

Aesthetics of Immersion in Interactive Immersive Environment : Phenomenological Case Study

Jinsil Hwaryoung Seo, Greg Corness, Diane Gromala, Thecla Schiphorst

Texas A&M University, Columbia College Chicago, Simon Fraser University
College Station, USA; Chicago, USA; Vancouver, Canada
hwaryoung@tamu.edu, gcorness@colum.edu, gromala@sfu.ca, thecla@sfu.ca

Abstract

This paper examines the aesthetics of immersive experience in *Light Strings*, an interactive immersive environment. One of prominent aspects of Interactive Art is the notion of immersion. The concept of immersion is generally defined as a viewer “forgetting” the real world outside of the virtual environment and by a sense of being in a make-believe world generated by computational hardware and software. As an interactive artist and researcher, I conceive of immersion as any experience where integrated bodily, conscious, and pre-conscious states thoroughly intertwine with the world. Moreover immersion is where mind, body and environment interweave and communicate with each other inside of technically-mediated, spatially enclosed, and sensuously-interactive computational environments. *Light Strings* was created based on my previous art practice and research into immersion as a way to study participants’ experiences with the artwork. In the participant study of *Light Strings*, participants were encouraged to describe the felt experiences of the installation through phenomenologically oriented research methods. As a result, an experiential model of the participants’ experiences was developed by exploring bodily, spatial, and contextual consciousness with temporal considerations.

Keywords

Immersive environment, aesthetics of experience, immersion, audio-visual, case study

Introduction

One prominent aspect of Interactive Art is a notion of immersion. Immersion has been historically explored mostly by literary and film theorists and more recently, by Virtual Reality (VR) scientists and artists. It is generally defined as a viewer “forgetting” the real world outside of the virtual environment and by a sense of being in a simulated world generated by computational hardware and software. Most research into immersive experience has been conducted from a scientific perspective. The scientific research tradition typically standardizes or objectifies results and doesn’t focus on the meanings and qualities of experience. Similar to other scientific studies, immersion researchers have largely used quantitative/empirical methods, such as measuring physiological data and conducting surveys after the participants’ experience. [1-3]

In a movement parallel to Computer Science research, many Interactive Artists have also explored immersion within VR environments in collaboration with computer scientists in many times. Their general approach to immersion is somewhat different from those of scientists. Artists have explored full-body, sensory immersion through their artistic creations. [4-6] Their approaches countered the disembodying tendency of virtual reality discourses and their artistic pursuit was centred on creating immersive experiences using new technology (new hardware or complex systems). Rather than quantifying the participants’ immersive experience, their focus was on creating new immersive experiences.

As an artist, I create interactive immersive installations exploring the idea of embodiment and materiality. My artist skills and interests have led me to experimenting with soft materials and light to create immersive environments. From over 15 years of experience with digital technology in Interactive Art, I believe that technology can help us to experience nostalgia and relive our memories, reawaken habituated senses and provide opportunities to perceive new things in a creative way. In this study, I created an interactive immersive installation, *Light Strings* and conducted participant study to examine how participants experience immersion, how immersion is constructed in my installation and what the main qualities are of the environment. This paper analyzes aesthetics of immersive experience collected from a case study. Participants were encouraged to describe their felt experiences through phenomenologically-oriented research methods. This allowed me to gather various data on participant experience.

Background

Understanding Immersion

The sense of immersion has been explored for a long time but there is no set or universally agreed upon definition for this term because all approaches converge on the word immersion from different knowledge areas. The term is widely used for describing immersive virtual reality, installation art and video games, but no one meaning dominates. Its meaning remains vague, but common to each meaning is the connotation of being absorbed, engaged and embraced. Different disciplines use these differ-

ent definitions. This means that immersion has multiple, flexible qualities that can be applied in different situations.

Contemporary Views

Immersion in New Media

Since the 1990s, more in-depth research on immersion has been conducted in the Arts and Humanities. The result is two streams of scholars and artists. One stream explores various immersive experiences in different realms: videogames, narrative, and human experience. The other stream focuses on building immersive experience within immersive VR spaces.

Salen & Zimmerman call immersion “double consciousness,” that the game player is fully aware of the character as an artificial construct. They argue that this makes character-based game play a rich and multi-layered experience. [7] For Bolter and Gromala, a participant’s awareness oscillates between feeling immersed and being aware of an immersive environment. However participants most of the time are still aware of the real environment and get immersed from the interplay between real media and virtual contents. [8]

Many other researchers have focused on the desire to use technology as the defining factors in immersion; they describe the term “immersion” as immersion into presence, a state of being engaged; in this way presence is a psychologically emergent property of an immersive system. Immersion describes a condition; presence describes an associated state of consciousness. [9] Carol Manetta and Richard Blade defined immersion as an observer’s emotional reaction to being part of a virtual world. [10] They consider immersion as mental process created during the use of immersive VR systems that include HMDs and other equipment. Immersion can be stimulating process, but in most cases immersion “absorbs and provokes a process, a change, and a passage from one mental state to another”. [11]

Immersion in Interactive Art

Immersion is in part a spatial experience, in the sense of enveloping the participant in a discrete and panoramic space. Moreover, it is also a temporal experience when combined with computational components. It creates an intimate connection as “a constitutive element of reflection, self-discovery, and the experience of art and nature”. [11] Immersion is considered paradoxically as distance, as absorption, and as space and time blur in the immersive environment. The pioneering immersive artist Davies explored the concept of immersion using the metaphor of scuba diving (submersing in water) and using a concept of cognitive absorption in her projects [4]. Around the 1960s, early new media artists conducted experiments related to immersion. Artists and designers have new possibilities for interactive immersive works become more accessible and more powerful with programming tools. In relation to VR art, the sense of

immersion is being explored in art projects that encourage the active involvement of the participant and evoke senses and/or fully engage with attention. Interactive artists often try to use limited, inexpensive technology but in creative ways to examine the sense of immersion because it is hard for them to use very expensive equipment and because the sense of immersion does not require photo-realistic or technologically complex multi-sensory environments. “Immersion can be created from perceptual cues.” [12]

Immersion in Physical Environment

Immersive spaces create subliminal awe [13], helping the viewer/participant become aware of inherent or internal body senses. Physically immersive environments expand the boundary of our vision and create imagination evoking immersive feelings from materials that affect with perceptions of dimension. Physical installations do not include normal architectural rooms or spaces where we live in the everyday life. Even though we are physically surrounded by a room or nature and may be engaged to something in the space, it is hard to call the phenomenon immersion. When we are habituated to the space, we are rarely aware of our connections to the environment and the reciprocal relationships within the space. In my study of immersion, it is critical to recognize that immersive consciousness is constructed through embodied experience in the relationships among body, mind and the world.

Methodology

Methodological Background

Art has been acknowledged as research among practitioners, theorists, and educators. [14] In contrast to academic and scientific research emphasizing the generalizability and repeatability of knowledge, art research expresses a form of experience-based knowledge [15] and explores subjective qualities of experience. Artists identify researchable problems discovered in practice, and respond or solve them through professional practice. Therefore, artists know their works and the questions around the works better than any other researchers. An artist is a researcher who has multifaceted roles: material experimenter, space designer, fabricator, critic, documenter and audience. [16] In other words, it is ideal that artists take a lead role in the research of their works, rather than being separated from the research process. In that respect, artists’ research activities seem to be appropriate for Baumgarten’s classical definition of the aesthetic domain.

Phenomenological Approach

In the realm of art research, there has not been much work dealing with research methods because artists’ interests often lean more towards creating new works than investigating the aesthetic qualities and meanings of participant experience. However recent movements in interactive art indicate that some interactive artists put value on the qualit-

ties and meanings of participant's experience with their works as well as the process of artistic creation. Phenomenology, especially as contained in Merleau-Ponty's work, has been acknowledged as an appropriate research method by contemporary new media artists. Phenomenology is not a single method. Phenomenological methods have been adopted and developed in many disciplines and are being actively explored in Cognitive Science and Human Science including Nursing. Because of the nature of phenomenology, there are multiple interpretations and modifications of phenomenological philosophy and phenomenological research methodology. However the focus is always to get descriptions about subjective experience from the first person perspective "in their fullest breadth and depth". [17]

Phenomenological Case Study

Concept of *Light Strings*

Bodily Experience

The idea of considering the body as a main felt medium inspired by phenomenologists, Merleau-Ponty [18], Varela [19], and Johnson [20] has been a strong motivation for me to create interactive environmental works. Treating "Body" as not separated from the being who experiences an interactive work was critical while I developed my ideas of immersion. In *Light Strings*, bodily and sensorial aspects of the immersive experience were emphasized as one of the key properties of immersion. The participant's body connects to the physical and virtual world through movement. Movement that occurs within an environment makes intimate connections and interactions with aspects of that environment. I built an immersive environment that makes an immediate connection to the body. There is no direct sensory mapping for interaction. Any kind of bodily movement affects the environment and computational system, creating unique but varied qualities. To pursue this concept, I focused on the creation of a physically immersive installation.

Physical Immersive Space

In *Light Strings*, I tried to create a physically embracing space that is flexible and open, and provides participants with free movement in the space. Participants and multi-media agents co-exist and meet in *Light Strings* through touching and using their whole bodies. Full freedom of physical body movement, creating relations to the physical installation and a virtual world is a critical condition of *Light Strings*.

Since I create physically immersive environments that engage bodily experience, materials are very important for me as an artistic media. Physical materials are simple, direct, and apparent in and of themselves. Once they are combined with digital technology, materials are no longer simple. They become complex, integrated and interconnected and these new relationships create their own beauty. When they move, responding to the participant's motion in

varying scales from wearables to environments, they can provoke a strong visceral feeling. The branching and joining of physical material and technology in my work echoes the symbiotic relationship between human and technology, exploring the idea of "hylozoism" [21] or life from material. In the process of art creation, fiber optics are not simply cold plastic strands to me. They live in the space the same as other computer generated interactive elements and participants as well as myself. This encourages active, self determined relationships within a work of art.

Implementation of *Light Strings*

The physical space of *Light Strings* (Figure 2) consists of over 2500 strands of fiber optics hung from the ceiling. I used custom produced, straightened fiber optics. Each end of the fiber optic strand was directly mapped to a point in the projection grid.



Figure 1. Audience Interaction with *Light Strings*

The interactive system design began with observations of participant experience. First of all, I tried the environment by myself with my collaborators. This exploration provided an ability to understand the range of movement possible in the space. Then, I invited a participant and observed their movement in the space without any interactive elements. I was able to classify their movements into four categories: ambient, exploration, play, and meditation.

- Ambient mode: no audience in the space.
- Exploration mode: slow walking
- Play mode: very active, fast movement
- Meditation mode: very slow or static movement

Based on this categorization, my sound designer and I started design behaviours for virtual agents (visual and sound) responding to participant behaviour by referencing the modes of movements. In addition, the agents' own behaviours were also designed. Similar to other living beings' behaviours, they come together, fight, and ignore each other sometimes.

Interactive System Design

The setup of *Light Strings* is a combination of three groups of equipment: a motion tracking system, a visual system, a sound system as well as a fiber optic structure. The motion tracking system consists of a computer (Macintosh), two video converters and two infrared (IR) cameras hung on the ceiling grid. The computer continuously tracks participant's movement in the space, and analyzes the movement and sends the movement data to the visual and sound systems. The visual system consists of a computer (PC) and a projector that projects visual data on the grid of fiber optics bundles. The sound system has a computer (Macintosh), the audio interface and four speakers. M-Audio, an audio interface, spatializes the sound processed through the four speakers.

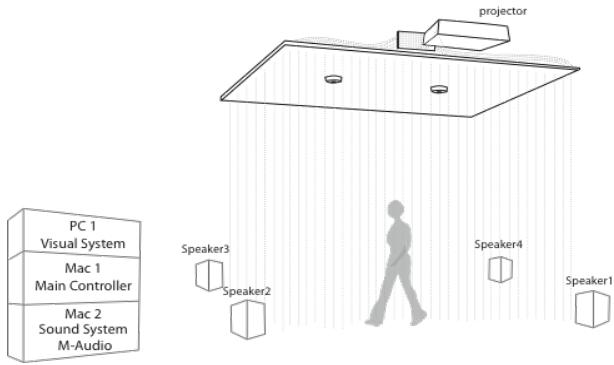


Figure 2. Technical Setup for *Light Strings*

Motion Tracking System

Two IR cameras detect the participants' motion in the installation. The light emitted by the fiber optics has a low level of infrared spectrum. This allows the use of IR cameras for tracking the movements of visitors in the space. Video images from two IR cameras were stitched together and the custom created application provided variables to produce interactive virtual agents. The visual and sound system received these values over the network and generated the interactive multimedia.

Visual System

The visual system consisted of a PC and a projector. The graphical aspect of visual agents was implemented using Processing. In the graphic environment, 8 to 10 visual agents are created and they move around depending on their characteristics and behaviours assigned to them initially. There are two kinds of visual agents: active and inactive. Two different colors (pink and blue) represent their characteristics. The pink ones behave actively and the blue ones are inactive. Their initial characteristics (color, size, movement, speed) may be changed in response to the participant's behaviour. All visual agents have circular shapes. Their sizes are randomly assigned between 80 to 100 pixels in diameter. The initial active agents (pink) are floating around in the space. They move faster than inactive agents (blue). They are curious and friendly beings

and they explore the environment very dynamically. When they hit each other, they bounce off each other. The inactive agents are slow and less friendly beings. They tend to gather in one area. They are not interested in other beings in the same space. They don't care about the pink ones or the participant.

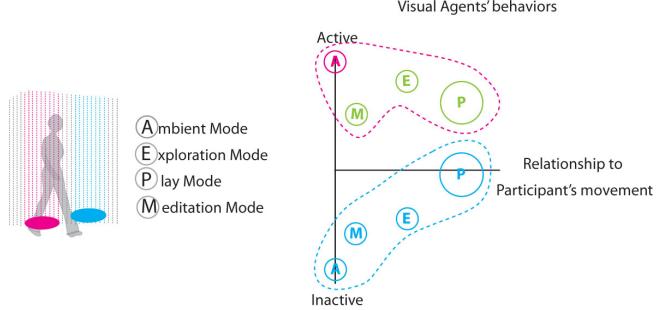


Figure 3. Diagram of the visual agents' behaviors

The images of the agents rendered by the system are projected on to the ends of a bundle of fiber optics. The fiber optic strands that fill up the installation space create a tactile light space allowing the light animation to move in the fiber optics hanging around the space. The behavioural movements of the agents create the illusion that they are alive.

Sound System

The sound system works along with the visual system to create an immersive environment. Our goal was to create natural but elemental sounds that respond to the participant's movement. They work as environmental sound agents similar to air in that they move around regardless of human existence and people can feel them through the movement of their bodies. The environment contains initial sound elements from white noise in Max, a visual programming language for music and multimedia. They are activated when the participant's movement is detected in the space and come and go while interacting with the participant.

Study Design

In the study, I focused on getting participants' experience from their first-person perspectives. To support the subjective first-person data, other data collection methods such as interviewing (second-person) and video recording (third-person) were also used. I used *Light Strings* as a case study to look at participants' qualities of aesthetics of immersive experience. The overall process can be summarized as 1) gathering a full set of naïve descriptions from participants who had experienced *Light Strings*; 2) analyzing the descriptions in order to grasp common elements that make the experience what it is; and 3) describing or giving a clear, accurate and articulate account of the phenomenon so that it can be understood by others.

Participants and Study Condition

16 participants were recruited through an open email call that was available to the general public. They were given ample opportunity to accept or decline. They were asked to pay attention to their sensory experience and felt experience. The participants had a chance to experience *Light Strings* three times with different conditions (*Both*, *Visual*, and *Sound*). The physical environment was the same for all three conditions. In the *Both* session *Light Strings* had visual elements and sound elements. In the *Visual* session, the sound elements were taken away and the participants only experienced responsive light patterns in the environment. In the *Sound* session, there were no visual images, only a soundscape filled with fiber optic strings. Early test runs showed that the participants' experiences were affected by the order they experienced the three sessions. Therefore I used four different orders of the three sessions to structure the study (Table 1).

Table 1. Four different orders of participants studies

	Session 1	Session 2	Session 3	Duration
4people	<i>Both</i>	<i>Visual</i>	<i>Sound</i>	1:30-2h
4people	<i>Both</i>	<i>Sound</i>	<i>Visual</i>	1:30-2h
4people	<i>Visual</i>	<i>Sound</i>	<i>Both</i>	1:30-2h
4people	<i>Sound</i>	<i>Visual</i>	<i>Both</i>	1:30-2h

Procedure

Participants in the study were asked to experience *Light Strings*, three times for as long as they want to stay. They were free to do anything and there were no time limitations on how long they stayed in the installation. Participants experienced *Light Strings* aesthetically via the artworks' kinaesthetic tactile quality as well as visual and auditory qualities. While the participants were experiencing *Light Strings*, their movement inside of the installation was video captured. *Light Strings* was already capturing the participant's movement from above using two IR cameras to analyze movement in the space in order to create responsive virtual agents that the participants can interact with. Therefore, I was able to record the camera capture screen using another video camera. This video data was digitized and processed to investigate how the participants moved and behaved in the installation. I did not extract the video images from the motion analysis process because recording a video at the same time as analyzing it uses too much of computer's processing ability and made the entire system unstable.

After each session of experience, the light level of the room was adjusted for the next activity and the participant was guided to a writing station. Participants were provided a single card with three open-ended questions: "What did you experience?", "How did you experience?", "How did you feel?" They were asked to write down their experiences quickly and fearlessly when answering the questions. The quick writing process without analytical thinking helps to extract their subjective experience

effectively. The participants were instructed: "think back and describe your subjective experience of the artwork as much detail as possible." They were assured of the confidentiality of the information. They could write, note or draw their experiences in a hand written "journaling" form. This would give the participants the opportunity to take their time and to reflect on their experiences and to reconstruct the event in more detail on their own, without interference.

As soon as the writing session ended, participants were involved in an interview procedure. The participants were told that the interviews would be treated confidentially. The research instruments for the interview was an open-ended method. This protocol focuses on the researcher facilitating the participant in articulating a description of their experience, creating a phenomenological description. Each interview was digitally video-recorded. Video files were marked only with the session number and the participant number. Transcriptions of the interview were used for the analysis of the data. The participants experienced three sessions of the installation experience and wrote three times and interviewed three times.

Data Collection and Analysis

16 participants provided written descriptions of their experience by responding to three questions: "What did you experience?", "How did you experience?", "How did you feel?" (first-person data). Second-person data (of the participants experience) was collected using an interview technique adopted from Petitmengin [22] and Varela [23]. All the participants' bodily movements in the environment were video recorded and digitized (third-person data).

After the collected data were transcribed and coded, I focused on "themes" arising from the data. In the end, all the different themes were grouped for each participant and used to construct a model of qualities of the participant's immersive experience. This allowed the individual models and general model to be developed concurrently while being compared for validity. Based on the analysis, I constructed a combined model of immersive experience which can be used to develop a further understanding of the aesthetics of immersive experience.

Aesthetics of Immersive Experience

The focus of the research was to investigate the qualities of participants' immersive experience in physically immersive and interactive environments and explore to find meanings created by the experience. During the case study, it became apparent that the participants' experiences in *Light Strings* were immersive. Unlike other researchers' understanding of immersion, I focus on bodily experience engaged with culture, society, environment, and history. My analysis concentrates on building an experiential structure based on immersive consciousness considering temporal aspects.

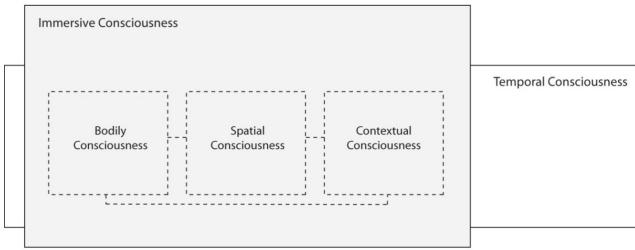


Figure 4. Experience structure of Immersive Experience

Immersive Consciousness

The notion of Immersive Consciousness that is built through my analysis is framed by Bodily Consciousness, Spatial Consciousness and Contextual Consciousness (Figure 4). I describe each of these elements in detail below. I have found that by using this model I am able to recognize similarities in sensorial and felt experience and processes across participants. In this paper, I define consciousness as embodied akin to the way it is defined by contemporary cognitive scientists [24-26]. Our consciousness can be affected by the existence of body or somatic or enactive processes. Therefore, Immersive Consciousness illustrates embodied consciousness as experienced through the body and explains how participants perceive an immersive space and make meanings out of it.

Bodily Consciousness

Body Consciousness focuses on the sensory experience of the participants in *Light Strings*. We learn and understand the world through our bodies. This is not just about a body rather a body in the space and in relationship to the installation. It is always connected to the world we live. Therefore investigating participants' sensory experiences allows me to examine the origin of immersive experience and frame immersive consciousness in terms of embodiment. Since *Light Strings* is a physically immersive installation, the participants experienced and described various sensory experiences including exteroceptive senses (sight, hearing, and touch) and interoceptive senses (proprioception, kinesthesia, and vestibular sense). The bodily consciousness includes mostly sensory experience focusing on what is seen, heard, touched, felt and some emotional valence from the sensory experience. Due to the aesthetic characteristics of *Light Strings*, multiple senses were stimulated and helped to create sense of immersion. Sensual richness helped create a deeper sense of immersion. It is also important to acknowledge that bodily consciousness is closely connected to spatial and contextual consciousness

New Sensations: Awe and Disrupted sensory habituation
Many participants described the experience in *Light Strings* as extremely new and said they never had a similar experience before. This was connected a feeling of being overwhelmed in the sense that their experience was sensorially very stimulating (awe).

"It was really hard to think of other things during that. I was sensorially overwhelmed by how cool that was."

In *Light Strings*, the habituated perception of not being aware of any tactile feeling when we walk normally became disrupted. *Light Strings* is filled with fiber optic strings at a distance of three inches from each other. Therefore, any movement in the environment causes the fiber optic strands to touch the body. Descriptions from participants revealed feelings about new sensations that they did not experience in a daily life.

"It was like experiencing air"

From this reawakened sensory experience, many sensory descriptions were collected. The descriptions focused on heightened individual senses. Sometimes senses were associated together and the participants experienced what might be described as a form of synesthesia, that is a recombination of their senses.

Associated Senses

Many of the participants said that they noticed two sensations at the same time. Senses worked together. In particular, the *Both* session showed a combination of sensory elements that really came together effectively. The associated sensations helped the participants to get engaged and immersed in the environment and created emotional and imaginative experiences. When the participants noticed two or more sensations at the same time, they often constructed associations and found meanings.

The tactile modality functioned primarily to integrate with the other senses. When other senses (visual or sonic) are prominent, the tactile sense intensifies those senses. In addition, the physicality and materiality of the fiber optics extended and enhanced the perceived quality of dynamicism.

"As I was moving through the fiber optics I just felt again that tactility but also the visual beauty of the lights combining together and moving away. And so that really had my focus for a really long time."

Spatial Consciousness

Many participants described *Light Strings* as a space not an object. This is important that they perceived it not just by seeing with their eyes but via embodied seeing through the whole body. *Light Strings* provided an opportunity to expand their conscious experience through the space. Participants' spatial consciousness can be characterized by an emphasis on the sensation of a different world, metaphoric space, embodied space, and vast or proximal scales.

Different Space/World

In the installation, many participants experienced a different space/world, very different from outside. Moreover the participants' experiences in each session

were very different depending on the computer generated visuals and sound. At a basic level, the space was physically always the same, only the media changed. In general, where it was visual-centric, the space was perceived as warm, enclosed, meditative space. Many participants described these different worlds using metaphors from their memory, movies, and books.

"I feel like I'm in a different space; some kind of entering into another dimension or something – a space that you can explore, but at the same time, you feel like you're floating. You feel the curve and things like that."

Metaphoric Spaces

After experiencing *Light Strings*, many participants told me that it is difficult to describe their experience in words. In the process of perceiving the space, the participants attempted to relate their bodily feeling to their previous knowledge or experience using metaphors (all 16 participants). Qualities of physical sensation evoked metaphors. The prevalence of metaphors means that as the participants were paying attention to their physical sensations, their imagination generated metaphors for the experience. The richness of poetic description really came from the interplay of their experience with the media of the system. This shows the success of the piece in terms of immersion.

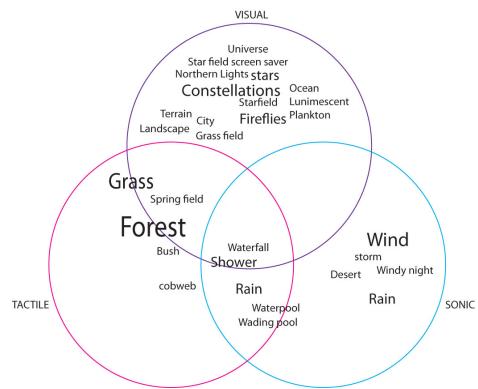


Figure 5. Metaphoric Spaces

Figure 5 is a visualization of word frequency in the descriptions of the participants' experience drawn from the written responses and interview data. All the metaphoric words for the space were collected and categorized by sensory modality. Some metaphors directly represent visual, sonic and tactile space such as fireflies and northern lights for visual space, wind and storm for sonic space, and bushes for tactile space. However, there were metaphors representing associated sensory spaces such as grass field for visual and tactile association. Different aspects of the sensory experience helped to build imaginative metaphoric spaces.

Embodied Space

Space is often defined by constituent and their behaviours: how inhabitants make a connection to environmental behaviours and how they frame it constitutes their space. If we look at *Light Strings* in terms of experiential qualities, it can be interpreted as a playful and meditative space. The most obvious qualities that the participants felt from the space were playfulness and meditativeness. These were characterized by the participants as extremely embodied. In the descriptions of the participants' experience, two different spaces (playful and meditative spaces) were being appeared depending on interaction with the environment.

"It felt very playful, kind of organic experience. It was very flexible and fluid and promoted my curiosity and sort of seemed to engage back because it was responsive and I really liked that. I just felt very open to it and sort of calm and curious at the same time."

"Very small like um..at one point I just started collecting one string with another string and looking at it and then another string..it's like watching insects. As opposed to running around in a forest trying to climb trees. That's kind of the experience, it's more quiet, more gentle, more detail."

Different Spatial Scale

The most interesting phenomenon of the immersive experience observed was that the participants perceived the space at widely different scales. *Light Strings* was perceived as two environments (vast and proximal) at the same time. The idea of multiple worlds means that the participants were able to connect to the physical sensation of vastness at the same time as noticing intimate poetic extrapolations. The specific amount of space in the installation was really contained. The participants were contained within the space but their subjective responses expanded beyond it. However, the space was often sensed and perceived as differently sized in a positive sense, evoking a feeling of wonder.

Discussion and Conclusion

Light Strings is a minimalistic but physically surrounded environment: it operates as part of a phenomenological case study. In the project, the physically immersive environment was created using fiber optic strings, with interactive components projected through the fiber optics and a surround-sound system. Due to the artistic use of fiber optics, kinesthetic tactility was found to be the main sense used in experiencing *Light Strings*, in association with other senses. The study reveals the primary qualities of *Light Strings*: connection, engagement, and attention. *Light Strings* became a medium for creating the participants' narratives by provoking metaphors. The participants brought various narratives and images related to nature and natural experience from the memories, books, and movies. Immersive environments like *Light Strings* provoke the participants into being creators instead of passive receptors.

The whole experience in *Light Strings* can be interpreted as a meaning making experience with an immersive property that is co-constructed by the environment and participant. In the model I elucidate in this paper, immersion consists of bodily, spatial, and contextual consciousness. This model suggests how to explore immersion as a meaningful experience. My research journey through this model shows that immersion is not only present in virtual reality environments but also in physical but interactive realities that strengthen body, space, and contextual consciousness. This is very critical. I believe that awareness of our immersive experience will provide a highly promising path for transforming all fields of human experience, including the artistic, medical, pedagogical, and entertainment fields.

References

1. Slater, M. and M. Usoh, *Body Centered Interaction in Immersive Virtual Environments*, in *Artificial Life and Virtual Reality*, N. Magnenat-Thalmann and D. Thalmann, Editors. 1994, Wiley: Chichester, West Sussex, England ; New York. p. 125-147.
2. Pausch, R., D. Proffitt, and G. Williams. *Quantifying immersion in virtual reality* in the 24th Annual Conference on Computer Graphics and interactive Techniques. 1997. ACM Press/Addison-Wesley Publishing Co.
3. Bangay, S. and L. Preston, *An Investigation into Factors influencing Immersion in Interactive Virtual Reality Environments*, in *Virtual Environments in Clinical Psychology and Neuroscience*, G. Riva, B.K. Wiederhold, and E. Molinary, Editors. 1998, Ios Press: Amsterdam, Netherlands.
4. Davies, C., *Landscapes of Ephemeral Embrace: A Painter's Exploration of Immersive Virtual Space as a Medium for Transforming Perception*. 2005, University of Plymouth: Plymouth, UK.
5. Gromala, D. and Y. Sharir, *Dancing with the Virtual Dervish: Virtual bodies*, in *Immersed in Technology: Art and Virtual Environments*, M.A. Moser, Macleod D., & Banff Centre for the Arts, Editor. 1996, MIT Press: Cambridge, Mass.
6. Laurel, B., R. Strickland, and R. Tow, *Placeholder: Landscape and Narrative in Virtual Environments*. Computer Graphics, 1994. **28**(2): p. 118-126.
7. Salen, K. and E. Zimmerman, *Rules of play: game design fundamentals*. 2003, Cambridge, Mass.: MIT Press.
8. Bolter, J.D. and D. Gromala, *Windows and mirrors : interaction design, digital art, and the myth of transparency*. 2003, Cambridge, Mass.: MIT Press. xi, 182 p.
9. Schneider, U. and M. Feustel, *Toyo Ito : blurring architecture*. 1999, Milan: Charta. 237 p.
10. Manetta, C. and R.A. Blade, *Glossary of Virtual Reality Terminology*. International Journal of Virtual Reality, 1998.
11. Grau, O., *Virtual art : from illusion to immersion*. 2003, Cambridge, Mass: MIT Press.
12. Proske, P., *LOWERING THE THRESHOLD OF IMMERSION IN EMBODIED INTERACTIVE ART*. Vague Terrain, 2010.
13. Griffiths, A., *Shivers down your spine : cinema, museums, and the immersive view*. Film and culture. 2008, New York: Columbia University Press. xv, 372 p.
14. Schön, D., *The Reflective Practitioner*. 1983, New York, NY: Basic Books.
15. Sullivan, G., *Art practice as research : inquiry in the visual arts*. 2005, Thousand Oaks, Calif.: Sage Publications. xxii, 265 p.
16. Gray, C. and J. Malins, *Visualizing Research: A guide to the research process in Art and Design*. 2008, Burlington, VT: Ashgate Publishing Company.
17. Spiegelberg, H., *The Phenomenological Movement: A Historical Introduction*. 1965, The Hague: Nijhoff.
18. Merleau-Ponty, M., *Phenomenology of perception*. International library of philosophy and scientific method. 1992, New York: Humanities Press. 466 p.
19. Varela, F.J., E. Thompson, and E. Rosch, *The embodied mind : cognitive science and human experience*. 1st MIT Press paperback ed. 1993, Cambridge, Mass.: MIT Press. xx, 308 p.
20. Johnson, M., *The meaning of the body : aesthetics of human understanding*. 2007, Chicago: University of Chicago Press. 308 p.
21. Beesley, P. and C. Macy, *Hylozoic soil : 1995/2007 : geotextile installations*. 2007, Cambridge, Ont.: Riverside Architectural Press. 182 p.
22. Petitmengin, C., *Describing One's Subjective Experience in the Second Person: An Interview Method for the Science of Consciousness*. Phenomenology and the Cognitive Sciences 2006. **5**(3-4).
23. Varela, F.J. and J. Shear, *First-Person Methodologies: What, Why, how?* Journal of Consciousness Studies, 1999. **6**(2-3): p. 1-14.
24. Noë, A., *Action in perception*. 2005, Cambridge, MA: MIT Press.
25. Varela, F.J. and J. Shear, eds. *The view from within: First-person approaches to the study of consciousness*. 2002, Imprint Academic: Bowling Green.
26. Prinz, J., *Is consciousness embodied?*, in *The Cambridge Handbook of Situated Cognition* P. Robbins and M. Aydede, Editors. 2008, Cambridge University Press: Cambridge.