyse the following works:

1. *SightLine: The Chair* (2014) by Tomáš “Frooxius” Mariančík;
2. *FIREBIRD: La Péri* (2016) by Innerspace VR;
3. *The Gallery: Call of the Starseed* (2016) by Cloudhead Games;
4. *Tilt Brush* (2016) by Google.

*SightLine: The Chair* is an experimental piece which invites users into a surrealistic environment where things do not work as they do in the real world. The title keeps reminding the participant that she is in a ‘virtual’ environment. *FIREBIRD: La Péri* presents the potential of virtual reality in performing arts and interactive storytelling. Based on the classical ballet, it transplants users onto the stage where beautiful dance performance happens. *The Gallery: Call of the Starseed* is a fantasy adventure game built for virtual reality experience. Featuring an environment with a high degree of photorealism, the title actively utilises properties of virtual reality in game play. The last work, *Tilt Brush* is a virtual reality painting application that lets participants create a life size painting in 3D space. Unlike in other selected works, the participant can fill the virtual space with her own creation. Selected works are discussed in detail in Chapter 6.

## 5.2. Research Methods

In this thesis, I employ a qualitative research approach to examine virtual reality artworks. Since my own observations and experiences are used in this analysis, the study is qualitative and interpretative by nature. Specifically, qualitative content analysis is used as a main research method. Qualitative content analysis is defined as “a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (Hsieh & Shannon, 2005, p. 1278). According to Philipp Mayring, qualitative content analysis is “an approach of empirical, methodological controlled analysis of texts within their context of communication, following content analytic rules and step by step models, without rash quantification” (2000, p.2).

I made an initial observation on selected works during the selection process. After trying out each piece, I made a quick note on the type of the experience, overall impression, and distinct features. After the selection was made, I tried them out again for a detailed observation. The whole session was recorded via a computer screen. I tried out some of the VR titles more than once to make sure I did not miss anything during the experience. Lastly, I conducted tertiary observation by reviewing the recorded experiences and related articles.

The aesthetics of virtual reality (see Chapter 4)—immersion, agency, navigation, and transformation—are employed as a theoretical framework of the research. How aesthetic pleasures are implemented in the installations is a main factor in the analysis. My observations on the selected works are presented in Chapter 6, and findings from the observation are discussed in Chapter 7.

## 6. Analysis of Four Cases

In this chapter, I present my observations on four creative VR installations: *SightLine: The Chair* (2014) by Tomáš “Frooxius” Mariančík, *FIREBIRD: La Péri* (2016) by Innerspace VR, *The Gallery: Call of the Starseed* (2016) by Cloudhead Games, and *Tilt Brush* (2016) by Google. The aesthetics of virtual reality (see Chapter 4) are employed as analysis factor of the research.

### 6.1. SightLine: The Chair (2014)

*SightLine: The Chair* is a virtual reality experience designed as a demoing tool. It was originally developed as a prototype during a three week VR jam held by Oculus Rift and IndieCade in 2013. Later in 2014, Tomáš “Frooxius” Mariančík, the developer of the installation, released a new version of the prototype and named it *SightLine: The Chair*. Since then several updated versions of the title have been released and the fully fledged game, *SightLine*, is in progress.

I tried the latest version of the work (*SightLine: The Chair 1.9*) with Oculus Rift CV1, and the whole session took a bit less than 10 minutes. It is designed to be experienced in a sitting posture in a chair. Except for starting the game, it does not require the participant to use any input devices other than a VR headset.

The experience started from a desk in a dark room. My hands were tracked in a virtual environment and my body was shown as an avatar in a sitting position in the chair. The computer screen on the desk started playing the video which Mariančík, the creator of the title, introduces the work. He encouraged me to look around the room and see what happens. Whenever I turned my head away from the desk and looked back, the small objects on the desk had changed into something else: the mug became a plastic cup, the plant changed into a different type of plant, and the box of donuts changed into fruit, etc.

After the first set, I was relocated to a surrealistic world in which white balls and cubes were floating in a dark liquid, and the beams of light were flying in the dark sky. Like in the previous setting, whenever the objects left my line of sight they changed into something else: the balls changed into the cubes and vice versa (Figure 8). After several turns of looking around, the background transformed into a grass field. In this setting, I could fill the environment with trees by looking around.

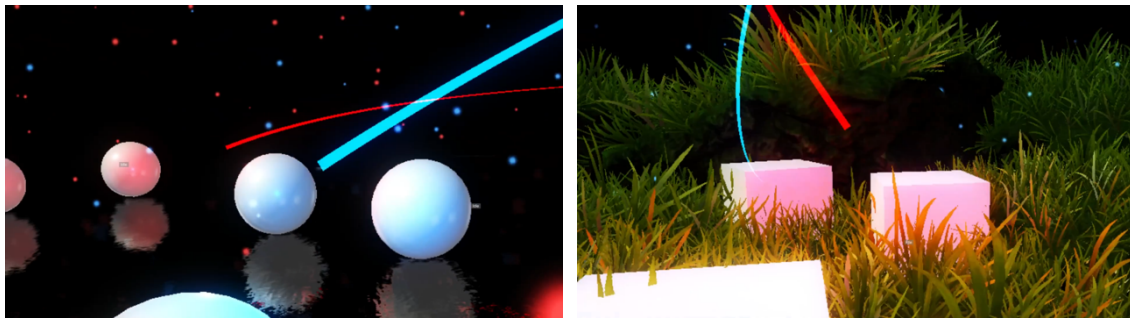


Figure 8: Floating balls (left) change into cubes in a grass field (right) when the participant looks back.

For the rest of the experience, I was transported into several different surroundings and could transform each environment in different ways by shifting my gaze; I made something appear and disappear or pulled the surrounding walls closer to me. In one setting, I could explode meteorites by staring at them for a certain amount of time (Figure 9). In the last stage, I was located on a plank of wood swinging in a high construction site. Unlike in previous scenes, I did not have any power to change the circumstances no matter how hard I looked around. The experience ended as I fell to the ground.



Figure 9: The meteorite about to explode by the participant's gaze. *When the participant stares at the meteorite for a certain amount of time, it first changes its color, and then explodes.*



*SightLine: The Chair* offers a surreal experience by placing a participant in an environment which represent a real world, but does not function as a real world. In the physical world, the laws of physics ensure us that everything stays the same when we look away. However, the same rule does not apply to the world of *SightLine: The Chair*. The moment the participant shifts her gaze to somewhere else, the surroundings out of the participant's field of view change. The transformation could be as simple as one or two objects changing their shape, but could be also as dramatic as whole environments converting into something completely different.

This installation offers a relatively low degree of agency. The participant has only one method of interacting with the system—gazing—and the relationship between the participant's action and the result is rather arbitrary. Whenever the participant shifts her gaze, the environment changes in an unexpected way. However, as this work uses a direct user interface approach, the participant can interact with a virtual environment in an intuitive and natural way (see Section 4.2.3). The whole experience is designed to follow a fixed order from the beginning to the end. In this level of agency, the participant can not affect the events nor the order of them (see Section 4.2.2).

Traveling in a virtual environment is limited in *SightLine: The Chair*'s experience. The participant is not allowed to move around the space, remaining stationary in a sitting position. The participant can navigate the space only via looking around. In addition to that, the participant's exploration does not have any desired direction. This navigation type is similar to the rhizome structure: the participant becomes anonymous observer, navigating through the space without any specific goal (see Section 4.3.1). In this structure, wandering around the space itself brings pleasure to the participant.

Although there are restrictions in interaction and navigation, *SightLine: The Chair* offers an immersive VR experience by empowering the most simple and intuitive interaction—looking around—in a virtual environment. The participant can not help but turning her head around constantly to find out what happens next. Contrary to most VR installations, this work keeps reminding the participant that she is not in a real world. As in René Magritte's paintings, realness in a virtual environment intensifies surrealistic experiences when the participant finds out ordinary things work in extraordinary ways.

## 6.2. FIREBIRD: La Péri (2016)

*FIREBIRD: La Péri* is a virtual reality experience based on the classic 1912 ballet by French composer Paul Dukas. Developed by Innerspace VR, the title drew inspirations from Walt Disney's *FANTASIA*. It was first released in March 2016, and later in August of the same year, the new version was released as a more fully-realised virtual reality experience. Balthazar Auxietre, CCO and co-founder of Innerspace VR, mentioned in the trailer of the project that the frustration of watching performing arts in the far distance drove his team to create a VR experience that invites users to the stage.

In the world of *La Péri*, the participant plays the role of a prince who is seeking to possess immortality. In order to do that, he needs to collect the petals of the 'flower of immortality' from guardian spirits. In the final part of the experience, the most enchanting guardian spirit is awakened to protect the last petal of the flower. The spirit dances around a prince with dazzling movements, trying to mesmerize him. The animation of guardian spirits is created by motion capture technology on ballet dancers (Al-Obaidi, 2016).

I tried the latest version of the work with HTC Vive, and the duration of the session was about 15 minutes. It is designed to be experienced from a standing position in a room-scale setup with a minimum dimension of 2 x 1,5 metres. The participant is encouraged to walk around and move her physical body during the experience. Vive's hand-held controller plays an essential part in the interaction with the system—the right hand-held controller functions as a capturing device and the left hand-held controller as storage.

The piece started at the dark backstage of the theater. I did not have a virtual body, but I could recognise both of the hand-held controllers gleaming with red light. The short tutorial session introduced how to capture the petals and store them with hand-held controllers. After the tutorial, the curtain on the stage opened to reveal the audience, and the orchestra tuning sound was heard from the orchestra pit. The book pedestal rose from the floor (Figure 10) and the narrator—actor John Rhys-Davies, known for his role of Gimli in *The Lord of the Rings* trilogy—introduced the story of Iskender, a prince who is after the flower of immortality.



Figure 10: The narrator introduces the story of Iskender.



Figure 11: The last guardian spirit performs a dazzling dance around the participant.

The title consists of four acts, and the petals need to be collected from each act. Each petal is protected by a different guardian spirit, who possess different shapes and movements. It became more difficult to take the petals from the creatures as the story continued. I needed to move my body actively—reaching hand out, bending down, and turning around—to complete the mission. In the final act, the last spirit in a silhouette of woman covered with shining light rose up and danced around me (Figure 11). The last petal, located in the chest of the spirit, remained just out of the tracking area where I could reach with hand-held controllers. It is designed to be impossible to catch the last petal while the spirit is dancing.

After the bewitching performance, the spirit suddenly fell down to the stage, allowing me to approach it. As I grabbed the last petal with the right hand-held controller, the text appeared above the controller saying, “choose between your immortality or La Péri’s eternal grace” (Figure 12). I could either take the last petal to complete the flower of immortality or give it back to La Péri. According to my choice, a different ending sequence followed.

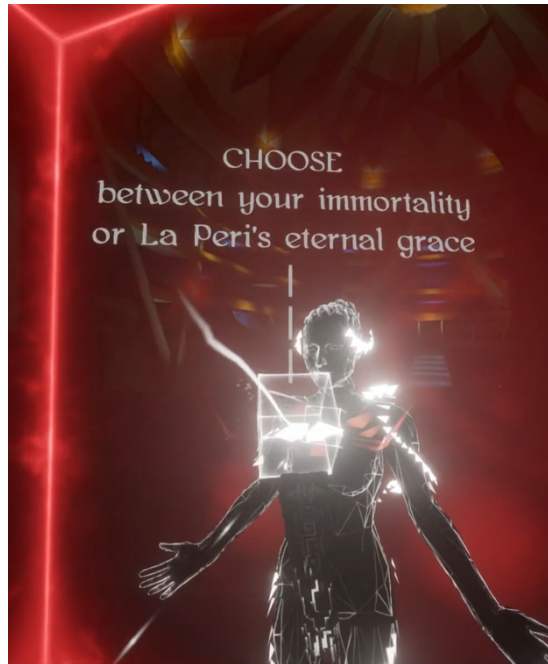


Figure 12: The moment of a decision.

The installation presents a relatively simple and abstract virtual environment compared to the other selected works. However, its minimalistic setting pays off when of the shining spirits dance around the participant in the final act, inarguably the most immersive part of the experience. The participant can pay full attention to the performance since there are no unnecessary details in the background which might take her attention away.

The physical control method using a hand-held controller is employed for interacting with the system. It is less intuitive than a direct user interface method, but the hand-held controllers are designed to be simple to use and the haptic feedback from them ensure that the participant makes the correct action (see Section 4.2.3). In addition to that, the installation shows the third level of agency, whereby the participant can create variation in a partly preprogrammed system (see Section 4.2.2). In this level of agency, the participant does not only interact with virtual characters, but also affects the virtual world by selecting one of the predefined paths.

The installation follows the solvable maze navigation structure, in which the participant takes a role as protagonist of the narrative (see Section 4.3.1). As a prince who desires to possess the flower of immortality, the participant needs to explore the world and find

desired objects. For traveling through virtual spaces, one of physical locomotion techniques is employed—walking (see Section 4.3.2). The participant can walk around inside the tracking area, and the outside area can be explored by a flashlight enabled through the hand-held controllers. The last part of the experience makes brilliant use of the constraint of this travel technique by positioning the dancing spirit just out of the tracking range. It makes the spirit literally the unreachable creature.

The piece beautifully realises performing art in virtual reality. During the experience, the participant does not only get a chance to be on the stage next to performers, but also becomes part of the performance. The work also invokes in participants a strong sense of agency by allowing them to interact with characters and affect the last sequence of the storyline. However, the limited navigation could be improved in further development. In conclusion, *FIREBIRD: La Péri* explores the potential of virtual reality as a medium for performing art and interactive storytelling.

### 6.3. The Gallery: Call of the Starseed (2016)

*The Gallery* is a virtual reality experience built as an episodic fantasy adventure game. The indie game company Cloudhead Games presented the first episode of the game, *Call of the Starseed*, on April 2016 with the help of a Kickstarter campaign. The piece was inspired by dark 80's fantasy movies and classic graphic adventure games.

In the experience of *The Gallery: Call of the Starseed*, the participant takes the role of Alex who is on a journey to find his or her missing twin sister, Elsie. Elsie was helping a loony professor in the secret laboratory and they have discovered a powerful yet dangerous artifact. Elsie's voice messages on cassette tape guide Alex's way through the mysterious island. To get to closer to the missing sister, the participant needs to scrutinise the place, get the clue, and solve the puzzle.

I tried the title with HTC Vive, and the duration of the game was about two hours. It is designed to be experienced from a standing position in a room-scale setup of 2 x 1,5 metres (minimum). The participant is encouraged to walk around and use her physical

body to interact with the system. Vive's hand-held controller enables participants to perform various interactions in a virtual environment.

The adventure started on an empty seashore in the midst of a starry night. The moment when I stepped onto the island, I could instantly feel a strong sense of immersion since the surrounding environment was represented in such high fidelity. The photorealistic visuals lent a mysterious atmosphere, and the sounds amplified the spooky mood of the island. In addition, the sense of touch was implemented to enhance the realism in virtual world. For example, I could feel a vibration through the hand-held controllers when I set off firecrackers on the beach.

The small path on the seashore led me to a campfire, where various little objects lay around the bonfire (Figure 13). I could make all kinds of interactions with those objects, such as making popcorn, tossing bottles into the fire, listening the sound of the ocean from seashells, etc. After spending some time in the bonfire area, I encountered a locked sewer gate which could not be opened without the key. In order to find the key, I needed to examine the surrounding area and get the clues to solve the puzzle. For example, Elsie's voice message on cassette tape gave the clue to find the gun from the upper shelf. Cryptic notes on the desk said to ring the bell by using the guns, and so on. The game moved into the next stage when I opened the gate to the sewer system.



Figure 13: The bonfire place. *The participant can make various interactions with objects in the place.*

This work consists of six sets, and the participant has to solve one puzzle in each set. Even though it seemed tricky to solve the puzzle at first, it did not require any twisted or unexpected way of thinking. Rather, the puzzle was solved in a reasonable way in most cases. In the last part of the experience, Alex is transported into another dimension of the world where the missing sister is waiting, implying that the first episode of the game was only a small part of the big puzzle.

The installation offers a wide range of interaction through physical control method—hand-held controllers (see Section 4.2.3). The participant can manipulate objects in various ways, such as picking up, throwing away, smashing, setting on fire, etc. The participant can also manage an inventory of items with a ‘backpack’ (Figure 14). The backpack can be pulled off by putting the controller behind the participant’s shoulder, clicking the trigger, and pulling her arm back around. When pulled off, the backpack shows all the items inside and the participant can take out one of the items. New items can be stored in the backpack by simply dropping it over the shoulder.

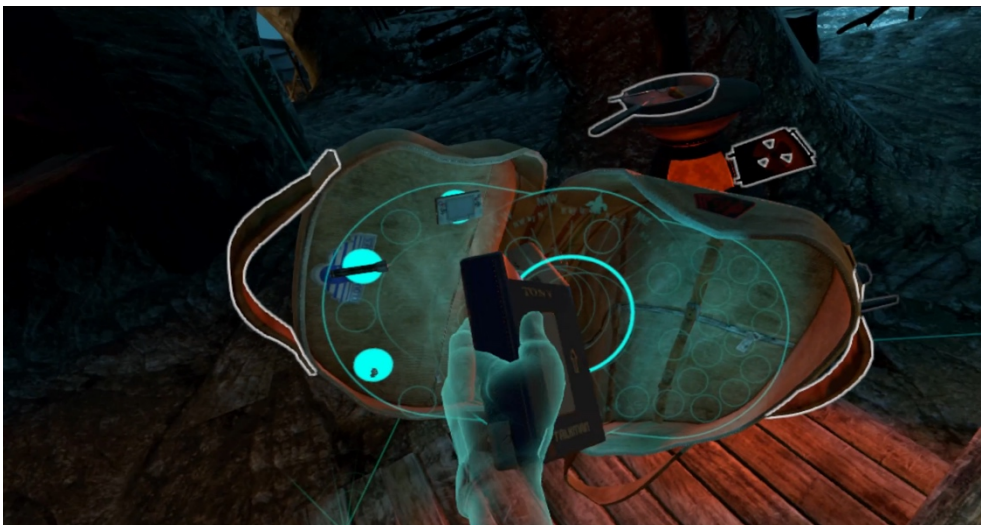


Figure 14: The backpack. *The participant can store the important item in the backpack and take it out when it is needed.*

Along with lots of interaction options, the title also offers highly autonomous actions, since it is entirely the participant's responsibility to figure out riddles. Solving the puzzle by taking the right action at the right moment brings a high degree of agency to the participant. Even though the participant follows a preprogrammed experience (see Section 4.2.2), it

gives a feeling that the participant is in control of storyline since it can not go forward before she completes the mission.

In one setting, the participant needs to find a way out in the sewer system. To guide the participant in the dark labyrinth, the system offers tools to aid in the process of wayfinding (see Section 4.3.3). First, the participant is given the map of the sewer system, albeit the map is not clearly drawn and difficult to read in dark. Then she needs to find the arrow signs on the wall by using the flashlight and follow those signs to reach the exit.

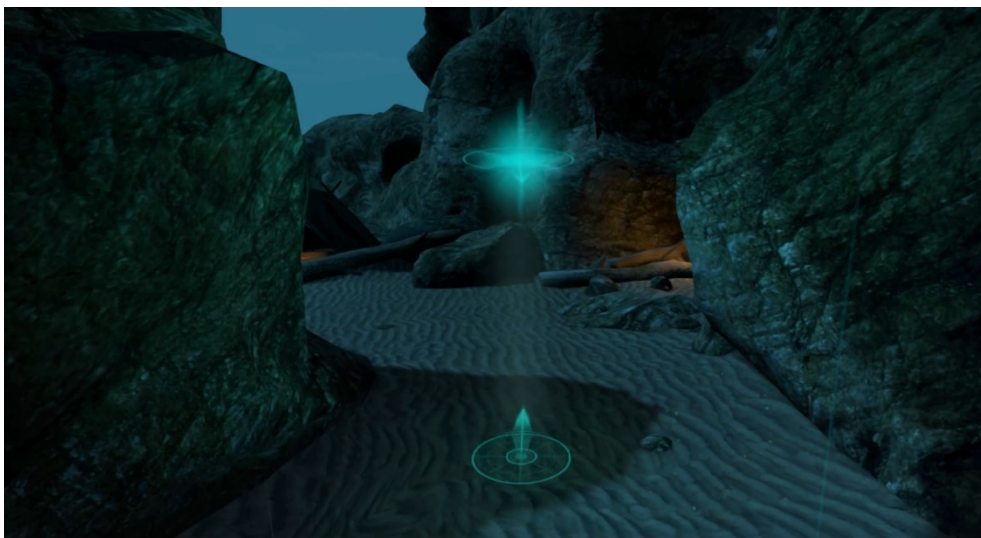


Figure 15: The 'BLINK' system. *When the participant presses the trackpad in hand-held controller, the target point of teleportation is shown as a shining circle.*

In the experience of *The Gallery*, the participant can travel the virtual space both with physical locomotion technique—walking—and virtual travel technique—teleporting. The latter technique employs the 'BLINK' system developed by the creators of the game. When the participant holds down the trackpad in the hand-held controller, the circle icon is shown on the ground based on the head-tracking (Figure 15). The participant can swipe her thumb to reposition which direction she is facing, then let go of the button to teleport herself to that spot. Although teleportation can be an effective traveling technique in a virtual environment, it can significantly decrease the participant's spatial orientation (Bowman, Koller, & Hodges, 1997). Bowman et al. (2005) suggest employing continuous movement in target-based techniques (see Section 4.3.2).



By following the journey structure, *The Gallery: The Call of the Starseed* makes a great use of virtual reality in realising a problem-solving and exploration game. As a protagonist of the storyworld, the participant is motivated to unfold the solutions for seemingly impossible situations and must be ready to encounter unknown surprises. Furthermore, a high degree of agency and the combination of physical and virtual travelling technique offers an immersive experience.

#### 6.4. Tilt Brush (2016)

*Tilt Brush* is a virtual reality painting application by which the participant can create art in a 3D space. The title was originally created by Drew Skillman and Patrick Hackett, and Google acquired their company, Skillman & Hackett, in 2015. Since its official release on April 2016, the installation has been extensively presented as an introductory application for VR experiences. As in the case of MacPaint & Microsoft Paint, a painting software has been known as the best way to introduce a new way of computing. (Ungerleider, 2016; Machkovech, 2016)

However, *Tilt Brush* is not the first immersive drawing program for virtual reality. The installation owes to several pioneering systems: *VIDEOPPLACE* (Krueger, 1985), *Surface Drawing* (Schkolne, Pruett, & Schröder, 2001), *CavePainting* (Keefe, Feliz, Moscovich, Laidlaw, & LaViola Jr, 2001), and *Helma* (Mäkelä, Reunanen, Takala, & Ilmonen, 2004). Early precursors have showed that constructing shapes in 3D space using the hand and tangible tools holds a great capacity as an artistic medium.

I tried the latest version of the title (*Tilt Brush version 6*) with HTC Vive. The experience can last as long as the participant chooses, since it does not have a fixed duration time. I spent about half an hour in the installation. Like *FIREBIRD* and *Call of the Starseed*, the work is designed to be experienced in a standing position in a room no smaller than 2 x 1,5 metres. Vive's hand-held controllers function as a tool for painting: the right controller works as a brush while the left controller as a tool box (though a left-handed person can switch the controller to have a brush controller in the left hand).

The experience started from an empty 3D space. Nothing was seen except the floating logo of the installation and both controllers. As soon as I swung the right hand-held controller, a blue stroke appeared in the air along my hand movement. The painting had started like that. Even though I was required to use a physical device—hand-held controllers—the interaction was as natural and intuitive as a direct user interface (see Section 4.2.3). In particular, the drawing operation with a hand-held controller was very similar to using a brush in the real world.

The left hand-held controller showed the tool selection menu on a four-faced shape which could be spun by sliding the trackpad (Figure 16). The menu consisted of brush selection, color picker, tool, and sketchbook. I could choose the item from the menu with the right hand-held controller, and the item was automatically applied in the virtual environment. The overall interface was simple and easy to learn without a tutorial.

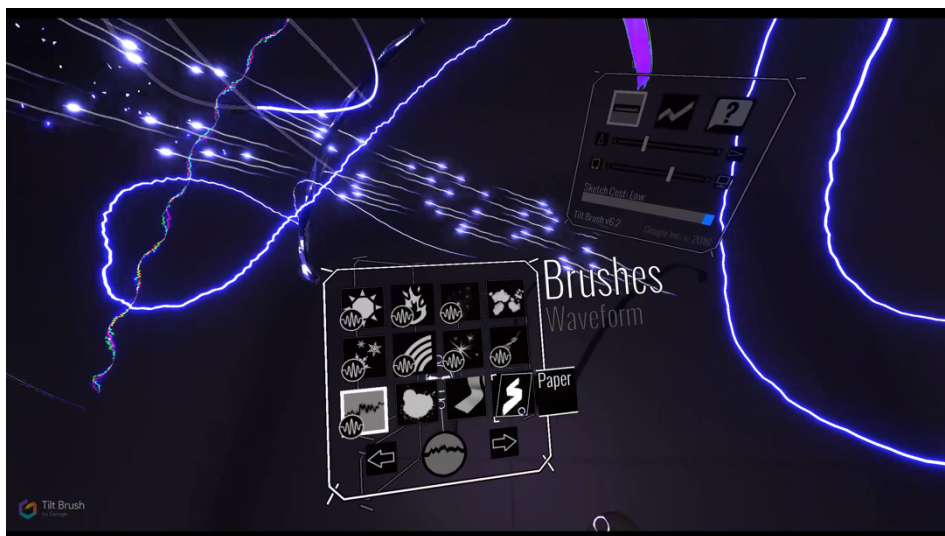


Figure 16: The tool selection menu in left hand-held controller.

In addition to common flat brushes, the installation also provides ‘dynamic brushes’, which feature live movements. For example, the line of sparkling little stars can be drawn with a ‘star’ brush, a line of blazing fire with ‘fire’ brush, and cascading rainbows with a ‘rainbow’ brush. Furthermore, ‘audio reaction brushes’ feature live reaction to the sound from the computer (Figure 17). According to the beat of the music, lines bounce, sway, move, and pulse.



Figure 17: Audio reaction brushes. *The lines show live reaction to the sound from the computer.*

Although the piece is designed to be experienced alone, the participant does not need to be a lonely creator. The artworks can be shared with others as life-sized works or compressed GIFs. The participant can also take a snapshot or a video of her work. The artworks done by others can be imported into the virtual space via the ‘gallery’, and the participant can create works on top of them.

This title shows the strongest agency among the four selected works because of highly autonomous action, the vast selection of choices, and the participant’s influence in the virtual environment (see Section 4.2.2). In addition, the piece shows the highest level of agency: real-time generation. In this level, the virtual world is modified on the fly according to the participant’s actions. There is not much to navigate in the default environment, but the participant can explore her own or others’ artwork in 360 degrees by walking around within the tracking area.

In the experience of *Tilt Brush*, the participant is not asked to take any specific role, but given a chance to create things freely in virtual space. According to Laurel (1994), co-director of *Placeholder*, virtual reality can be a playground for adults when their imaginations are ‘booted up’ by a rich virtual environment. As in *Placeholder* (see Section 3.3), *Tilt Brush* enables participants to fully exercise their imagination in a virtual space. The installation brings adults childhood joy by letting them enjoy the process of creation.

*Tilt Brush* shows the great potential of virtual reality as an artistic medium. Making life-sized artworks in 3D spaces by using one's own hands is a very pleasant experience itself. However, my experience proved that it is not easy to draw 3D objects (such as a cube or sphere) in the air. Further improvement could be done to enable the participant to construct 3D objects easily in a virtual environment. Also, limited navigating area could be enhanced by employing a virtual travel technique along with walking.

## 7. Findings

Phil and Susan Turner (2006) argue that sense of place is ‘an emergent property’, deriving from the interaction between an individual and the environment. Investigating sense of place in selected works has revealed that the coherence of a virtual world is an essential factor to induce a sense of immersion. Even though the level of fidelity in terms of representing the real world is relatively low, immersive VR experiences can be achieved if the virtual environment has its own logic and rules. For instance, in the experience of *SightLine: The Chair*, whenever the participant shifts her gaze from objects or environment, they change into something different. However, the virtual world is consistent with its logic during the experience that the participant accepts the world as it is and enjoys the surrealistic experience it offers.

This finding is related with realism in a virtual environment. Sherman and Craig (2003) claim that magical elements in a virtual environment enable the participant to enter a dream or fantasy state of mind where anything is possible. All four selected works feature surrealistic properties in virtual environments: the laws of physics are broken in *SightLine: The Chair*, the participant needs to collect the flower petals to achieve immortality in *FIREBIRD: La Peri*, magical artifact transports the participant into another dimension of the world in *The Gallery: Call of Starseed*, and the participant creates paintings in the air in *Tilt Brush*. Observation has shown that strict realism in a virtual environment is not always necessary for a sense of immersion, so long as the virtual world keeps its coherence.

In Chapter 4, I suggested four levels of agency in VR experience based on Marie-Laure Ryan’s theory on interactivity in digital narrative texts (2005). The lowest level does not allow the participant to affect the events or the order of their presentation, while the highest level modifies elements and structure of the virtual world in real-time based on the participant’s input. Reviewing levels of agency in selected works has suggested that there is an inverse relationship between the degree of agency and the degree of authorship. *SightLine: The Chair* shows a low degree of agency, but a high degree of authorship. The installation follows a predefined storyline while the participant has a limited way to interact with the system. On the contrary, *Tilt Brush* shows a high degree of agency, but a

low degree of authorship; there is no preprogrammed narrative the participant needs to follow while the participant is free to construct her own experience within the system.

However, a low degree of authorship does not mean that the participant replaces the role of the author. Murray (1997) argues that playing a creative role within an authored environment is different from having authorship of the environment itself. She further claims that we must distinguish derivative authorship of the participant from the originating authorship of the system itself (pp. 152–153). Even though the participant has a high control over the system, it is not authorship, but rather agency.

Although navigation in virtual reality has been studied to maximize the participant's freedom (Bowman et al., 2004; Sherman & Craig, 2003), examining the four VR titles in the previous chapter has shown that placing constraints on the participant's movement may bring more compelling experiences than providing limitless freedom of navigation in a virtual environment. For example, the participant is not allowed to travel outside of the tracking area in *FIREBIRD: La Péri*. In the last act of the piece, the guardian spirit performs a beautiful dance just out of the range of the tracking device. No matter how hard the participant stretches out her hand to capture the last petal from the spirit, the petal remains intact. The restricted scope of participant movement offers a tantalising experience that might not have been possible otherwise.

Another example can be found in the case of *SightLine: The Chair*. During the experience, the participant remains stationary in a virtual environment. The participant can explore the space only by looking around. However, constraint on navigation makes the participant more curious about their surrounding environment. The participant is eager to find out what is going on and enjoy the unexpected results the experience brings.

Sherry Turkle (1994) claims that the participant can explore new identities as well as reflecting on their own identity within a virtual environment. Reviewing transformation in four VR installations has revealed that the behaviour and the attitude of the participant may change according to the given role in a virtual environment. Each VR experience transforms the participant into a different being, and the participant experiences the work through the lens of this new identity. The participant becomes a curious explorer who

enjoys investigating a virtual environment in the experience of *SightLine: The Chair*, while the participant transforms into an obsessed prince who is after collecting the petals of the flower of immortality in *FIREBIRD: La Péri*. In the case of *The Gallery: Call of Starseed*, the participant is a heroic protagonist who is willing to take a risk to find their missing twin sister. Lastly, the participant becomes an imaginative child who enjoys free-form creation in 3D space in *Tilt Brush*.

In this Chapter, I have discussed findings from my observations on the four creative virtual reality projects. The following summarises the findings:

1. The coherence of a virtual environment is more crucial than a realistic representation of the physical world in inducing a sense of immersion;
2. The degree of agency and the degree of authorship have an inverse relationship;
3. Placing constraints on a participant's movement in a virtual environment can bring about a strong emotional impact;
4. The participant's attitude and behaviour changes according to the given identity in a virtual environment.

This is not exhaustive list, but it does cover important aspects in terms of the aesthetic dimension of VR experience. The findings suggest that each aesthetic pleasure should be carefully considered when designing an immersive VR experience.

## 8. Conclusion

Virtual reality has been commonly considered as a medium for practical application or entertainment rather than a medium for artistic expression (Bates, 1992; Laurel, Strickland, & Tow, 1994). Furthermore, there has been a lack of research in the aesthetic dimensions of virtual reality. In this thesis, I aimed to examine the aesthetic pleasures in VR experience and analyse four contemporary VR installations based on them.

The journey began by reviewing the changes that VR has gone through over the course of time. Conceptual innovation, along with technological advancement, have been key factors in the development of the medium. Although I had an inkling that virtual reality has existed long before the current hype, I was pleasantly surprised to learn just how long it had been an unfulfilled dream for artists and researchers. Reviewing the history of VR also helped me to better understand the current state of the medium in a wider context.

Pioneering first-generation VR artworks provided great examples of virtual reality being used as an artistic medium. Myron Krueger's *VIDEOPLACE* (1974) introduced a new paradigm of full-body interaction in a computer generated environment, while Jeffrey Shaw's *The Legible City* (1989) shed new light on constructing a navigable space in a virtual environment. In Brenda Laurel & Rachel Strickland's *Placeholder* (1992), virtual reality became an imaginative playground for adults by transporting the participant to a virtual world embedded with narrative elements. Char Davies' *Osmose* (1995) demonstrated how a VR installation can provide a strong emotional experience by allowing the participant freely float around a poetic environment.

In Chapter 4, I proposed four aesthetic pleasures of virtual reality that I consider to be a vital part of this thesis. This list can by no means be exhaustive, but includes some fundamental properties of VR experience based on the literature research I studied, as well as my personal experiences in various VR installations. I highlighted the following key concepts in my writing: immersion, agency, navigation, and transformation.



A look at the immersive aspect of virtual reality suggested that there needs to be further research on clearly defining the term ‘immersion’, and how a sense of immersion is achieved in a virtual world. I had a particularly difficult time in defining the relationship between immersion and presence, since researchers represent conflicting perspectives according to the orientation of their research. However, going through extensive literature review helped me to redefine the primary focus of this study.

Interaction with a virtual world is a key ingredient of VR experience. As Murray (1997) claims, participation or activity alone does not bring the participant a sense of agency. Agency and navigation are aesthetic pleasures derived from well designed user interface (UI). Exploring different ways to interact with the system and travelling in a virtual environment revealed that the extent of control over the system should be decided based on the objective of each VR experience.

Virtual reality has a strong capacity for personal transformation by allowing the participant to enact certain events. As it has been used in psychotherapy and immersive journalism, the transformative power of virtual reality can be used for artistic expression as well. In addition, the participant reflects their own self in virtual reality, constructing and reconstructing identity in virtual environments (Turkle, 1994).

Although there is room for improvement, all selected works showed great potential for using virtual reality for artistic expression. Each installation expressed the aesthetics of virtual reality in different ways, providing an immersive VR experience. The findings from these observations demonstrated important aspects with respect to the aesthetic pleasures of virtual reality. Overall, an analysis on the four selected VR titles has given me a good basis for further production and research work on virtual reality.

Due to a time and budget limit, I could not conduct an interview with the authors of the selected artworks, which might have revealed artistic goals and intentions behind each work alongside the production process. In addition, I did not carry out user observations or user tests other than an analysis of my own experiences with each piece. Further research could be done by evaluating VR experience with different users, adding new layers to the result.

I remember the moment when I tried head-mounted displays for the first time. It was the first version of Oculus Rift, which my friend received from a Kickstarter campaign in 2012. In addition to the heavy weight of the headset and inferior resolution, a terrible motion sickness swept over me. I could not find any reason to try it again. However, three years later I tried it again in a side event of Slush, and this time I was mesmerised. Dramatic advancements in both technology and aesthetics led me to a completely different experience from three years before. We do not know how VR experience could be three years from now. It is responsibility of artists, developers, and researchers to explore the potential of the aesthetic dimension of the medium and establish its own language as an expressive medium.

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## Figure Sources

**Figure 1: Reality–Virtuality (RV) Continuum.** Redrawn from Milgram et al., 1995.

**Figure 2: Gartner Hype Cycle.** Redrawn from The Gartner Group.

**Figure 3: The *VIDEOPLACE* Concept.** Redrawn from Krueger, 1991, p.37.

**Figure 4: Creating art in *VIDEOPLACE*.** Photograph of *VIDEOPLACE*. Retrieved from <http://www.inventinginteractive.com/2010/03/22/myron-krueger/>

**Figure 5: The installation setting of *The Legible City*.** Caselli, M. (n.d.). Photograph of *The Legible City*. Retrieved from <http://www.jeffreyshawcompendium.com/portfolio/legible-city/>

**Figure 6: The installation setting of *Placeholder*.** Laurel, B. & Strickland, R. (n.d.). Photograph of *Placeholder*. Retrieved from [http://90.146.8.18/en/archives/picture\\_ausgabe\\_03\\_new.asp?iAreaID=6&showAreaID=6&iImageID=34975](http://90.146.8.18/en/archives/picture_ausgabe_03_new.asp?iAreaID=6&showAreaID=6&iImageID=34975)

**Figure 7: The visual representation in *Osmose*.** Davies, C. (1995). Screenshot of *Osmose*. Retrieved from <http://www.immersence.com/osmose/>

**Figure 8: Floating balls (left) change into cubes in a grass field (right) when the participant looks back.** Two Screenshots of *SightLine: The Chair*, taken by the author.

**Figure 9: The meteorite about to explode by the participant’s gaze.** Screenshot of *SightLine: The Chair*, taken by the author.

**Figure 10: The narrator introduces the story of Iskender.** Screenshot of *FIREBIRD: La Péri*, taken by the author.

**Figure 11: The last guardian spirit performs a dazzling dance around the participant.** Screenshot of *FIREBIRD: La Péri*, taken by the author.

**Figure 12: The moment of decision.** Screenshot of *FIREBIRD: La Péri*, taken by the author.

**Figure 13: The bonfire place.** Screenshot of *The Gallery: Call of the Starseed*, taken by the author.

**Figure 14: The backpack.** Screenshot of *The Gallery: Call of the Starseed*, taken by the author.

**Figure 15: The ‘BLINK’ system.** Screenshot of *The Gallery: Call of the Starseed*, taken by the author.



**Figure 16: The tool selection menu in left hand-held controller.** Screenshot of *Tilt Brush*, taken by the author.

**Figure 17: Audio reaction brushes.** Screenshot of *Tilt Brush*, taken by the author.

## Appendix: VR Projects from Selection Process

Giant

In the Eyes of the Animal

The Leviathan Project

Real Virtuality: Immersive Explorers

#100humans

6x9: An Immersive Experience of Solitary Confinement

Across the Line

Cardboard Crash

Collisions

Condition One

A History of Cuban Dance

Kiya

Nomads: Maasai

Nomads: Sea Gypsies

Notes on Blindness—Into Darkness

The Unknown Photographer

Waves of Grace

The Abbot's Book

theBlu: Encounter

Defrost

Fabulous wonder.land

Hard World for Small Things

Irrational Exuberance

Job Simulator

The Martian VR Experience

Perspective; Chapter 1: The Party

Perspective 2: The Misdemeanor

The Rose and I

Sequenced

Sisters

Sonar

Stonemilker

Surge

Viens! (Come!)

Waves

Click Effect

Dear Angelica

Assent

Birdy

Evolution of Verse  
Kaiju Fury!  
Project Syria  
The VR Works of Felix & Paul  
Way to Go  
Zero Point  
Lost  
Wild–The Experience  
EVE: Valkyrie  
Sound + Vision  
Clouds  
Hunger in Los Angeles  
Jet Lag  
Mad God  
The Marchland  
Old Friend  
La Péri: A Prelude  
Tana Pura  
Blocked In  
Bright Shadows  
Butts  
Colosse  
The Crossing  
Future of VR  
Der Grosse Gottlieb  
I am You  
LoVR  
Lucid Trips  
Real  
Reframe Iran  
Reminder  
Witness 360: 7/7  
Edge of Space  
Invasion!  
Tilt Brush  
The Archer  
DMZ: Memories of a No Man's Land  
Kurios  
The Last Mountain  
The Nepal Quake Project  
The Night Café  
SightLine: The Chair  
Uplift

Welcome to Aleppo  
Pollen  
The Lab  
Diorama No.1: Blocked In  
Diorama No.3: The Marchland  
Budget Cuts  
Fantastic Contraption  
Kumoon: Ballistic Physics Puzzle  
GE Neuro