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RÉALITÉ ÉVOQUÉE: DES RÊVES AUX SIMULATIONS

Un cadre conceptuel de la Réalité au regard de la Présence

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T H È S E

EVOKED REALITY: FROM DREAMS TO SIMULATIONS

A conceptual framework of Reality referring to Presence

to my Dad . . .

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ABSTRACT

Why do we sometimes wake up from a dream that felt so real that we wonder about it as if it were a place we had just visited? Why do we sometimes lose ourselves in our thoughts during an uninteresting lecture or while walking along a familiar path or even in the middle of a crowded and chaotic subway journey? Why do we wander into our mental imagery while reading textual passages without even understanding what we just read? Why do we transport ourselves to wonderful fantasy worlds while reading stories? Why do we feel scared while standing on top of a skyscraper and looking down, even though we know that it is just a virtual reality simulation?

Research on "presence" in virtual reality, teleoperators and media technologies has gathered much attention in the last few decades. However, the concept of experiencing presence in a virtual world has been explored for centuries, especially from the perspective of humanities, arts and philosophy. The idea of representing or communicating about such illusions of reality beyond the limits of our real world has been evolving since the dawn of mankind. Today many theories on presence (especially from the domains like virtual reality and cognitive science) compete against one another to make sense of our mental experiences of reality.

In this study, we introduce the concept of "Evoked Reality" (Pillai et al., 2013a) and attempt to bring together various ideas about presence and reality and place them onto a common platform.

To begin with, we establish the research areas and examine the problems associated with the study and definition of presence. Then, in order to analyse and confirm our hypotheses pertaining to the concept of Evoked Reality, we define our objectives based on the research questions that we strive to answer.

We present an outline of the current state-of-the-art relating to the research on presence. We examine various definitions of presence that have been proposed, especially in field of virtual reality. Ideas and theories relating to reality, from different perspectives are also presented. We attempt to differentiate between our experience of perception and perceptual illusion as well as cognition and psychological illusion. Finally, we illustrate our concept, that an 'illusion of reality' (Evoked Reality) is what evokes a 'sense of presence' (Evoked Presence) in our minds.

As we explore the concept of Evoked Reality in detail, related propositions are made, which we would analyse using experiments. We clearly define the differences between a Media-Evoked and a Self-Evoked Reality. That would help us introduce the Three Pole Reality Model that redefines the classical Two Pole Reality Model. We also present a graphical model called Reality-Presence Map, which will help us locate and analyse every possible cognitive experience relating to presence and reality. We also explore the *qualia* and subjectivity of our experiences of Evoked Reality. Two experiments that were conducted are presented, each in the area of Media-Evoked and Self-Evoked Reality respectively. The experiments in fact led to fruitful conclusions regarding our hypotheses and convincingly showed us what could be further empirically studied.

In addition, a part of our study explores a few imminent but speculative concepts relating to altered states of consciousness, future of Media-Evoked Reality, reality within reality, reality continuum, etc. Ultimately, we illustrate different implications and shed light on prospective applications and uses of our concept, especially in the area of research on presence. We propose to expand presence research beyond the domain of virtual reality and communication media, and examine it from a broader perspective of cognitive science.

We suggest that this study will lead to a better understanding of our experience of presence, with respect to reality. As our concept of Evoked Reality observes presence in different disciplines from a common perspective it may help towards better understanding of our consciousness as well. We strongly believe that this concept of Evoked Reality and the proposed model will have significant applications in the study of presence, and in exploring the possibilities beyond virtual reality, or dreams or what we call 'reality'.

RÉSUMÉ

Pourquoi nous arrive-t-il de nous réveiller et de nous extraire d'un rêve qui semblait si réel que nous nous demandions s'il ne s'agissait pas d'un endroit que nous venions juste de visiter? Pourquoi nous arrive-t-il de nous perdre dans nos pensées lors d'une conférence sans intérêt ou en marchant le long d'un chemin que nous connaissons bien ou même au milieu d'un voyage en métro bondé et chaotique ? Pourquoi nous arrive-t-il d'errer dans notre imaginaire tout en lisant des passages de textes sans même comprendre ce que nous venons de lire ? Pourquoi devons-nous nous transporter dans des mondes imaginaires merveilleux lorsque nous lisons des histoires ? Pourquoi avons-nous peur lorsque l'on est au sommet d'un gratte-ciel et que nous regardons en bas alors que nous savons que c'est seulement une simulation de réalité virtuelle ?

La recherche sur la « présence" en réalité virtuelle, les téléopérateurs et les techniques de communication a suscité beaucoup d'intérêt ces dernières décennies. Cependant, le concept qui consiste à expérimenter la présence dans un monde virtuel a été étudié pendant des siècles, en particulier du point de vue des sciences humaines, des arts et de la philosophie. L'idée de représenter ou de communiquer au sujet de telles illusions de la réalité au-delà des limites de notre monde réel existe depuis la nuit des temps. Aujourd'hui, de nombreuses théories sur la présence (en particulier dans les domaines de la réalité virtuelle et des sciences cognitives) rivalisent pour donner un sens à nos expériences mentales de la réalité.

Dans cette étude, nous présentons le concept de «Réalité Évoquée» (Evoked Reality) (Pillai et al., 2013a) et nous tentons de relier différentes notions entourant la présence et la réalité au sein d'un cadre commun.

Pour commencer, nous déterminerons les domaines de recherche et nous étudierons les problèmes liés à l'étude et à la définition de la présence. Afin d'analyser et de valider nos hypothèses sur le concept de Réalité Évoquée, nous définirons nos objectifs en fonction des problématiques de recherche auxquelles nous nous efforcerons de répondre.

Nous présenterons un panorama du savoir existant (état de l'art) concernant les recherches sur la présence. Nous examinerons les diverses définitions de « la présence » qui ont été avancées/proposées, notamment dans le domaine de la réalité virtuelle. Différents concepts relatifs à la réalité telle qu'elle est envisagée selon d'autres points de vue seront également présentés. Nous tenterons de distinguer, d'une part, notre expérience de la perception et l'illusion perceptive, et d'autre part, la cognition et l'illusion psychologique. Nous finirons par montrer que notre concept est en fait une « illusion de la réalité » (Réalité Évoquée) qui évoque un « sentiment de présence » (Présence Évoquée) dans nos esprits.

Nous détaillerons ensuite le concept de « Réalité Évoquée ». Nous ferons ensuite quelques propositions connexes qui seront analysées à l'aide d'expériences. Nous définirons clairement la « Réalité Média-Évoquée » et la « Réalité Auto-Évoquée ». Cela nous permettra de présenter le modèle tripolaire de la Réalité qui remet en cause le modèle classique de la réalité à deux pôles. Nous présenterons également un modèle schématique appelé «Reality-Presence Map» (« Carte Réalité-Présence »), qui nous permettra d'identifier et d'analyser toutes les expériences cognitives possibles et imaginables se rapportant à la présence et à la réalité. Nous explorerons également les « *qualia* » et la subjectivité de nos expériences de la Réalité Évoquée. Deux expériences ayant été menées seront ensuite présentées, l'une dans le domaine de la Réalité Média-Évoquée et l'autre dans la Réalité Auto-Évoquée. Les expériences nous ont permis de valider nos hypothèses et de mettre en perspective d'autres recherches empiriques à développer.

En outre, une partie de notre étude présente quelques concepts dignes d'intérêt mais spéculatifs, relatifs aux états de conscience modifiée, à l'avenir de la Réalité Média-Évoquée, à la réalité dans une réalité, au continuum de la réalité, etc. En bref, nous montrons les différentes implications et les applications et utilisations possibles de notre concept, en particulier dans le domaine de la recherche sur la présence. En outre, nous proposons d'étendre la recherche sur la présence au-delà du domaine de la réalité virtuelle et des moyens de communication et de l'étudier dans une perspective plus large que celle des sciences cognitives.

Nous espérons que cette étude contribuera à une meilleure compréhension de notre expérience de la présence dans son rapport à la réalité. Comme notre concept de Réalité évoquée permet d'observer et d'analyser « la présence » dans une perspective commune, il peut aider à une meilleure compréhension de notre conscience également. Nous sommes convaincus que ce concept de Réalité Évoquée et le modèle proposé peuvent avoir des applications significatives dans l'étude de « la présence » et dans l'exploration des possibilités, au-delà de la réalité virtuelle, des rêves ou de ce que nous appelons « réalité ».

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CHAPTER 1: INTRODUCTION

“I find myself sitting in a rather dark living room. There is a small open window with a beautiful vista. It is snowing outside. Although I’m freezing, I walk up to the window and stretch my arms to feel those strangely appealing snowflakes. I hurt my arm as if it hit a solid wall. I realize that the snowing vista is in fact just an image. On closer observation I find that the window itself is an image, and so is everything else around me. With an uncanny feeling of mild disorientation, like waking up from a dream, I remove my head mounted device. I think to myself, 'I went too close to the wall', as I walk out of the cold simulation room.”

There are two ideas that emerge from the above scenario. First, how and why does our mind experience a ‘sense of presence’ in a computer generated virtual environment? Up until what is this sense of presence intact in such virtual reality simulations? It’s truly intriguing to see how our mind is capable of such an experience in a computer generated ‘illusion of reality’. Understanding this experience of ‘presence’ is the key to effective virtual reality systems in the future, making it one of the most researched topics in the field of virtual reality.

The second idea that arises is about where the reader’s imagination took him during the entire scenario? In other words, what went through the mind of the reader while reading that passage? Do we experience a similar ‘sense of presence’ through images or from senses generated entirely in our mind? If so, there is certainly a connection between these experiences - presence in media-aided as well as self-generated illusions of reality. So, why do we not study this experience from both perspectives? These arguments became the source of motivation for this research.

1.1 MOTIVATION: The Experience of Presence

The sense of ‘presence’ (evolving from ‘telepresence’) has always been associated with research in virtual reality and is still an exceptionally mystifying constituent. Now the study of presence clearly spans over various disciplines associated with cognitive science. The concept of experiencing presence in a reality different from our real world has interested scholars and researchers for years. We definitely experience a sense of presence in a virtual reality environment. It is achieved with the help of media that primarily affects our external perception that eventually leads to presence. A strong sense of presence can be experienced in dreams or even daydreams that are evoked entirely internally. How these experiences could be connected between virtual reality, dreams and other experiences of transient virtual worlds, has always been fascinating and is particularly what this thesis attempts to explore.

At the outset, we were primarily interested in how one experiences this 'presence' rather than why. Shortly the secondary interest evolved regarding the reason for and the subjectivity of this experience. In the field of virtual reality, there have been many moderately successful attempts to objectively measure presence. The most important reason behind this concern was to predict the efficiency of virtual reality systems and to create better and stronger experiences; to bring the experience of virtual reality as close as possible to our experience of the real world. But virtual reality researchers often ignore the part of ‘presence’ that is created and affected entirely by our mind. Similarly, researchers from others fields of cognitive science tend to overlook presence study from a virtual reality point of view. Although we can find that there have been few excellent comparisons between virtual reality and dreams in the past (Putnam, 1982;

Revonsuo, 1995; Biocca, 2003; Bostrom, 2003; Metzinger, 2009), there has been no common consensus between these disciplines in terms of the experience of presence.

1.2 BACKGROUND: Presence and Reality

Ongoing research on presence has brought to our understanding various elements that certainly cause or affect the experience of presence in one way or another. But in order to evoke an illusion of presence, we in fact try to generate an illusion of reality different from our apparent (real world) reality through different mediations (like Virtual Reality). The attempt to evoke an illusory reality is what brought researchers to think about presence in the first place. 'Reality', despite its being a major concept, is most often either overlooked or confused with other aspects that affect presence. To study presence, we must first understand the reality evoked in one's mind (Mantovani and Riva, 1999). It is this illusion of reality that forms a space-time reference in which one would experience presence. It is evident from the research in the field of virtual reality, that if a medium is able to create a convincing illusion of reality, there will certainly be a resultant feeling of presence.

Various theories have been proposed, to explore and define the components of this mediated presence (Steuer, 1992; Slater et al., 1994; Barfield et al., 1995; Steuer, 1995; Kim and Biocca, 1997; Lombard and Ditton, 1997; Witmer and Singer, 1998). This thesis aims to abridge those theories in an efficient manner. Moreover, studies in the field of cognition and neuroscience confirm that the illusion of reality can as well be non-mediated (without the help of external perceptual input), that is purely evoked by our mind with an inception of corresponding presence. One of the most common but intriguing examples of a non-mediated illusion of reality would be - a dream. This self-evoking faculty of mind leading to the formation of presence is often neglected when observed from the perspective of virtual reality.

Sanchez-Vives and Slater (2005) suggested that presence research should be broadened beyond the domain of computer science and other technologically oriented disciplines. Loomis (1992) pointed out that presence is in fact a basic state of consciousness, and Biocca (1996) added that presence in virtual reality might be used to study the classic epistemological topics of consciousness. Revonsuo (1995) proposed that we should consider both - the dreaming brain and the concept of Virtual Reality, as a metaphor for the phenomenal level of organization; they are excellent model systems for consciousness research. He argues that the subjective form of dreams reveals the subjective, macro-level form of consciousness in general and that both dreams and the everyday phenomenal world may be thought of as constructed 'virtual realities'. According to Revonsuo (2006), any useful scientific approach to the problem of consciousness must consider both the subjective psychological reality and the objective neurobiological reality. In Virtual Reality it's not just the perceptual inputs or the technical faculties that contribute to a stronger illusion of reality but also various psychological aspects (Lombard and Ditton, 1997; Slater, 2003; 2009) relating to one's emotion, attention, memory and *qualia* (Tye, 2009) that help mould this illusion in the mind. In the case of non-mediated illusion of reality like dreams or mental imagery, the perceptual illusion is generated internally (Kosslyn, 1994; LaBerge, 1998; Kosslyn, 2005). The dream images and contents are synthesized to fit the patterns of those internally generated stimulations creating a distinctive context for the dream reality (Hobson and McCarley, 1977; Hobson, 1988). Whether mediated or non-mediated, the illusion of reality is greatly affected by the context. "A context is a system that shapes conscious experience without

itself being conscious at that time" (Baars, 1993, p.138). Baars describes how some types of contexts shape conscious experience, while others evoke conscious thoughts and images or help select conscious percepts. In fact it's a fine blend of perceptual and psychological illusions (explained in **Chapter 2**) that leads to a strong illusion of reality in one's mind. This study attempts to explore the subjective reality that is the fundamental source of our experience for presence.

1.3 PROBLEM STATEMENT: Need for a Connecting Perspective

As researchers who started from a virtual reality perspective, we found an increasing number of definitions for presence, without any scientific conclusions. Even after years of research, the definitions of presence were found to be confined to specific disciplines although its study spanned over many disciplines that deal with cognition. Moreover, there isn't hitherto a common platform where we could put these ideas on presence to be examined from a global perspective. The idea of objectively studying presence required researchers in virtual reality to come up with various questionnaires. There have also been different elements defined that would contribute to the experience of presence, which are also spread in different directions without coming to a concurrence. But the question of why this experience is particularly subjective is seldom explored. These concerns guided us to enquire into the root of presence experience.

While exploring the state-of-the-art and going deep into the research background of presence, we encountered many questions. Primarily, what is the fundamental reason for the experience of presence in virtual reality? How can it be compared to the experience of presence in a reality, evoked endogenously by our mind? Why is it important to study presence from the perspective of different disciplines of cognitive science? Why are all the disciplines talking about presence but never join forces to tackle this problem together? Why is the experience of presence subjective? Can there be an objective approach to study or represent coherently this 'sense of presence' with respect to 'presence' in the real world? Above questions led to the most important question: *What is this common element in the experience of 'presence' that we find in diverse research disciplines?*

Attempting to answer this question formed the basis of this thesis research. This question drove the study towards finding that common factor which might help bring together different theories connected to the sense of presence. We believe that this common constituent may be traced down to the 'illusion of reality' (created by external mediation of senses or generated internally) that evokes the sense of presence; or as we would like to call it - "*Evoked Reality*" (Pillai et al., 2013a) (which will be explored throughout this study).

1.4 HYPOTHESES AND RESEARCH QUESTIONS

Based on the questions that would be explored in this research, two main hypotheses were developed:

1. It is through an experience of an Evoked Reality (illusion of reality) that our mind experiences an Evoked Presence (sense of presence) different from the real world.
    - An Evoked Reality is either Media-Evoked or Self-Evoked.

2. An Evoked Reality is a subjective spatio-temporal experience.
    - These *qualia* of experience of Evoked Reality are what define Evoked Presence.

For the first hypothesis the state-of-the-art was analyzed and different elements in the experience of presence were studied. The common elements found from different points of view were put together in such a way as to view presence from a novel perspective. How a medium like virtual reality affects the sense of presence is then compared to non-mediated sense of presence in internally evoked mental imagery and dreams. This study then attempts to put forth a concept that argues that it's an experience of an 'Evoked Reality' (illusion of reality) that triggers an 'Evoked Presence' (sense of presence) in our minds. A Three Pole Reality Model is proposed to explain this phenomenon. To coherently represent real and virtual experiences and to demonstrate the relationship between Evoked Reality and Evoked Presence, a Reality-Presence Map is developed. The second hypothesis deals with the *qualia* of our experiences. How our *qualia* of the real world experiences are reflected in Evoked Reality experiences and how they lead to subjective experience of Evoked Presence is questioned. These hypotheses are thoroughly examined in **Chapter 3**.

To break down our study on these hypotheses, we designed two experiments (**Chapter 4**).
The first experiment tried to answer the following research questions:
1. Do all media evoke an illusion of reality?
2. How can we study and compare presence evoked by different media with the help of Reality-Presence Map?
3. How can physiological data contribute to the understanding and comparison of presence evoked by these different types of media?

The second experiment tried to answer the following research questions:
1. Does one experience a 'sense of presence' in mental imagery (without any media)?
2. Can this sense of presence be objectively identified by analysing verbal expressions, gestures and movements?

1.5 RESEARCH OBJECTIVES

The main objectives of this thesis are:
1. To study how we experience presence and reality from disciplines within and outside virtual reality.
2. To propose and justify the concept of Evoked Reality that would help in observing and defining sense of presence from a global perspective.
3. To develop a graphical model that combines reality, presence, Evoked Reality and Evoked Presence in a coherent manner.
4. To study the *qualia* of experience of presence and reality
5. To suggest the future scope of Evoked Reality in the research of presence.

There is a possibility for certain readers to confuse the term 'presence' with interpretations different from the one intended here. Therefore it is necessary to clarify that this thesis does not deal with the questions relating to our existence; To be precise, the term 'presence' mentioned here does not in any way relate to the ontological or existential questions. The specific terms used in this study will be explained and defined in the first part of **Chapter 3-A**.

1.6 CONTRIBUTIONS TO PRESENCE RESEARCH

We strongly consider that this research work will provide a better understanding of our notion of experience of presence, especially with respect to reality. The proposed concept suggests that our state of mind continuously shifts or fluctuates with time for which the graphical model could be used to locate one's state at any point in time. As the concept of Evoked Reality attempts to bring together different disciplines into a single platform where we will be able to study the experience of presence and reality from a macro level, it will help towards better understanding of our consciousness itself. We believe that this concept of Evoked Reality and the proposed model will have significant applications in the study of presence, and in exploring the possibilities beyond virtual reality, or dreams or what we call 'reality'. Details on prospective contributions are outlined in **Chapter 6**.

1.7 ORGANIZATION OF THE MANUSCRIPT

Chapter 1 introduces the research subject (as seen above) and the gaps that exist in the study of presence. In this chapter, we clearly define the objectives of our study and put forward two hypotheses that will be investigated in the following chapters.

Chapter 2 gives an outline of the current state-of-the-art of the research on 'presence'. The various definitions of presence that have been proposed, especially in field of virtual reality, are analysed. A comprehensive report on the ideas relating to 'reality' from various perspectives is then presented. It would help us understand how this research leads to the theme of 'Evoked Reality' (illusion of reality) and why this experience is therefore important to study.

Chapter 3 is divided into two parts. The first part probes into the concept of Evoked Reality. Here, we introduce all the propositions that are made in this PhD research. We attempt to define clearly the differences between a Media-Evoked and Self-Evoked Reality. We demonstrate where different experiences of virtual reality, simulated reality or dreams fall in the large spectrum of our experiences. We also introduce the Three Pole Reality Model, eventually leading to a graphical model that we call Reality-Presence Map. In the second part of this chapter, the Reality-Presence Map is explored in detail, demonstrating how it accommodates every kind of experience of presence in our mind. We also examine the *qualia* of the experience of Evoked Reality. Here, we question the subjectivity of our experiences and attempt to analyze how and why we experience them, from the perspective of Evoked Reality.

Chapter 4 presents two experiments that were conducted, one in the area of Media-Evoked Reality and one in Self-Evoked Reality. Experiment-1, a detailed set of experiments based on Media- Evoked Reality was conducted at Arts et Métiers ParisTech France, while exploring and comparing presence experiences between virtual worlds evoked by a video game (audio-visual and interactive) and a short story (simple textual narrative). Experiment-2 deals with presence in Self-Evoked Reality, which is seldom well explored. To objectively study and demonstrate this phenomenon, an experiment on mental imagery was conducted at Indian Institute of Technology Bombay. In this chapter, we show how these experiments led to fruitful conclusions regarding our hypotheses and what could be further empirically studied.

Chapter 5 deals with further discussion on the concept of Evoked Reality. Although our concept of Evoked Reality and Evoked Presence along with the proposed map provides us a simplified way to look at reality and presence, it raises several scientific and philosophical questions. This chapter explores speculative ideas on altered states of consciousness, future of Media-Evoked Reality, reality within reality, reality continuum, etc.

Chapter 6 concludes this study by outlining prospective contributions of our proposed concept and model to the field of presence research. We illustrate how the hypotheses were validated with different stages of theoretical analysis and experimental results. We finally suggest the implications and the future possibilities that this PhD research leads to.

Additionally, at the end of each chapter, a comprehensive summary in French is presented.

RÉSUMÉ DU CHAPITRE 1 : INTRODUCTION

Dans ce chapitre, nous présentons le sujet de la recherche et le vide qui existe dans l'étude de la présence. Nous définissons clairement les objectifs de cette étude et nous présentons deux hypothèses principales qui seront étudiées tout au long de la thèse.

Le sens de la «présence» (provenant de « téléprésence ») a toujours été associé à la recherche en réalité virtuelle et en constitue un composant exceptionnellement mystificateur. Aujourd'hui, l'étude de « la présence » concerne différentes disciplines liées aux sciences cognitives. Expérimenter la présence dans une réalité différente de notre monde réel a suscité l'intérêt de beaucoup de chercheurs et d'universitaires depuis des siècles. Nous pouvons affirmer avoir éprouvé un sentiment de présence dans un environnement de réalité virtuelle. Il a été rendu possible grâce aux médias qui modifient notre perception extérieure, laquelle nous conduit tout droit à la présence. Un sentiment fort de présence peut être expérimenté dans les rêves ou même les rêveries qui sont vécus entièrement à l'intérieur de soi. Comment ces expériences peuvent être connectées entre la réalité virtuelle, les rêves et les expériences d'autres mondes virtuels transitoires, c'est ce qui a toujours fasciné et c'est ce que cette thèse s'évertue à explorer.

Lorsque nous avons commencé, notre intérêt était principalement de savoir comment nous expérimentons cette «présence» plutôt que pourquoi. Puis l'intérêt a bientôt porté sur le pourquoi et la subjectivité de cette expérience. Dans le domaine de la réalité virtuelle, il y a eu de nombreuses tentatives moyennement efficaces pour mesurer objectivement la présence. La principale motivation était de prédire l'efficacité des systèmes de réalité virtuelle et de créer des expériences plus efficientes ; de rapprocher autant que possible l'expérience de la réalité virtuelle de notre expérience du monde réel. Mais les chercheurs qui ont étudié la réalité virtuelle ignorent souvent la part de « présence » qui est créée et affectée entièrement par notre esprit. De même, les chercheurs qui proviennent de disciplines autres que celles des sciences cognitives tendent à négliger l'étude de la présence du point de vue de la réalité virtuelle. Même si l'on peut considérer qu'il y a eu des comparaisons d'une excellente qualité entre la réalité virtuelle et les rêves dans le passé (Putnam, 1982; Revonsuo, 1995; Biocca, 2003; Bostrom, 2003; Metzinger, 2009), il n'y a pas eu de consensus entre ces disciplines en termes d'expérience de la présence.

La recherche sur la présence a porté à notre connaissance sur les différents éléments qui, indubitablement, causent ou affectent l'expérience de la présence d'une manière ou d'une autre. Car, en effet, pour évoquer une illusion de présence, nous essayons de générer une illusion de la réalité différente de notre réalité apparente (monde réel) à travers des médiations différentes (comme la réalité virtuelle). La tentative d'évoquer une réalité illusoire est ce qui a d'abord amené les chercheurs à réfléchir à « la présence ». Diverses théories ont été proposées pour découvrir et définir les composantes de cette présence médiatisée. Cette thèse vise à relier ces théories d'une manière efficace. Par ailleurs, des études dans le domaine de la cognition (sciences cognitives) et des neurosciences confirment que l'illusion de la réalité peut tout aussi bien être non médiatisée (sans sollicitations perceptives externes), et qu'elle est purement évoquée par notre esprit avec le commencement/l'avènement d'une présence correspondante. Un des exemples les plus banals mais le plus intrigant d'une illusion non médiatisée de la réalité serait : un rêve. Cette faculté d'auto-évocation de l'esprit menant à la formation de la présence est souvent négligée quand on l'observe du point de vue de la réalité virtuelle.

Lorsque nous avons exploré l'état des connaissances actuelles et que nous avons approfondi la recherche sur la présence, nous nous sommes heurtés à bon nombre d'interrogations. Avant toute chose, quelle est la raison fondamentale de l'expérience de la présence dans la réalité virtuelle ? Comment peut-elle être comparée à l'expérience de la présence d'une Réalité Évoquée de façon endogène par notre esprit ? Pourquoi est-il important d'étudier « la présence » d'un autre point de vue que celui des seules sciences cognitives ? Pourquoi toutes les disciplines parlent-elles de « présence », mais n'unissent-elles jamais leurs forces pour s'attaquer à ce problème ensemble ? Pourquoi l'expérience de la présence est-elle subjective ? Peut-il y avoir une approche objective pour étudier ou représenter de manière cohérente et compréhensible ce « sentiment de présence » par rapport à « la présence » (telle qu'elle est vécue) dans le monde réel ? Ces questions conduisent à la question la plus importante : *Quel est l'élément commun aux diverses disciplines de recherche dans l'expérience de la «présence» ?*

Deux hypothèses principales ont été développées, découlant de ces questions qui seront abordées dans la recherche :

1. C'est à travers l'expérience d'une Réalité Évoquée (illusion de la réalité) que notre esprit éprouve une Présence Évoquée (sentiment de présence) différente de celle du monde réel.
    - Une Réalité Évoquée est soit Média-Évoquée soit Auto-Évoquée.
2. La Réalité Évoquée est une expérience subjective spatio-temporelle.
    - Ces *qualia* de l'expérience de la Réalité Évoquée sont ce qui définit la Présence Évoquée.

Pour la première hypothèse, l'état des connaissances actuelles a été analysé et différents éléments concernant l'expérience de la présence ont été étudiés. Les éléments communs mis en évidence à partir de différents points de vue ont été rassemblés de telle sorte que la présence pouvait être envisagée dans une perspective originale. Comment un média comme la réalité virtuelle affecte-t-il le sentiment de présence, qui est alors comparé avec le sentiment de présence non-médiatisée dans l'imaginaire et les rêves vécus à l'intérieur de soi. Cette étude tente ensuite de présenter un concept qui atteste que c'est l'expérience d'une « Réalité Évoquée » (illusion de la réalité) qui déclenche une « Présence Évoquée » (sentiment de présence) dans nos esprits. Un modèle tripolaire de la réalité est proposé pour expliquer ce phénomène. Pour représenter de manière cohérente les expériences réelles et virtuelles et démontrer la relation entre la Réalité Évoquée et la Présence Évoquée, une Reality-Presence

Map (Carte Réalité-Présence) a été créée. La deuxième hypothèse traite des *qualia* de nos expériences. Comment les *qualia* relatifs aux expériences du monde réel se reflètent-ils dans les expériences de la Réalité Évoquée et comment ils conduisent à une expérience subjective de la Présence Évoquée ?

Les objectifs principaux de cette thèse sont les suivants :

1. Etudier la façon dont nous expérimentons la présence et la réalité à l'intérieur et à l'extérieur de la réalité virtuelle.
2. Présenter et justifier le concept de Réalité Évoquée de façon à observer et définir « le sentiment la présence » d'un point de vue global.
3. Développer un modèle schématique qui associe la réalité, la présence, la Réalité Évoquée et la Présence Évoquée de manière cohérente.
4. Etudier les *qualia* de l'expérience de la présence et de la réalité.
5. Aborder les perspectives de la Réalité Évoquée dans la recherche sur la présence.

Nous considérons que ce travail de recherche contribuera à une meilleure compréhension de la notion d'expérience de la présence, en particulier dans son rapport avec la réalité. Le concept proposé indique que notre état d'esprit vogue en continu ou fluctue avec le temps ; c'est ainsi que le modèle visuel peut être utilisé pour localiser l'état de chacun à n'importe quel moment. Comme le concept de Réalité Évoquée tente de réunir différentes disciplines dans un seul et même cadre commun, où nous pouvons étudier l'expérience de la présence et de la réalité dans un niveau global, il peut contribuer à une meilleure compréhension de notre conscience. Nous sommes convaincus que ce concept de Réalité Évoquée et le modèle proposé peuvent avoir des applications significatives dans l'étude de la présence et dans l'exploration des possibilités de la présence au-delà de la réalité virtuelle.

CHAPTER 2: STATE-OF-THE-ART

2.1 PRESENCE: Definitions and Measurement Techniques

With the growing interest in the field of Virtual Reality, the subject of presence has evolved to be a prime area of research. The concept of presence, as Steuer (1992) described it, is the key to defining Virtual Reality in terms of human experience rather than technological hardware. Presence refers not to one's surroundings as they exist in the physical world, but to the perception of those surroundings as mediated by both automatic and controlled mental processes.

Early interest in the field of presence can be traced back to the study of 'telepresence' (Minsky, 1980) in the field of artificial intelligence and human-machine interaction in teleoperation. In fact the concept of 'Being There' was introduced by Reeves (1991) to describe how viewers experience the environment they encounter on television, borrowing the idea from the 1970 novel 'Being There' (Kozinski, 1970) and the 1979 movie of the same name. Johnsen and Corliss (1971) also discussed the importance of designing displays and controls that will 'help the operator project his presence' into a remote work space (Draper et al., 1998; Ijsselsteijn et al., 2000). In fact some argue that the pursuit of telepresence has been part of the evolution of all media (Biocca et al., 1995; Kim and Biocca, 1997) and that a theory of telepresence should apply to all mediated environments (Steuer, 1995; Lombard and Ditton, 1997).

2.1.1 Telepresence to Sense of Presence

The term 'telepresence' was coined by Marvin Minsky (Minsky, 1980). It referred to the phenomenon of a human operator developing a sense of being physically present at a remote location through interaction with a human-machine interface; i.e. through the user's actions and the subsequent perceptual feedback he/she receives via the appropriate teleoperation technology (Ijsselsteijn et al., 2000).

> *"You don a comfortable jacket lined with sensors and muscle-like motors. Each motion of your arm, hand, and fingers is reproduced at another place by mobile, mechanical hands. Light, dexterous, and strong, these hands have their own sensors through which you see and feel what is happening. Using this instrument, you can "work" in another room, in another city, in another country, or on another planet. Your remote presence possesses the strength of a giant or the delicacy of a surgeon. Heat or pain is translated into informative but tolerable sensation. Your dangerous job becomes safe and pleasant. To convey the idea of these remote control tools, scientists often use the words 'teleoperator' or 'telefactor'. I prefer to call this 'telepresence', a name suggested by my futurist friend Patrick Gunkel. Telepresence emphasizes the importance of high-quality sensory feedback and suggests future instruments that will feel and work so much like our own hands that we won't notice any significant difference."*
> - (Minsky, 1980)

Sheridan was one of the first among the researchers to differentiate the terms 'telepresence' with 'presence'. He referred to presence elicited by a virtual environment as 'virtual presence' and used 'telepresence' for the case of teleoperation as suggested by Minsky (Sheridan, 1992b).

> *"Allegedly, such sophisticated, high fidelity human interfaces, characterized by terms such as 'telepresence' in the case of teleoperation (feeling like you are actually 'there' at the remote site of operation) and 'virtual presence' (feeling like you are present in the environment generated by the computer), will improve sensorimotor or cognitive performance and efficiency of training and planning. Yet at present we have very little fundamental understanding of what effect such conveyors of 'presence' do for us."*
> - (Sheridan, 1992b)

Nevertheless, telepresence has since been a subject well explored in teleoperation and telecommunication technology (Held, 1992; Schloerb, 1995; Draper et al., 1998; 1999). Gradually, as its significance was observed by researchers in the field of advanced media interfaces such as virtual reality, it evolved into the 'being there' sensation (Reeves, 1991; Sheridan, 1992a), 'virtual presence' (Sheridan, 1992b) and finally into the concept of 'presence' in general (Steuer, 1992; Slater et al., 1994; Barfield et al., 1995; Steuer, 1995; Kim and Biocca, 1997; Lombard and Ditton, 1997).

2.1.2 Defining Presence

Presence is a concept describing the effect that people experience when they interact with a computer-mediated or computer-generated environment (Sheridan, 1992b). Witmer and Singer (1994) defined presence as the subjective experience of being in one environment (there) when physically in another environment (here). Lombard and Ditton (1997) described presence as an 'illusion of non-mediation' that occurs when a person fails to perceive or acknowledge the existence of a medium in his/her communication environment and responds as he/she would if the medium were not there. Presence induced by computer applications or interactive simulations was believed to be what gave people the sensation of, as Sheridan called it, 'being there' (Sheridan, 1992b). Thus presence also came to be defined as a user's subjective sensation of 'being there' in a scene depicted by a medium (Barfield et al., 1995).

Although the definitions by Lombard and Ditton (1997) concentrated on presence due to media, they explained how the concept of presence is derived from multiple fields - communication, computer science, psychology, science, engineering, philosophy, and the arts. Schubert and Crusius (2002) also pointed out how the phenomenon of presence has always been researched in other domains, but with different labels. Following is the summarised list of influential definitions of presence (**Table 1**) proposed by researchers from multiple perspectives:

Definition	**Context**	**Reference**
'Diegetic Effect' (whereby spectators experience the 'diegetic' world through recounting of events in the words of a narrator)	Film Theory / Art	(Burch, 1979) Also mentioned in (Schubert and Crusius, 2002)
'Mimesis effect' (imitation or representation of reality/nature in art forms)	Art / Literature	(Gebauer and Wulf, 1996; White, 2000)
'Being There' (to describe how viewers experience the environment they encounter on television.)	Television / Media	(Reeves, 1991)
A form of out-of-the-body experience	Virtual Reality	(Rheingold, 1991)

Feeling like you are actually there at the remote site of operation	Teleoperation	(Sheridan, 1992b)
A mental manifestation (Virtual Presence)	Virtual Reality	(Sheridan, 1992b)
Transportation	Literature Theory	(Gerrig, 1993)
Telepresence occurs when a user perceives that he/she is physically present in a remote environment	Teleoperation	(Schloerb, 1995)
A user's subjective sensation of 'being there' in a scene depicted by a medium.	Communication Media	(Barfield et al., 1995)
A cognitive state that results from attending to and evaluating incoming sensory information	Communication Media	(Barfield et al., 1995)
A feeling of being in a location other than where you actually are	Teleoperation	(McLellan, 1996)
A perceptual illusion of non-mediation	Communication Media	(Lombard and Ditton, 1997)
The suspension of disbelief that the users of virtual reality systems are in a world other than where their real bodies are located. "willing suspension of disbelief" (that Samuel Taylor Coleridge referred to as 'engagement') was originally quoted in (Steuer, 1992)	Virtual Reality Communication Media Drama / Story	(Slater and Usoh, 1993) Also mentioned in (Lombard and Ditton, 1997)
The perception of presence within a physically remote or simulated site.	Teleoperation	(Draper et al., 1998)
Mediated Presence	Communication Media	(Biocca et al., 2001)

Table 1: Definitions of Presence [source: author]

As an attempt to explain the overall experience of presence, (Lombard, 2000) [also International Society for Presence Research (ISPR, 2000)] provides a comprehensive definition of presence:

> *"Presence (a shortened version of the term "telepresence") is a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience."*

They add to the explication:

> *"Except in the most extreme cases, the individual can indicate correctly that s/he is using the technology, but at "some level" and to "some degree", her/his perceptions overlook that knowledge and objects, events, entities, and environments are perceived as if the technology was not involved in the experience. Experience is defined as a person's observation of and/or interaction with objects, entities, and/or events in her/his environment; perception, the result of perceiving, is defined as a meaningful interpretation of experience."*
> - (ISPR, 2000)

2.1.3 Measuring Presence

Researchers working on human performance and experience in virtual reality have noted that there is a need to conceptualize and measure telepresence more effectively (Sheridan, 1992b; Biocca and Delaney, 1995; Kim and Biocca, 1997). Several authors have suggested the use of reflexive responses (e.g. ducking in response to a looming virtual object) and socially conditioned responses (e.g. smiling) as objective approaches to measuring presence (Held, 1992; Sheridan, 1992b; Slater and Wilbur, 1997). In an attempt to develop objective corroborative measures of presence, the behavioural realism approach was proposed, which is based on the premise that as a display better approximates the environment it represents, an observer's responses to stimuli within the display will tend to approximate those which he/she would exhibit in response to the environment itself (Freeman et al., 2000). Allocating sufficient attentional resources to the mediated environment has also been proposed as an important component in measuring presence (Barfield and Weghorst, 1993; Draper et al., 1998). Witmer and Singer (1998) point out that presence depends on the ability to focus on one meaningful, coherent stimulus set, in a virtual environment. They note that this theory is similar to the concept proposed by McGreevy (1992) that the experience of presence is based in attention to continuities, connectedness, and coherence of the stimulus flow. The coherence of the virtual environment characteristics and stimuli thus enables the focusing of attention, but does not force that on the experiencer. This concept of enabling without forcing distinguishes the experience of presence from the factors that typically support the experience (Witmer and Singer, 1998). In fact the need to measure presence led to definition of various elements that form the determinants of presence (which will be discussed in **2.5.1** below).

Sheridan (1992b) indicated that subjective report is the essential basic measurement. Since presence is a subjective experience, the most direct way of assessment is through users' subjective report. Objective measures, such as postural, physiological or social responses to media, can be used to corroborate subjective measures, thereby overcoming some of their limitations (Ijsselsteijn et al., 2000). They classified the different approaches taken to measuring presence into two general categories of presence measures: subjective measures and objective corroborative measures.

For an extensive and well organized guide to current measurement approaches with respect to presence, the reader is referred to Van Baren and Ijsselsteijn (2004). However, the following is a summarised review of those approaches.

2.1.4 Subjective Measures of Presence

The subjective measures could be broken down into:

(1) Post-test rating scales / questionnaires
(2) Continuous presence assessment
(3) Qualitative measures
(4) Psychophysical measures
(5) Subjective corroborative measures

There have been numerous 'Presence Questionnaires' proposed that may help assess the subjective quality of presence. The few influential among them are:

Presence Questionnaire (PQ) (Witmer and Singer, 1998)

They developed the 'Presence Questionnaire' in order to measure the degree to which individuals experience presence in a virtual environment and the influence of possible contributing factors (control, sensory, distraction and realism factors) on the intensity of this experience. Thirty-two items were originally designed based on the four factors, to be rated on a seven point rating scale with a midpoint anchor (e.g., 1= not compelling, 4 = moderately compelling, 7 = very compelling). They suggested that the total score will indicate the strength of presence evoked. The final version of this questionnaire was reduced to 19 items. They argued that strength of presence is a function of subjective individual differences as well. So in addition they developed an immersive tendencies questionnaire (ITQ) to measure differences in the tendencies of individuals to experience presence. (Both these questionnaires were used in Experiment-1, discussed in **Chapter 4**).

Slater-Usoh-Steed Questionnaire (SUS) (Slater et al., 1994)

They originally defined three main presence indicators:
(1) Sense of being there (in the computer-generated world)
(2) Extent to which the computer-generated world becomes 'reality' (that they almost forgot about the outside 'real world')
(3) Extent to which the computer-generated world is thought of as somewhere visited.
Later the questionnaire was extended to have six questions for the participants, with a seven point rating scale. (This questionnaire was also used in Experiment-1)

ITC-Sense of Presence Inventory (ITC-SOPI) (Lessiter et al., 2001)

Analysing many questionnaires, Lessiter et al. (2001) proposed the ITC-SOPI. Their idea was to focus on users' experiences of media. Their approach towards the questionnaire was based on two determinants:
(1) Media characteristics (media form and media content)
(2) User characteristics
Initially, there were sixty-three items designed, while the revised version was reduced to forty-four items under the categories: Sense of Physical Space (19 items), Engagement (13 items), Ecological Validity (five items), Negative Effects (six items) (Van Baren and Ijsselsteijn, 2004).

Breaks in Presence (BIP) (Slater and Steed, 2000; Brogni et al., 2003)

Distractions that draw the user's attention from the mediated environment to the real world (e.g. a telephone ringing) are likely to diminish the user's sense of presence (Ijsselsteijn et al., 2000). The distractions may also be triggered by the media itself. Among the several subjective measures which do not directly assess presence, but provide essential information about mental processes related to presence, 'breaks in presence' is an important factor of assessment that was introduced recently in Slater and Steed (2000). They argued that there are two alternate gestalts available to the individual experiencing a virtual environment: state V (virtual world) and state R (real world). Users were asked to report transitions from V to R during the experiments, which were counted for analysing presence. They also noted that reporting transitions from R to V was not considered as this would require them to immediately break out

of their state of presence in order to report back to the 'real world'. The BIPs method was developed with the goal to measure presence unobtrusively during the course of an experience of virtual environment (Van Baren and Ijsselsteijn, 2004). The concept of breaks in presence will be further explored in the **Chapter 3**.

2.1.5 Objective Corroborative Measures of Presence

Post-experience questionnaires and BIP measurement techniques are particularly subjective. Ijsselsteijn et al. (2000) defined four approaches which would help us validate and analyse presence objectively: postural responses, physiological measures, dual task measures and social responses. Later Van Baren and Ijsselsteijn (2004) redefined these objective measures into following four categories:

(1) Psycho-physiological Measures
(2) Neural Correlates
(3) Behavioural Measures
(4) Task Performance measures

It is clear that the studies on presence progressed with a slow realization of the fact that it's more than just 'being there'. The concept of presence started as a telecommunication design goal and has evolved into an intriguing theoretical problem and philosophical issue (Loomis, 1992; Biocca, 1996; 1997). As Mantovani and Riva (1999) suggested, presence is in fact closely linked to the concept we have of reality. We propose that presence, whether strong or mild is the result of an 'experience of reality'.

2.2 REALITY: Theories and Perspectives

2.2.1 Theories

The term 'reality' itself is very subjective and controversial. While objectivists may argue that reality is the state of things as they truly exist and is mind-independent, subjectivists would reason that reality is what we perceive to be real and there is no underlying true reality that exists independently of perception. Naturalists argue that reality is exhausted by nature, containing nothing supernatural and that the scientific method should be used to investigate all areas of reality, including the human spirit (Papineau, 2009). Similarly a physicalist idea is that the reality and nature of the actual world conforms to the condition of being physical (Stoljar, 2009). Reality is independent of anyone's beliefs, linguistic practices or conceptual schemes from a realist perspective (Miller, 2010). The Platonist view is that reality is abstract and non-spatiotemporal with objects entirely non-physical and non-mental (Balaguer, 2009). While some agree that the physical world is our reality, the Simulation Argument suggests that this perceivable world itself may be an illusion of a simulated reality (Bostrom, 2003). Still others would endeavor to say that the notion of physical world is relative as our world is in constant evolution due to technological advancement; also because of numerous points of view on its acceptation (Schmidt, 2008).

Resolving this confusion about theories or the true nature of reality is not our primary aim and is beyond the scope of this thesis. However we should take a stand regarding our perspective

before we continue further. This thesis explores the 'experience' of presence and reality in the mind with a strong notion of mind-body duality and phenomenological reality. We strive to eventually propose a model that would embrace different views on reality in a coherent manner. So we would like to reserve the term 'Primary Reality' to signify the reality of our real world (physical world) experiences, which would be explained later in **Chapter-3,** Part-A.

2.2.2 Perspectives and hypotheses

Reality has been observed, examined, studied and theorized by various disciplines and doctrines over ages, especially in overlapping scientific fields relating to cognitive science. In this attempt to understand reality and consciousness, many new fields of study evolved. One of the very important among them that we would like to highlight is Phenomenology - the study of structures of consciousness with respect to our subjective experience or as experienced from the first-person point of view (Smith, 2011), a philosophical tradition launched by Edmund Husserl and his successors.

> *"We all experience various types of experience including perception, imagination, thought, emotion, desire, volition, and action. Thus, the domain of phenomenology is the range of experiences including these types (among others). [. . .]This experiential or first-person feature - that of being experienced - is an essential part of the nature or structure of conscious experience. [. . .] In a strict empiricist vein, what appears before the mind are sensory data or qualia: either patterns of one's own sensations (seeing red here now, feeling this ticklish feeling, hearing that resonant bass tone) or sensible patterns of worldly things, say, the looks and smells of flowers (what John Locke called secondary qualities of things). In a strict rationalist vein, by contrast, what appears before the mind are ideas, rationally formed "clear and distinct ideas" (in René Descartes' ideal). In Immanuel Kant's theory of knowledge, fusing rationalist and empiricist aims, what appears to the mind are phenomena defined as things-as-they-appear or things-as-they-are-represented (in a synthesis of sensory and conceptual forms of objects-as-known). In Auguste Comte's theory of science, phenomena (phenomenes) are the facts (faits, what occurs) that a given science would explain."*
> - (Smith, 2011)

In short, phenomenology is the study of our experience and in this study we are talking principally about our experience of reality and the presence associated with it. In fact Plato's distinction of the visible world and the intelligible world suggested towards phenomenology long before its becoming a field of study. Plato's allegory of cave questions reality as compared to our experience of reality (or how reality may appear to us). Metzinger (1995) asks "If the presence of the phenomenal 'Now' can be shown to be an illusion, is it then correct to say that our conscious model of reality as a whole is only a virtual world?" He suggests in his 'Ego Tunnel' (Metzinger, 2009) that our phenomenal self itself may be an illusion and everything we experience may be a simulated reality.

> *"Note that Loomis (1992) says that all 'contact with the physical world is mediated,' by which he means the primordial communication medium, the body. The default sense of "being there" is the basic state of consciousness in which the user attributes the source of the sensation to the physical environment. We have been present in this environment*

for so long and it is so natural, that the idea that presence might be a psychological construct is only raised by philosophers and perceptual psychologists."
- (Biocca, 1997)

From different points of view, especially philosophical, many powerful sceptical hypotheses have also been suggested. They propose that reality may perhaps be partially or completely different from what think it is and we may not necessarily be able to prove it otherwise; for instance, the famous 'Brain in a vat' hypothesis (Putnam, 1982), which is proposed from a scientific perspective as well. It suggests a scenario according to which one might be a disembodied brain kept alive in a vat, which is fed false sensory signals through an exceptional technology. With a similar view, Dennett (1978) proposed a strange but thought provoking scenario, where one would be forced to question one's own perspective in the real world and ask oneself 'Where am I?'. Another interesting hypothesis from the perspective of computer science an artificial intelligence is the 'Simulation argument' (Bostrom, 2003). It suggests that we might be inside a computer simulation of a perfect virtual reality (similar to brain in a vat scenario).

These recent hypotheses resonate the classical ones like the 'Dream Argument' by Zhuangzi, which reasons that reality may be indistinguishable from a dream, or Descarte's 'evil demon' that supposes that a powerful and deceitful being may be misleading us into believing in this reality, or Bertrand Russell's five minute hypothesis that makes us wonder how reliable our reality is - what if the universe sprang into existence five minutes ago (or perhaps last Thursday) from nothing, somehow with everything what we find in reality, including the physical historical records and traces as well as our memory of the past.

All of these theoretical perspectives and hypotheses attempt to question the credibility of what we call reality. This study proposes a graphical model (at a later point in **Chapter-3**) using which we may be able to, in future, analyse and categorize to an extent different reality experiences along with their corresponding sense of presence.

2.2.3 *Qualia*

'*Qualia*' (singular '*quale*') is the term that refers to our subjective conscious experience, especially in phenomenological perspective. In fact, the problem of explaining how and why we have *qualia* or phenomenal experiences is considered as the hard problem of consciousness. The hard and the easy problems were formulated by one of the proponents of *qualia* - David Chalmers (Chalmers, 1995b). According to Tye (2009), the mental states that possess *qualia* may be (1) perceptual experiences (of the sort involved in seeing green, hearing loud trumpets, tasting liquorice, smelling the sea air, handling a piece of fur), (2) bodily sensations (like feeling a twinge of pain, feeling an itch, feeling hungry, having a stomach ache, feeling hot, feeling dizzy), (3) felt reactions or passions or emotions (like feeling delight, lust, fear, love, feeling grief, jealousy, regret) and (4) felt moods (like feeling elated, depressed, calm, bored, tense, miserable). For further on *qualia*, see also Lycan (2008) and Byrne (2010).

Qualia, being an intriguing topic, are criticized by many. Philosophers like Dennett (Dennett, 1988; Dennett and Weiner, 1993) suggest that *qualia* are intrinsic properties of experiences that are in fact ineffable. They are essentially private although directly or immediately apprehensible

in consciousness. Marvin Minsky, who coined 'telepresence', is as well a critic of subjective experience of *qualia*. He suggested that "the idea of a separate world for 'subjective experience' is just an excuse for the shameful fact that we don't have adequate theories of how our brains work" (Minsky, 1998).

In his 'Absent Qualia, Fading Qualia, Dancing Qualia', Chalmers argued that if an appropriately configured system reproduces the functional organization of the brain, it may reproduce the *qualia* associated with the brain. He proposed 'the principle of organizational invariance', holding that experience is invariant across systems with the same fine-grained functional organization (Chalmers, 1995a). Another recent proposition on *qualia* includes 'three laws of *qualia*' suggested by Ramachandran and Hirstein (1997), from a neuroscience perspective. They suggested that (1) *Qualia* are irrevocable and indubitable; (2) Once a representation is created the choice of response or output is potentially infinite, and (3) The input creates a representation that persists in short-term memory, long enough to allow time for choice of output. Later, it was suggested by Ramachandran and Hubbard (2001) that attention is closely related to *qualia* and that the study of circuits involved in attention may help uncover the mysteries of *qualia*. The theoretical physicist, Erwin Schrödinger also defended the notion that qualitative experiences are beyond the physical (Schrödinger, 1944).

> *"Corresponding to the supposed duality of matter and mind, there are, in orthodox psychology, two ways of knowing what exists. One of these, the way of sensation and external perception, is supposed to furnish data for our knowledge of matter, the other, called 'introspection,' is supposed to furnish data for knowledge of our mental processes. To common sense, this distinction seems clear and easy. When you see a friend coming along the street, you acquire knowledge of an external, physical fact; when you realize that you are glad to meet him, you acquire knowledge of a mental fact."* - Bertrand Russell, The Analysis of Mind (Russell, 1921)

It is clear that we have perceptual and associated cognitive experiences. But how do we differentiate real perceptual information with a deceptive perceptual illusion? As we will see, later in **section 2.5** below, the determinants of presence (the elements that evoke an illusion of reality) due to media can be principally classified with respect to its technical ability (affecting perceptual experiences) and associated cognitive experiences. So, in order to examine 'illusion of reality', we must clearly differentiate between 'Perceptual Illusion' (relating to perception) and 'Psychological Illusion' (relating to cognition). In the next two sections, we attempt to distinguish 'illusion' from 'real', with respect to perceptual and cognitive experiences.

2.3 PERCEPTION AND PERCEPTUAL ILLUSION

According to our position, there is a world with objects that form the precepts that provide us with stimulus. The sensory information is accessed by our sensory organs at different points - the process called sensation. And then our neural configuration helps interpret that information in a meaningful manner - the process called perception. Perception is the organization, identification and interpretation of sensory information in order to represent and understand the environment (Schacter, 2011). If sensations are the first stages in the functioning of senses to represent stimuli from the environment, then perception is a higher brain function that deals

with interpreting events and objects in the world (Myers, 2004). According (Gazzaniga et al., 2006) the goal of sensation is to detect stimuli while perception is what creates useful information of the surroundings from the detected stimuli.

2.3.1 External Perception - Real Percepts or Perceptual Illusion

A truly comprehensive explanation of presence with respect to our perception of the real world and mediated world was given by ISPR (2000). It was quite precisely explained that we could not resist quoting:

> *"All experience of the physical world is mediated by the human senses and complex perceptual processes. This experience, identified by some scholars as 'first order' mediated experience, is the 'normal' or 'natural' way we perceive the physical world and provides a subjective sensation of being present in our environment (constituting a broader conception of the term 'presence'[. . .]) Although this 'first order' mediated experience generally provides perceptions that correspond to the true nature of the physical world, it can also provide perceptions that do not correspond to the true nature of the physical world; presence refers to the subset of human experience in which this misperception involves, at least in part, the actual role of technology in the experience: Presence occurs when part or all of an individual's experience is mediated not only by the human senses and perceptual processes but also by human-made technology (i.e., 'second order' mediated experience) while the person perceives the experience as if it is only mediated by human senses and perceptual processes (i.e., 'first order' mediated experience)."*
> - (ISPR, 2000)

It should be noted that, in this study 'first order' mediation is what is referred to as 'Primary Reality', and 'second order' mediation is what will be defined as 'Media-Evoked Reality' (explained in the next chapter). To clarify, we would like to add that there is (1) the physical stimulus object, (2) the physical stimulus field and (3) the conscious perceptual experience; and the subjective experience of the 'sense of presence' occurs in (3) along with associated cognitive experiences.

In fact perception is not just a passive receipt of stimuli, but can be shaped by learning, memory and expectation (Gregory, 1987). This is one of reasons why our perception can be deceived by providing incorrect sensory stimuli. When encountered with mediated or misleading sensory stimulation, our perception does its best to organize and interpret the stimuli as it would normally do (in an attempt to make sense). And that is the primary reason why we experience a strong illusion of being in an environment (virtual) in good quality virtual reality systems. This phenomenon of our perception is undoubtedly a boon, but is the very reason why our perception can easily be altered or distorted [cf. Revonsuo et al. (2009)]. The simplest example would be our experience of 3D movies (with a stereoscopic display) where our eyes are provided with two different 2D images, which due to our perceptual interpretation, gives an illusion of the third dimension. Below is an example of a stereo image optimised for wall-eyed viewing (**Figure 1**).

Figure 1: A stereo image for wall-eyed viewing (image of Château des Ducs de Bretagne, Nantes, France) [source: author]

In order to view this wall-eyed stereo image, it requires that our two eyes adopt a relatively parallel angle, until the two dots above merge.

We constantly perceive and interact with three-dimensional objects. So, our perception has been so evolved over the ages, that we can recognize a 3D object even by its representation on a two-dimensional space. Even if a cube has all of its sides perpendicular to each other, it's representation on a paper immediately gives us its essence. An example of a real mouse and its 2D image can be seen below (**Figure 2**). Although we distinguish these two images as 3D and 2D, in fact both the images here are 2D representations.

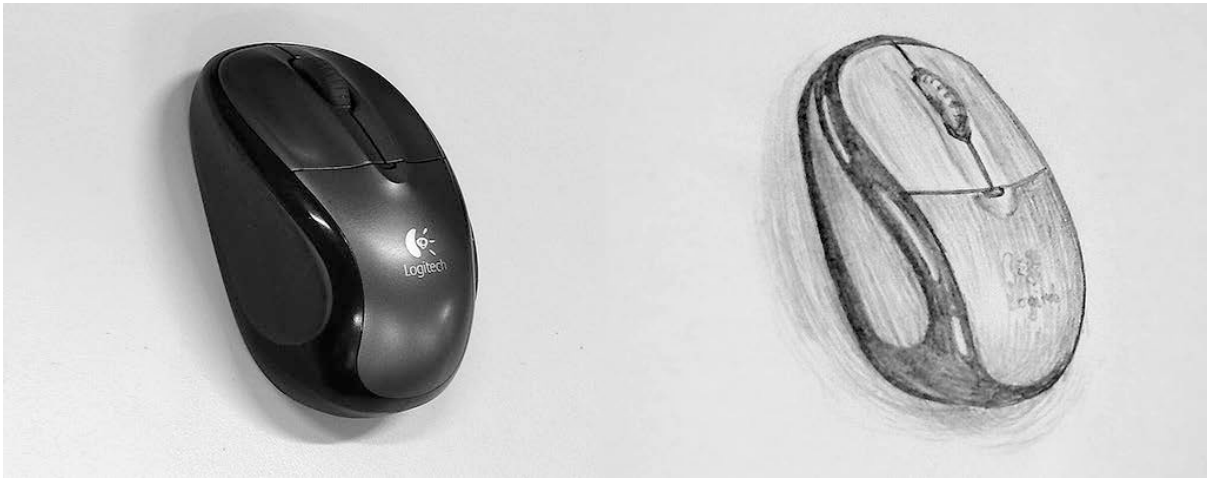


Figure 2: An object (mouse) and its representation on a medium [source: author]

As vision often dominates the other senses, visual illusions have been explored greatly; for example, ambiguous images like the classic 'Rabbit-Duck illusion' and 'Rubin's Vase', or illusions like M. C. Escher's 'Relativity', 'Ascending and Descending Stairs' and impossible objects, or spatial illusions like 'Ames Room' and anamorphic images. **Figure 3** shows an anamorphic visual illusion of a 3D object and the actual 2D image (as seen from above) that was used to create the illusion. [For more on illusions, see also Gregory (1997)]. In short, *Perceptual Illusion is the feeling of perceiving objects or spaces that are physically not present* (but evoked by mediating our perception with the help of different media or endogenously evoking internal perception in the mind - as we see in the next section).

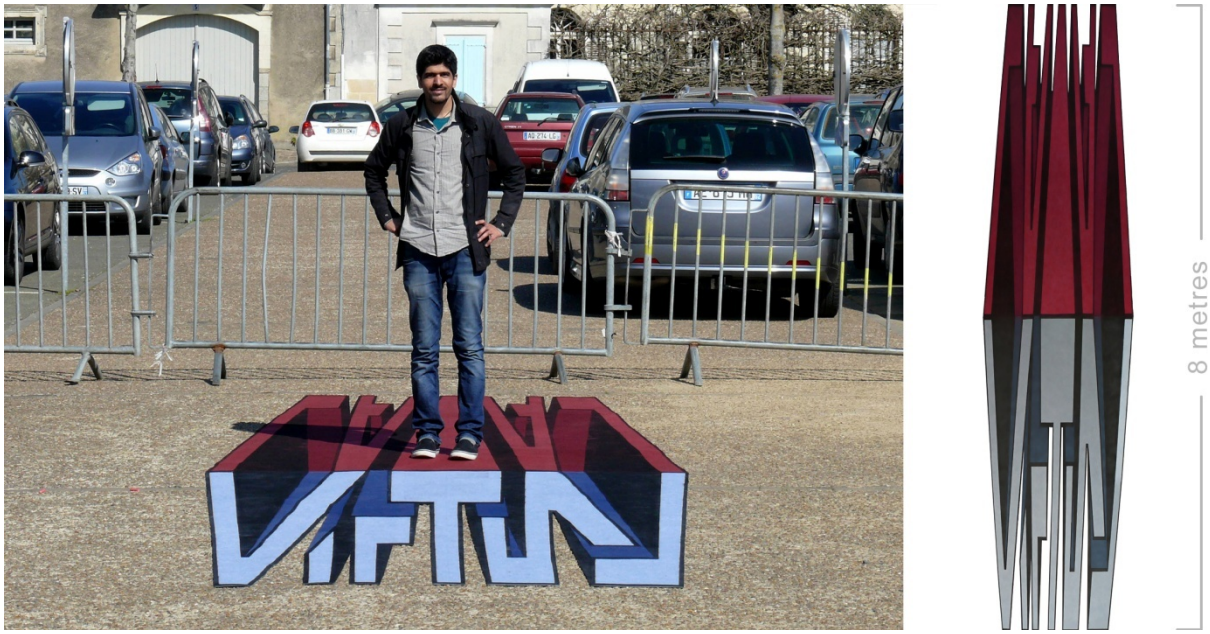


Figure 3: Anamorphic illusion of a 3D object, and the 2D image that was used to create the illusion. [source: author]

> *"Now, a picture is nothing but a more convenient way of arranging matter so that it projects a pattern identical to real objects. [. . .] The trick was stated succinctly by Leonardo da Vinci: 'Perspective is nothing else than seeing a place behind a pane of glass, quite transparent, on the surface of which the objects behind the glass are drawn.' If the painter sights the scene from a fixed viewing position and copies the contours faithfully, down to the last hair of the dog, a person who then views the painting from the position of the painter would have his eye impaled by the same sheaf of light rays that the original scene projected. In that part of the visual field the painting and the world would be indistinguishable. Whatever assumptions impel the brain to see the world as the world and not as smeared pigment will impel it to see the painting as the world and not as smeared"*
> - (Pinker, 1997)

"A virtual environment that truly 'feels real' should be able to simulate the sensation of surface textures like sandpaper or velvet, the resistance of surfaces like rocks or pillows, and the sensation of physical resistance like moving an oar or stick through water, mud, oil, or rocks" (Biocca and Levy, 1995). But with the developing research work in the field of virtual reality and similar technologies that deal with multisensory interfaces, there's a growing interest among researchers on multimodal illusions as well [for example the Rubber hand Illusion by Botvinick and Cohen (1998) was extended to virtual reality research using a virtual arm by Slater et al. (2008)]. Research on multimodal integration deals with how different sensory modalities interact with one another, whether they alter each other's processing and how it allows us to perceive a world of coherent perceptual entities (Lewkowicz and Ghazanfar, 2009).

2.3.2 Internal Perception - Perceptual Illusion

We often have internal perception leading to mental imagery experiences, without any interference of external mediation. The easiest way to examine mental imagery is in fact

through 'introspection'. But as it is very subjective, research on mental imagery required objective methods of analysis to support its evidence. This is why researchers came up with a method, which Kosslyn (1980) called 'the quantification of introspection'. This method attempted to externalize mental events in order to detect and measure the behavioural consequences, often in terms of performance time of internal processing.

One of the best examples in this direction was Shepard and Metzler's (1971) experiment on the mental rotation of geometric shapes (**Figure 4**). They hypothesised that the subjects would evoke a three-dimensional image of the first depicted object in their mind and then mentally rotate it to verify if it matches its pair (for each series). They found that the time it took for each subject to identify whether the two objects were identical was directly proportional to the angular rotational difference between them. Moreover, the greater the angular rotational difference, the greater the time it took to identify the similarity. Thus they were able to objectively explore their hypothesis and confirm mental imagery experience. Studies also show that mental transformations in fact involve our visual system and take place largely in the same areas of our brain that deal with visual perception. Additionally, the operations are guided by inputs from the motor system as well (Kosslyn, 1994; Annett, 1995; Wohlschläger, 1998). Findings from the neuro-physiological experiments that monitored the neural activity in the parietal cortex also suggest that mental transformations may be preceded by motor intentions ahead of the actual transformations (Reisberg and Logie, 1993). Currently mental imagery is studied extensively, through various methods of externalization of mental activities.

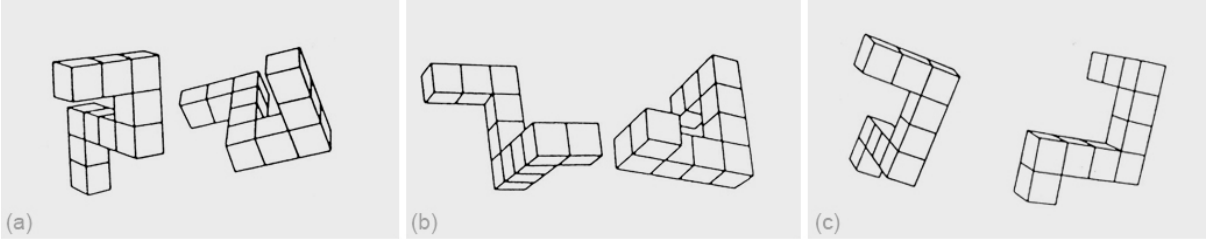


Figure 4: Experiment on the mental rotation of geometric shapes [source: Shepard and Metzler, 1971]

To give a real-time example, if you may imagine an elephant that is pure white and has wings to fly around. Immediately the images are formed in our mind, adding the required elements to the visual mental imagery, according to the textual narration. Now if we consider scenarios in which the mental imagery is evoked without any external input, few examples being thinking, planning, daydreaming or dreaming, in which case the experiences will fall under internal Perceptual Illusion.

In this study we suggest that presence may occur solely due to internal Perceptual Illusion as well. Although it may seem apparent, most research works on presence deal specifically with media related experiences. Therefore, one of the experiments in this study (**Chapter 4, 4.2**) is dedicated to objectively demonstrating that the experience of presence is evoked in mental imagery (i.e. by internal Perceptual Illusion without any external mediation involved).

2.4 COGNITION AND PSYCHOLOGICAL ILLUSION

Cognition refers to the mental processes involved in acquiring knowledge and comprehension. It represents various mental activities like attention, remembering, learning, reasoning, problem solving, decision making and above all, processing information to making sense of our perceptual world. In the case of perceptual experience of our real world, we experience cognitive responses. Similarly, we suggest that, *as a response to Perceptual Illusion evoked by external mediation, we experience corresponding Psychological Illusion.* In immersive virtual reality systems, the Perceptual Illusion evoked is exceptionally strong, that users usually behave as if they were experiencing the real world. Psychological Illusion is especially evident in how we emotionally relate and respond to different artistic media.

> *"Autostereograms exploit not one but four discoveries on how to trick the eye. The first, strange to say, is the picture. We are so jaded; by photographs, drawings, television, and movies that we forget that they are abenign illusion. Smears of ink or flickering phosphor dots can make us laugh, cry, even become sexually aroused. Humans have made pictures for at least thirty thousand years, and contrary to some social-science folklore, the ability to see them as depictions is universal."* - (Pinker, 1997)

A simple but good example of Psychological Illusion is how our mind responds to the Perceptual Illusion of depth evoked by a stereo image (as in **Figure 1** above). People often express their experiences during a 3D movie or a virtual reality system, as if the objects or spaces were truly near or far from them; as if they were in fact there in the reality depicted by the media. Although this may happen in lower levels of (perceptual) immersion as well, like in the case of simple 2D images or videos, but a simple enhancement in the Perceptual Illusion may effectively strengthen the Psychological Illusion.

In fact many cognitive factors influence Psychological Illusion. For instance, sometimes the contents of a simple textual or audio narrative or a simple image may evoke strong Psychological Illusions, even though Perceptual Illusion may not be as perfect. So, they often complement each other as well. How Perceptual Illusion and Psychological Illusion together form the whole spatio-temporal illusion of reality is a major part of this study. How these ideas lead to the concept of Evoked Reality is given in the section **2.5.2** below.

2.5 ILLUSION OF REALITY: The Source of Sense of Presence

2.5.1 Determinants and Types of Presence

Research into presence may still be at an early stage of development. But there is a consensus that presence has multiple determinants (Ijsselsteijn et al., 2000). The factors determining the experience of presence in a virtual environment (in this case, environments generated through virtual reality and associated media) have been explored by many in different ways.

For example, presence due to media has previously been reviewed in at least 9 different ways, namely:

2.5.1.1 Three Determinants of Presence

(Sheridan, 1992b)

Sheridan, among the first to put forward the concept of breaking down the sense of presence into different components, identified the sense of presence as having three principal determinants (**Figure 5**):

(1) The extent of sensory information (i.e., the amount of useful and salient sensory information concerning a cue available to the appropriate sensors of the observer)

(2) The control of the relation between sensors and the display (i.e., the degree of control a participant has over the positioning of his or her sensors within the environment)

(3) The ability to modify the physical environment (i.e., the degree to which a participant is free to modify objects and their positions within the environment)

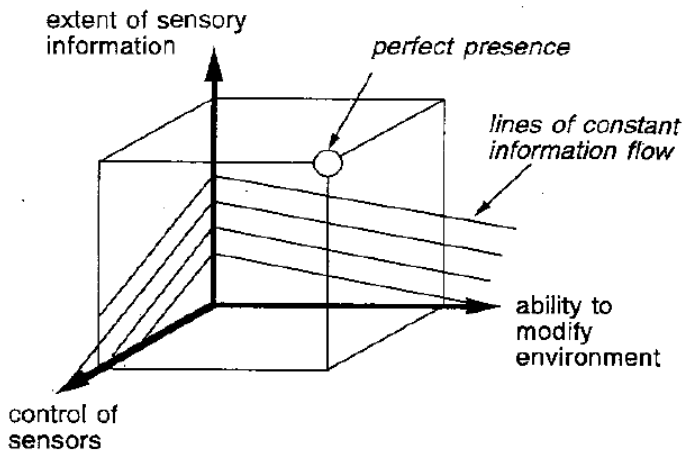


Figure 5: Principal determinants of sense of presence for a given task [source: Sheridan, 1992b]
[Referred to as Independent components of virtual presence in (Sheridan, 1995)]

He added that that the three principal determinants of presence do not operate alone. He proposed two major properties of tasks that may affect behaviour (both subjective and objective) which he called (1) task difficulty and (2) degree of automation.

2.5.1.2 Technology and Human Experience

(Steuer, 1992)

Steuer proposed the variables that influence telepresence in 1992 and was one among the first to clearly differentiate the technological capabilities with subjective personal experience. In fact Witmer and Singer (1998) also agree that the strength of presence experienced in a virtual environment varies both as a function of its characteristics and individual differences within users. Steuer rightly noted that, of the variables proposed by Sheridan (1992b), three are technological: the extent of sensory information, control of sensors relative to environment, and the ability to modify the physical environment; and the other two are task (or context) based: task difficulty and degree of automation.

"When considering these dimensions, one should remember that virtual realities reside in an individual's consciousness; therefore, the relative contribution of each of these dimensions to creating a sense of environmental presence will vary across individuals. Similarly, differences in the content of the mediated environment - that is, in the kinds of entities represented and in the interactions among them - will also affect the perception of presence. However, the variables vividness and interactivity refer only to the representational powers of the technology, rather than to the individual; that is, these variables determine properties of the stimulus that will have similar but not identical ramifications across a range of perceivers."
- (Steuer, 1992; 2006)

Vividness, as he explained was the representational richness of a mediated environment as defined by its formal features (i.e., the way in which an environment presents information to the senses). He defined interactivity as the extent to which users can participate in modifying the form and content of a mediated environment in real time. According to him, virtual reality should be defined in terms of human experience and not merely with respect to technological hardware (**Figure 6**).

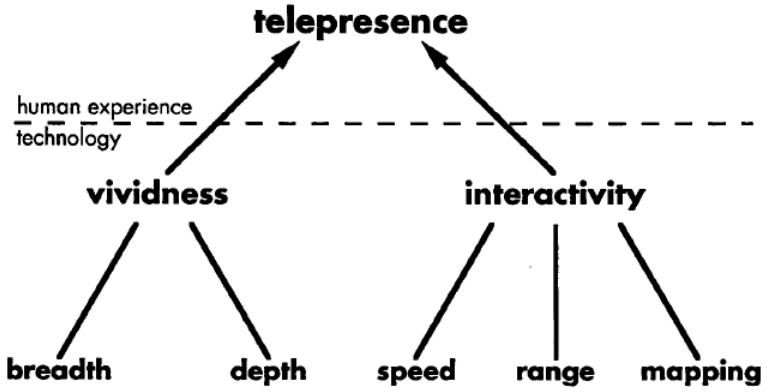


Figure 6: Technological variables influencing telepresence [source: Steuer, 1992]

2.5.1.3 Six Dimensions of Presence
(Lombard and Ditton, 1997)

Their study in 1997 was simply one of the exceptionally well documented manuscripts on Presence. Numerous later works borrowed ideas from their classification of presence. We believe that they were among the first who analysed various definitions of presence referring to literature from multiple fields of research (beyond teleoperators and virtual reality). Although eventually they define presence as "the Perceptual Illusion of non-mediation", they found six interrelated but distinct conceptualizations of presence:

(1) Presence as social richness (Subjective or objective social richness)
(2) Presence as realism (Perceptual or social realism)
(3) Presence as transportation (Transportation of self, place, or other selves)
(4) Presence as immersion (Perceptual or psychological immersion)
(5) Presence as social actor within medium (Social interaction with an entity in a medium)
(6) Presence as medium as social actor (Social interaction with a medium itself)

For a well summarised version of these conceptualizations, the reader is referred to Lee (2004).

2.5.1.4 Physical, Social and Co-Presence

(Ijsselsteijn et al., 2000; Riva et al., 2003)

Ijsselsteijn et al. (2000) suggested that the conceptualizations that Lombard and Ditton (1997) identified can be grouped into two broad categories - physical and social. The physical category refers to the sense of being physically located somewhere, whereas the social category refers to the feeling of being together (and communicating) with someone. They also noted that the two are not unrelated and that there are likely to be a number of common determinants such as the immediacy of the interaction, which are relevant to both social and physical presence. Later in Riva et al. (2003), they attempted to locate the overlap between the two. They proposed that at the intersection, we can then identify co-presence or a sense of being together in a shared space, combining significant characteristics of both physical and social presence.

2.5.1.5 Four Determinants of Presence

(Ijsselsteijn et al., 2000)

While putting the conceptualizations of presence into two broad categories – physical and social presence, Ijsselsteijn et al. (2000) also proposed four broad categories for the determinants of presence:

(1) The extent and fidelity of sensory information
(2) The match between sensors and the display
(3) Content factors
(4) User characteristics

They noted that Factors (1) and (2) may be regarded as 'media form' variables that are aimed at making the medium as transparent as possible, thereby creating the illusion of non-mediation. While (3) and (4) could be considered the subjective part of the presence experience.

2.5.1.6 Proto-Presence, Core-Presence, and Extended-Presence

A new perspective in the study of presence was presented by Riva and Waterworth (2003) and Waterworth et al., (2003). With the help of an evolutionary account of the psycho-neurology of presence, they proposed three component layers: proto presence, core presence, and extended presence (**Figure 7**).

Proto-Presence corresponds to the earliest development of a sense of self versus other and can be identified with the proto consciousness of sensation and of proprioception, of the body's orientation and of what is happening at the body boundary. Core-Presence can be identified with perception of an external world surrounding the body, of things in space in the proximity of the body in the here and now. Extended-Presence relies on memory and imagination and relates what is happening in the present with respect to stored knowledge from past experiences, but which may also be about possible futures. They described Core-Presence and Extended-Presence, both as conscious feelings due to the perceptual and conceptual element of media respectively; Whereas Proto-Presence as mostly unconscious (spontaneous - in this context) and relates to proprioception (the sense of the relative position of neighbouring parts of our body).

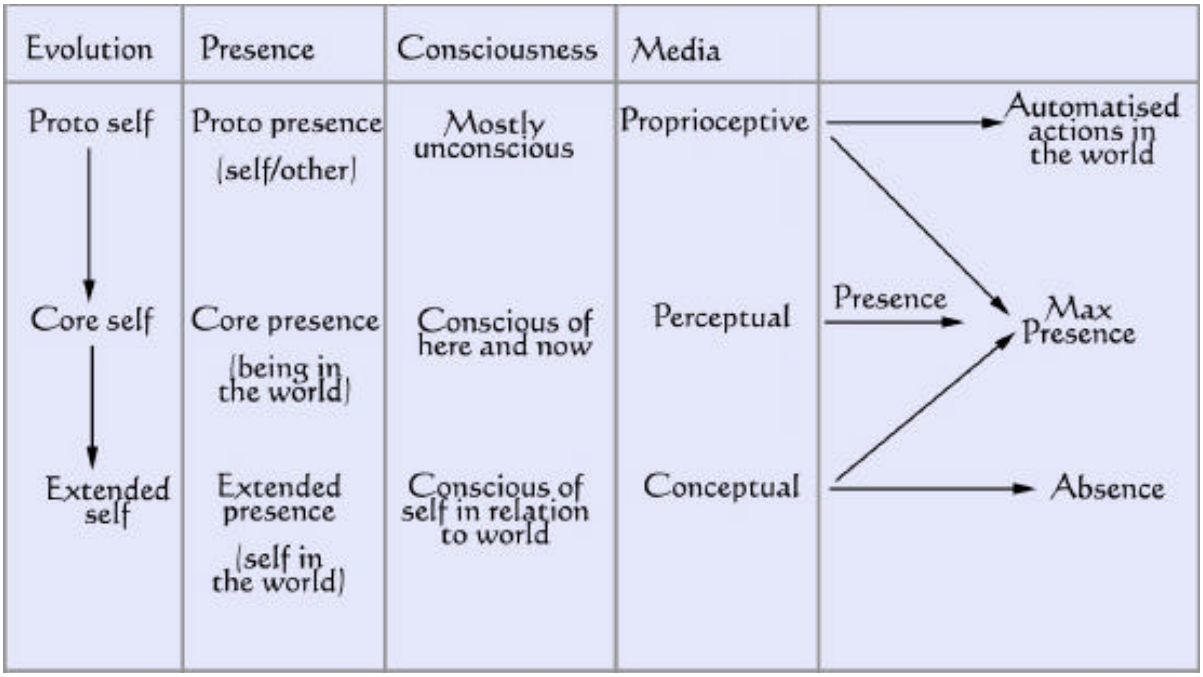


Figure 7: Layers, media and states corresponding to presence [source: Waterworth et al., 2003; Waterworth and Waterworth, 2006]

2.5.1.7 Physical, Social and Self Presence

(Biocca, 1997; Lee, 2004)

Biocca presented in the cyborg dilemma and how the representation of the body in virtual environments affects the mind? He proposed three types of presence:

(1) Physical Presence - Being There
According to him, physical presence is the sense of being physically located in a virtual environment. He also proposed that at any point in time, users feel being present in any one of the following environments - physical environment, virtual environment, or in the imaginal environment.

(2) Social Presence - Being with another body
He defined social presence as a simulation run in the body and mind of the perceiver of the internal experience of a moving, expressive body. He noted that it is defined as simulation, because the simulation occurs whether or not the perceived intelligence is another human or nonhuman intelligence (such as an animal, a form of artificial intelligence, an imagined alien or a god).

(3) Self Presence - Body schema, self-consciousness and identity
Self Presence, as he suggested is the effect of virtual environment on the perception of one's body schema or body image, physiological states, emotional states, perceived traits, and identity. It is the user's mental model of the self inside the virtual world.

2.5.1.8 Six Types of Virtual Experience

(Lee, 2004)

In one of the more recent works on presence, we can find Lee's perspective in terms of human experience. He redefined presence (in general) as 'a psychological state in which virtual (para-authentic or artificial) objects are experienced as actual objects in either sensory or nonsensory

ways' and then defined them specifically to the three domains - physical, social, and self presence.

He suggested that a thorough typology of virtual experience can be made by mixing two characteristics of virtuality (para-authentic and artificial) and three domains of virtual experience (physical, social and self); binging us to six types of virtual experience that technology users can have [for details, please refer to Table.2 in (Lee, 2004)]. Thus according to him, physical presence is 'a psychological state in which virtual (para-authentic or artificial) physical objects are experienced as actual physical objects in either sensory or nonsensory ways'. Social presence is 'a psychological state in which virtual (para-authentic or artificial) social actors are experienced as actual social actors in either sensory or nonsensory ways'. And self presence is "a psychological state in which virtual (para-authentic or artificial) self/selves are experienced as the actual self in either sensory or nonsensory ways."

2.5.1.9 Place Illusion and Plausibility Illusion

(Slater, 2009)

Very recently Mel Slater suggested an alternative terminology for the components of presence. Place Illusion, as he suggested is the 'being there' *qualia* that was previously referred to as 'presence'. It is the strong illusion of being in a place in spite of ascertained knowledge that you are not there. Plausibility Illusion is the illusion that what is happening is real (even though you know that it is not).

Plausibility Illusion is concerned with the 'reality' of the situation depicted. It is maintained through correlations between actions and reactions, and correlations between events that can be perceived within the virtual environments that are directed towards the participant. While Place Illusion is about how the world is perceived, the Plausibility Illusion is about what is perceived. Place Illusion is constrained by the sensorimotor contingencies afforded by the virtual reality system while Plausibility Illusion is determined by the extent to which the system can produce events that relate directly to the participant, the overall credibility of the scenario being depicted in comparison with expectations. He argues that when both the illusions occur, participants tend to respond realistically within virtual reality environments.

2.5.2 Perceptual Illusion and Psychological Illusion

It is clear that the illusion of reality is what evokes a sense of presence. After examining the various determinants and components of presence, we can confidently summarise all the factors of presence into two broad categories (1) Perceptual Illusion: The perception of a continuous stream of sensory input (either from a media or generated internally), and (2) Psychological Illusion: The continuous cognitive processes with respect to the perceptual input, responding almost exactly how the mind would have reacted in Primary Reality.

Virtual reality systems create highest levels of illusion simply because it can affect more senses and help us experience the world as if we were inside it with continuous updated sensory input and the freedom to interact with virtual people or objects. However other forms of media, like a movie (where the sensory input is merely audio-visual and there is no means to interact with the reality presented) can still create a powerful illusion if it manages to create a stronger

Psychological Illusion through its content (for example a story related to one's culture or past experiences, would excite the memory and emotional aspects). One of the obvious examples illustrating the strength of Perceptual Illusion is a media that enforces stereoscopic view enhancing our depth perception (the illusion works due to the way our visual perception would work otherwise, without a medium). The resultant of the two, Perceptual Illusion and Psychological Illusion, evokes an illusion of reality in the mind, although subjectively varying for each person - in strength and experience.

We would like to define these terms before we go further. *Perceptual Illusion is the experience that our mind undergoes when presented with either deceptive sensation of external stimuli or a sensation of internal stimuli (with no external perception). Psychological Illusion is the cognitive response associated with the induced Perceptual Illusion.* Therefore 'Perceptual Illusion and Psychological Illusion' have to be observed and studied from two contexts. In the case of communication media (like films, games, teleoperators, telecommunications, simulators, virtual reality), our external perceptual stimuli are mediated creating a Perceptual Illusion which in turn gives rise to a Psychological Illusion. When it comes to internal perceptual states (like dreams, daydreams, hallucinations, mental imagery experiences) although there are no external perceptual stimuli to mediate the reality experience, the Perceptual Illusion is generated internally leading to the associated Psychological Illusion. The phenomenon of Perceptual Illusion and Psychological Illusion and their interrelation (in both contexts) will be investigated thoroughly in the **Chapter 3**.

2.5.3 Towards the Concept of Evoked Reality

'Reality' is a collective experience of space and time, forming the source of 'presence'. It is when there is a spatio-temporal 'illusion of reality', that we experience an evoked 'sense of presence'. As many researchers (Sheridan, 1992a; b; Lessiter et al., 2001) have noted, presence is a transient experiential state and is susceptible to variation within the same person, given the same physical conditions on two separate occasions. The subjective temporal perspectives and duration estimation with respect to the sense of presence were explored in Waterworth et al. (1983). Later Waterworth and Waterworth (2006) proposed a graphical model as well, representing presence level and temporal perspective. Studies by Garau et al. (2004; 2008) clearly pointed out that the sense of presence is not a stable experience and varies with time.

We know that it's not presence that we create directly but rather an illusion in our minds as a result of which we experience presence. When we use virtual reality systems and create convincing illusions of reality in the minds of users, they feel present in it. This illusion of reality that we evoke through different means in order to enable the experience of presence is what we intend to call 'Evoked Reality' (Pillai et al., 2013a).

As deduced earlier, all the factors influencing presence would essentially be categorized as Perceptual Illusion and Psychological Illusion which together form Evoked Reality. This combined spatiotemporal illusion is what evokes a different reality in our minds (**Figure 8**) inducing presence. Thus, to explore the experience of our sense of presence we must first better understand what Evoked Reality is.

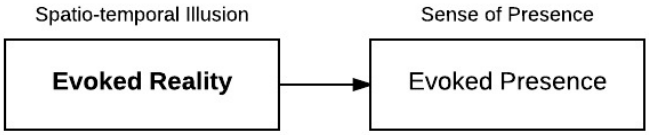


Figure 8: Evoked Reality (the spatio-temporal illusion): Reality so evoked generates the experience of Presence [source: author]

2.6 TERMINOLOGY

Steuer (1992) argued that telepresence is the mediated perception of an environment in which users are being transported via technologies, whereas presence refers to the natural perception of an environment. Biocca et al. (2001) argued that non-mediated (or natural) perception of an environment should not be included in presence research, because its inclusion makes the area of presence research too broad. On the terminology of presence, Waterworth and Waterworth (2003) rightly stated- "Presence is still a vague concept; researchers in the area agree that there is something important conveyed by the term, but differ widely on exactly what that something is"

In fact 'presence' has come to have multiple meanings and it is difficult to have any useful scientific discussion about it given this confusion (Slater, 2009). There can be no advancement simply because when people talk about presence they are often not talking about the same underlying concept at all. No one is 'right' or 'wrong' in this debate; they are simply not talking about the same things (Slater, 2003). On the general problems in conveying knowledge due to the intersection of the conceptual, material and linguistic representations of the same thing, there exists an attempt to explain the workings of communication and its mishaps (Schmidt, 1997a; b), which clearly states that scientists must always indicate which representation they speak of. In this study, it is the phenomenon of experience of presence that we explore. The specific terms used in this study will be defined in first part of the next chapter (**Chapter 3-A)**.

Lombard and Jones (2006) provided a framework to examine different overlapping definitions of presence and promote a standardized terminology for discussing presence phenomena. They presented five key questions that if taken into consideration while defining presence, will help locate the definition in the framework of definitions. They are: (1) Is technology involved in the phenomenon? (2) What is the phenomenon a property of? (3) What is the source of the stimuli? (4) How is technology perceived? (5) What aspect of the phenomenon is of interest? In this thesis these questions will also be answered, at different stages.

RÉSUMÉ DU CHAPITRE 2 : ÉTAT DE L'ART

Dans ce chapitre, nous donnons un aperçu de l'état des connaissances actuelles concernant la recherche sur la « présence ». Les différentes définitions de « la présence » qui ont été proposées, notamment dans le domaine de la réalité virtuelle, sont passées en revue. Un rapport détaillé sur les idées relatives à la « réalité » de différents points de vue est présenté. Ainsi, nous observons ici comment cette recherche conduit au concept de « Réalité Évoquée », et pourquoi cette expérience est si importante à étudier.

La Présence

Compte tenu de l'intérêt croissant pour le domaine de la réalité virtuelle, le sujet de la présence a évolué pour devenir un domaine privilégié de la recherche. Le concept de présence, comme le décrit Steuer (1992), est la clé pour définir la réalité virtuelle en termes d'expérience humaine plutôt que du point de vue du matériel technologique. « La Présence » ne se rapporte pas à l'environnement de tout un chacun, tel qu'il existe dans le monde physique, mais à la perception de cet environnement tel qu'l est médiatisé par des processus mentaux à la fois automatiques et contrôlés.

L'intérêt précoce sur le domaine de la présence trouve son origine dans l'étude de la « téléprésence » (Minsky, 1980), dans le domaine de l'intelligence artificielle et de l'interaction homme-machine en téléopération. En fait, le concept de « Being There » (=être là-bas) a été introduit par Reeves (1991) pour décrire comment les téléspectateurs expérimentaient le milieu qu'ils observaient à la télévision, empruntant ainsi l'idée du roman « Being There » (Kozinski, 1970) et le film de 1979 du même nom. Johnsen et Corliss (1971) ont également débattu de l'importance de la façon de concevoir des écrans et des objets de commandes qui seraient susceptibles d'aider l'utilisateur à projeter sa présence dans un espace de travail à distance (Draper et al., 1998; Ijsselsteijn et al., 2000). En fait, certains soutiennent que la course à la téléprésence a fait partie de l'évolution des médias (Biocca et al., 1995; Kim et Biocca, 1997) et que la théorie de la téléprésence devrait s'appliquer à tous les milieux médiatisés (Steuer, 1995 ; Lombard et Ditton, 1997).

Le terme de téléprésence, introduit par Marvin Minsky (Minsky, 1980), se rapporte au fait qu'un opérateur humain développe le sentiment d'être présent physiquement dans un emplacement éloigné grâce à l'interaction avec une interface homme-machine, lui servant ainsi d'intermédiaire ; c'est à dire à travers les actions de l'utilisateur et les rétroactions subséquentes perceptives qu'il reçoit via la technologie téléopérative (Ijsselsteijn et al., 2000). Sheridan a été l'un des premiers chercheurs à différencier les termes « téléprésence » et « présence ». Il fait référence à la présence induite par un environnement virtuel comme « présence virtuelle », et utilise « téléprésence » pour le cas de la téléopération telle qu'elle a été décrite par Minsky (Sheridan, 1992b).

Néanmoins, la téléprésence a été depuis un sujet bien exploité dans la téléopération et les technologies de télécommunication (Held, 1992; Schloerb, 1995; Draper et al., 1998; 1999). Progressivement, comme son importance a été remarquée par les chercheurs dans le domaine des interfaces multimédia avancées telles que la réalité virtuelle, la téléprésence a abouti aux concepts de « Being There » (= la sensation d'être là-bas) (Reeves, 1991; Sheridan, 1992a), de

« présence virtuelle » (Sheridan, 1992b) et enfin au concept de « présence » en général (Steuer, 1992; Slater et al., 1994; Barfield et al., 1995; Steuer, 1995; Kim et Biocca, 1997; Lombard et Ditton, 1997). Une liste récapitulative des définitions admissibles de « la présence » proposée par des chercheurs de différents courants est présentée dans le **Tableau 1**.

Les chercheurs qui travaillent sur la performance et l'expérience humaines dans la réalité virtuelle ont constaté qu'il était nécessaire de conceptualiser et de mesurer plus efficacement la téléprésence (Sheridan, 1992b; Biocca et Delaney, 1995; Kim et Biocca, 1997). Plusieurs auteurs ont avancé l'idée d'utiliser des réponses réflexes (par ex. : se dérober en réponse à un objet virtuel qui apparaît soudain) et des réponses socialement conditionnées (par ex. : sourire) lorsque l'objectif consistait à mesurer la présence (Held, 1992; Sheridan, 1992b; Slater et Wilbur, 1997). Dans le souci de développer des mesures objectives de la présence, l'approche réaliste comportementale a été proposée, laquelle est basée sur le principe selon lequel si un environnement virtuel ressemble fidèlement à l'environnement qu'il représente, les réponses d'un observateur aux stimuli tendront à se rapprocher de celles qu'il aurait eues si l'on avait fait l'expérience directement avec l'environnement lui-même (Freeman et al., 2000). Selon certains chercheurs, le degré de mobilisation des ressources attentionnelles à l'égard du milieu ambiant constitue un élément de mesure important de la présence (Barfield et Weghorst, 1993; Draper et al., 1998).

Witmer et Singer (1998) soulignent que la présence dépend de la capacité à se concentrer sur un ensemble de stimuli qui ont du sens dans un environnement virtuel. Ils constatent que cette théorie se rapproche du concept proposé par McGreevy (1992) selon lequel l'expérience de la présence est basée sur l'attention portée aux enchaînements, à l'interdépendance et à la cohérence des mouvements du stimulus. La cohérence des caractéristiques de l'environnement virtuel et des stimuli permettent ainsi de focaliser son attention mais n'influencent pas le sujet de l'expérience dans ce sens. Ce concept qui consiste à permettre sans influencer isole l'expérience de la présence des facteurs qui soutiennent généralement l'expérience (Witmer et Singer, 1998). Pour un guide détaillé et méthodique sur les méthodes de mesure actuelles relatives à la présence, nous renvoyons le lecteur à Van Baren et Ijsselsteijn (2004). Cependant, voici un petit aperçu de ces méthodes :

Les mesures subjectives de présence:

(1) Echelles d'évaluation associées aux tests de contrôle et questionnaires
(2) Evaluation de présence continue
(3) Mesures qualitatives
(4) Mesures psychophysiques
(5) Mesures corroborantes subjectives

Questionnaires

(1) Questionnaire de présence (PQ)
(2) Questionnaire Slater-Usoh-Steed (SUS)
(3) Questionnaire ITC-Sense of Presence (ITC-SOPI)

Les 'Breaks in Presence' (BIP)

Les mesures objectives de confirmation de présence

(1) Mesures psychophysiologiques
(2) Corrélations neurales

(3) Mesures comportementales
(4) Mesures associées à l'exécution de tâches

Le concept de présence est d'abord apparu comme une façon de concevoir les télécommunications et a évolué en prenant la forme d'une énigme théorique et intrigante et d'une question philosophique (Loomis, 1992; Biocca, 1996; 1997). Il apparaît clairement que les études sur la présence ont mis le temps avant de réaliser qu'il ne s'agissait pas seulement « d'être juste là » (being there). Nous avançons l'idée que la présence, qu'elle soit forte ou légère, est le résultat d'une «expérience de la réalité».

La Réalité

Le terme « réalité » lui-même est très subjectif et controversé. Bien que les objectivistes soutiennent que la réalité est l'état des choses telles qu'elles existent vraiment et qu'elle est indépendante de l'esprit, les subjectivistes affirment que la réalité est ce que nous percevons comme vrai, et il n'y a pas de véritable réalité sous-jacente qui existe indépendamment de la perception. Les naturalistes prétendent que la réalité est affaiblie par la nature, qu'elle ne renferme rien de surnaturel, et que la méthode scientifique doit être utilisée pour étudier tous les aspects de la réalité, y compris l'esprit humain (Papineau, 2009). De même, une idée physicaliste est que la réalité et la nature du monde réel n'existent qu'à la condition d'un état physique (Stoljar, 2009). La réalité est indépendante des croyances de quiconque, des pratiques linguistiques ou des schémas conceptuels issus d'une perspective réaliste (Miller, 2010). Le point de vue platonicien est que la réalité est abstraite et non spatio-temporelle composée d'objets entièrement non physiques et non mentaux (Balaguer, 2009). Bien que certains conviennent que le monde physique est notre réalité, l'argument de simulation suggère que ce monde perceptible, lui-même peut être l'illusion d'une réalité simulée (Bostrom, 2003). D'autres encore s'évertuent à dire que la notion de monde physique est relative car notre monde est en constante évolution - en raison du progrès technologique - et que la conception qu'on en a varie d'une personne à l'autre (Schmidt, 2008).

Résoudre ces divergences théoriques ou trouver la vraie nature de la réalité n'est pas notre objectif principal et dépasse le cadre de cette thèse. Cependant, nous devons nous positionner sur la perspective à adopter avant d'aller plus loin. Cette thèse étudie «l'expérience» de la présence et de la réalité dans l'esprit avec pour principes fondamentaux la dualité corps-esprit et la réalité phénoménologique. Au fond, nous nous efforçons de proposer un modèle qui regroupe des vues différentes sur la réalité d'une manière cohérente. Donc, nous aimerions consacrer le terme «Réalité Primaire» pour désigner la réalité de nos expériences du monde réel (monde physique).

« *Qualia* » (au singulier « *quale* ») est le terme qui fait référence à notre expérience consciente subjective, en particulier dans une perspective phénoménologique. En fait, le problème qui consiste à expliquer comment et pourquoi nous avons des expériences des *qualia* ou phénoménales est considéré comme le point nodal de la conscience. Les problèmes complexes et simples ont été formulés par l'un des promoteurs des *qualia* - David Chalmers (Chalmers, 1995b). Selon Tye (2009), les états mentaux qui possèdent des *qualia* peuvent être : (1) des expériences perceptives (du type observer un voyant lumineux vert, entendre des trompettes bruyantes, déguster des réglisses, sentir l'air marin, manipuler un morceau de fourrure) ; (2)

des sensations corporelles (telles que sentir un petit pincement de douleur, sentir une démangeaison, avoir faim, avoir mal au ventre, avoir chaud, être pris de vertige) ; (3) des réactions, des passions ou des émotions ressenties (comme les sentiments de joie, de jouissance, de peur, d'amour, de chagrin, de jalousie, de regret) ; (4) des humeurs (comme les sentiments d'exaltation, de dépression, d'accalmie, d'ennui, de tension, de misérabilité). Pour plus de détails sur les *qualia*, voir aussi Lycan (2008) et Byrne (2010).

Ainsi, nous avons tenté de faire la distinction entre «réel» et «illusion» en termes de perception et de cognition.

Illusion Perceptive et Illusion Psychologique

La perception est l'organisation, l'identification et l'interprétation des informations sensorielles permettant de représenter et de comprendre l'environnement (Schacter, 2011). Si les sensations sont les premières étapes dans le fonctionnement des sens pour représenter les stimuli de l'environnement, alors la perception est une fonction supérieure du cerveau qui traite de la lecture des évènements et des objets du monde (Myers, 2004). Selon (Gazzaniga et al., 2006) le but de la sensation est de détecter les stimuli tandis que la perception est ce qui crée des informations utiles relatives à l'environnement à partir des stimuli détectés.

"Toute l'expérience du monde physique sert d'intermédiaire aux sens humains et aux processus complexes de perception. Cette expérience, identifiée par certains chercheurs comme une expérience médiatisée de «premier ordre», est la façon «normale» ou «naturelle» avec laquelle nous percevons le monde physique et qui donne lieu à la sensation subjective d'être présents à notre environnement. Bien que cette expérience médiatisée de «premier ordre» fournisse généralement des perceptions qui correspondent à la vraie nature du monde physique, il peut arriver qu'elle fournisse également des perceptions qui ne correspondent pas à la véritable nature du monde physique ; la présence se réfère à la partie de l'expérience humaine dans laquelle cette perception erronée implique, au moins en partie, le rôle réel de la technologie dans l'expérience : la présence survient lorsqu'une partie ou la totalité de l'expérience d'un individu sert d'intermédiaire non seulement par les sens humains et les processus perceptifs, mais aussi par la technologie anthropiques (c.-à-d., expérience médiatisée de «deuxième ordre»), tandis que la personne perçoit l'expérience comme si elle était vécue par les sens humains et les processus perceptifs (c.-à-d., expérience médiatisée de «premier ordre»)." - ISPR (2000).

Il faut noter que, dans cette étude, la médiation de «premier ordre» est ce qui est désigné comme «Réalité Primaire», et la médiation de «deuxième ordre» est ce qui va être défini comme la «Réalité Média-Évoquée» (expliquée dans le prochain chapitre).

Lorsque qu'elle est confrontée à une stimulation sensorielle intermédiaire ou trompeuse, notre perception fait de son mieux pour organiser et interpréter les stimuli comme elle le ferait normalement (dans une tentative de donner un sens). Et c'est la raison principale pour laquelle nous éprouvons une illusion de forte intensité d'être dans un environnement (virtuel) dans des systèmes de réalité virtuelle de bonne qualité. Cet aspect de notre perception est sans aucun doute un avantage, mais c'est la raison même qui fait que notre perception peut facilement être modifiée ou déformée. L'exemple le plus simple est notre expérience des films en 3D (avec un

affichage stéréoscopique) où nos yeux perçoivent deux images différentes en 2D, ce qui, grâce à notre interprétation perceptive, donne l'illusion d'une troisième dimension.

Nous avons souvent une perception interne menant à des expériences imaginaires, sans aucune interférence de la part de la médiation. Pour donner un exemple dans le domaine du temps réel (RV), vous pouvez imaginer un éléphant d'un blanc pur qui possède aussi des ailes. Immédiatement, les images sont formées dans notre esprit, en ajoutant les éléments nécessaires à l'imaginaire visuel, en fonction de la narration. A présent, si l'on considère les scénarios dans lesquels l'imaginaire est évoqué sans aucune intervention extérieure -quelques exemples comme penser, planifier, rêvasser ou rêver- auxquels cas les expériences tomberont sous l'Illusion Perceptive interne. Dans cette étude, nous avançons que la présence peut se produire uniquement grâce à l'Illusion Perceptive interne. Bien que cela puisse sembler évident, la plupart des travaux de recherche sur la présence traitent spécifiquement des expériences liées aux médias. Bref, l'Illusion Perceptive est le sentiment de percevoir des objets ou des espaces qui ne sont pas physiquement présents (mais évoqués par le truchement de notre perception externe à l'aide de différents médias/moyens ou évoqués de façon endogène par la perception interne dans l'esprit).

La cognition désigne les processus mentaux impliqués dans l'acquisition de connaissances et de compréhension. Elle regroupe diverses activités mentales comme l'attention, la mémoire, l'apprentissage, le raisonnement, la résolution de problèmes - la prise de décision et, surtout, le traitement des informations permettant de donner un sens à notre monde perceptif. Dans le cas de l'expérience perceptive de notre monde réel, nous expérimentons des réponses cognitives. De même, nous suggérons que, en réponse à l'Illusion Perceptive évoquée par la médiation externe, nous expérimentons l'Illusion Psychologique correspondante. Dans les systèmes de réalité virtuelle immersive, l'Illusion Perceptive évoquée est tellement forte que les utilisateurs se comportent généralement comme s'ils faisaient l'expérience du monde réel. L'Illusion Psychologique est particulièrement manifeste dans la façon dont nous réagissons et établissons un lien émotionnellement avec les différents médias artistiques.

En fait, de nombreux facteurs cognitifs influencent l'Illusion Psychologique. Par exemple, parfois le contenu d'un simple discours écrit ou entendu ou une simple image peut provoquer de fortes illusions psychologiques, même si l'Illusion Perceptive ne peut pas être aussi parfaite. Souvent, il arrive aussi qu'elles se complètent mutuellement. Décrire comment l'Illusion Perceptive et l'Illusion Psychologique forment à elles seules l'ensemble de l'illusion spatio-temporelle de la réalité constitue une partie importante de cette étude.

L'Illusion Perceptive est l'expérience que notre esprit éprouve lorsqu'il est confronté à une sensation trompeuse causée par des stimuli externes ou à une sensation de stimuli internes (sans perception externe). L'Illusion Psychologique est la réponse cognitive associée à l'Illusion Perceptive induite. Par conséquent, « l'Illusion Perceptive et l'Illusion Psychologique » doivent être observées et étudiées à partir de deux contextes différents. Dans le cas de supports de communication (comme les films, les jeux, les téléopérateurs, des télécommunications, des simulateurs, la réalité virtuelle), nos stimuli perceptifs externes sont modulés, créant ainsi une Illusion Perceptive qui à son tour donne lieu à une Illusion Psychologique. Pour ce qui est des états de perception interne (comme les rêves, les rêveries, les hallucinations, les expériences

imaginaires), bien qu'il n'existe aucun stimulus perceptif interne, l'Illusion Perceptive est générée en interne menant à l'Illusion Psychologique qui lui est associée.

Illusion de la Réalité

La réalité est une expérience collective de l'espace et du temps. C'est quand il y a une illusion spatio-temporelle de la réalité, que nous éprouvons un sentiment évoqué de présence. Comme des chercheurs (Sheridan, 1992a, b; Lessiter et al., 2001) l'ont observé, la présence est un état transitoire de l'expérience. Elle est sujette à des variations au sein d'une même personne, avec des conditions physiques identiques dans deux contextes distincts. Les perspectives temporelles subjectives et le calcul de la durée concernant le sentiment de présence ont été explorés dans Waterworth et al. (1983). Des années après cela, Waterworth et Waterworth (2006) ont proposé un modèle visuel représentant le niveau de présence et de perspective temporelle. Des études menées par Garau et al. (2004; 2008) ont clairement mis en évidence que le sentiment de présence n'est pas une expérience stable une fois pour toutes mais qu'il varie dans le temps.

Nous savons que ce n'est pas de la présence que nous créons directement, mais plutôt une illusion dans nos esprits qui nous amène à expérimenter la présence. Lorsque nous utilisons des systèmes de réalité virtuelle et que nous créons des illusions convaincantes de la réalité dans l'esprit des utilisateurs, ils se sentent présents en elle. *Cette illusion de la réalité que nous évoquons par différents moyens afin d'aboutir à l'expérience de la présence est ce que nous appelons la «Réalité Évoquée»* (Pillai et al., 2013a).

Comme démontré précédemment, tous les facteurs qui influent sur la présence sont essentiellement classés dans les catégories de l'Illusion Perceptive et de l'Illusion Psychologique, qui, ensemble, forment la Réalité Évoquée. Cette illusion qui combine à la fois l'espace et le temps est ce qui évoque une réalité différente dans nos esprits (Figure 7) et qui aboutit à la présence. Ainsi, afin d'explorer l'expérience de notre sens de la présence, nous devons d'abord mieux comprendre ce qu'est la «Réalité Évoquée».

CHAPTER 3: PROPOSITION

A. THE CONCEPT OF EVOKED REALITY

As we dive into the concept of Evoked Reality, here is a schematic review of the classification of reality and presence as gathered from the state-of-the-art. There is Primary Reality which we normally refer to as the 'real world' or the 'experience of the physical world'. Subsequently there is reality that is evoked with or without the help of an external medium - 'Evoked Reality' (Pillai et al., 2013a). Together they constitute reality (**Figure 9**).

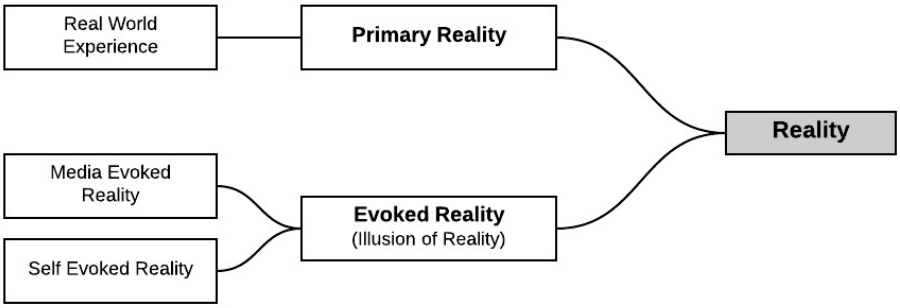


Figure 9: Reality Classification - Primary Reality and Evoked Reality [source: author]

To avoid confusion involving the terms relating to presence, the experience of presence in the Primary Reality will hereafter be denoted as Primary Presence. The various names and definitions that point to the experience of a 'sense of presence' (with or without the help of a media) will be signified by the term 'Evoked Presence'. Therefore the term 'presence' will be used only in a broader and general context (**Figure 10**).

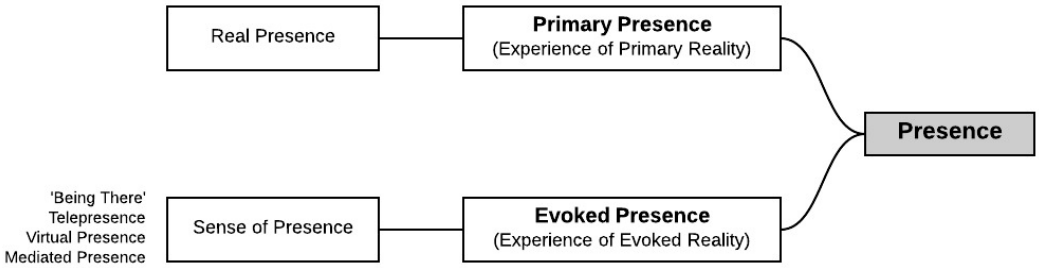


Figure 10: Presence Classification - Primary Presence and Evoked Presence [source: author]

In his chapter, we will attempt to define Primary Reality, Evoked Reality and the two types of Evoked Reality: Media-Evoked Reality and Self-Evoked Reality, mainly with respect to the spatio-temporal experience in our mind. We will then explore presence as an 'experience of reality' (accordingly, Evoked Presence as an experience of Evoked Reality). Later in this chapter, we will introduce the concept of a three pole reality model. Eventually we will propose a graphical map (that attempts to merge different perspectives and domains) representing our experience of reality and presence in the mind at any point in time.

3.1 EVOKED REALITY

Even though the terms like telepresence and virtual reality are very recent, their evidence can be traced back to ancient times (Biocca and Levy, 1995; Blascovich et al., 2002; Biocca, 2003; Grau, 2004; Blascovich and Bailenson, 2011). The urge to evoke reality different from our

Primary Reality (real world reality) is not at all new and can be observed through the evolution of artistic and scientific media throughout history. According to Blascovich and Bailenson (2011), we travel virtually via media all the time and throughout human history we have been using media to wander into and explore virtual worlds. Biocca et al. (1995) pointed out that 'virtual reality' is a heterogeneous cluster of simulator technologies that has been slowly diffusing for decades. They noted that there is in fact no particular starting point, but virtual reality has been a part of the grand evolution of media technology towards the achievement of the ancient desire for 'physical transcendence' and to escape from the confines of the physical world.

> *"When anything new comes along, everyone, like a child discovering the world, thinks that they've invented it, but you scratch a little and you find a caveman scratching on a wall is creating virtual reality in a sense. What is new here is that more sophisticated instruments give you the power to do it more easily. Virtual Reality is dreams."*
> - Morton Heilig [as quoted in Hamit, (1993, p.57)]

3.1.1 From Caves to CAVEs: Evolution of Media

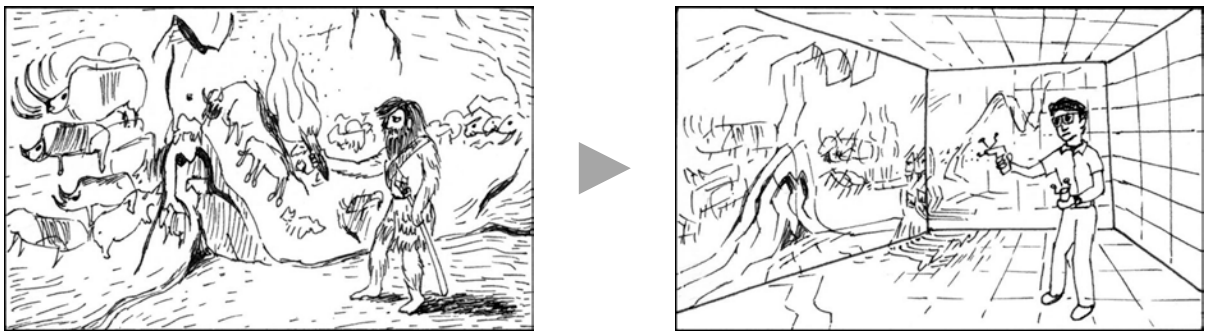


Figure 11: From caveman to CAVE-man [source: author]

Since the beginning of civilizations, man has always tried to 'express his feelings', 'convey an idea', 'tell a story' or just 'communicate' through a number of different media. For example, the cave paintings and symbols that date back to prehistoric times may be considered as one of the earliest forms of media. We could argue, for instance the paintings at Chauvet caves to be one of such earliest known attempts that eventually paved the way for today's extremely immersive Cave Automatic Virtual environments - CAVEs (**Figure 11**) [see Cruz-Neira et al., (1993) for CAVE systems]. As technology progressed media evolved as well (**Figure 12**) and presently we are on the verge of extreme possibilities in mediation, thus equivalent mediated presence.

We all like to experience presence different from our everyday happenings. To do so, we basically find methods to create an illusion of reality different from the reality that we are familiar with. With the help of different media we have already succeeded to evoke a certain amount of presence and we further aim for an optimum level - almost similar to our real world. Every form of mediation evokes a different kind of illusory reality and hence different degrees of presence. In the early examples of research in presence, studies were conducted based on television experiences before Virtual Reality became a more prominent field of research (Hatada and Sakata, 1980). While some types of media evoke mild illusion of presence, highly

advanced media like Virtual Reality may evoke stronger presence. “But we must note that the basic appeal of media still lies in the content, the storyline, the ideas and emotions that are being communicated. We can be bored in VR and moved to tears by a book” (Ijsselsteijn, 2003). This is precisely why the reality evoked (by media) in one’s mind depends greatly on the eventual Psychological Illusion, although it may have been triggered initially by a Perceptual Illusion. Media that could evoke mild or strong presence may range from simple paintings to photos to televisions to films to interactive games to 3D IMAX films to simulation rides to immersive Virtual Reality systems.

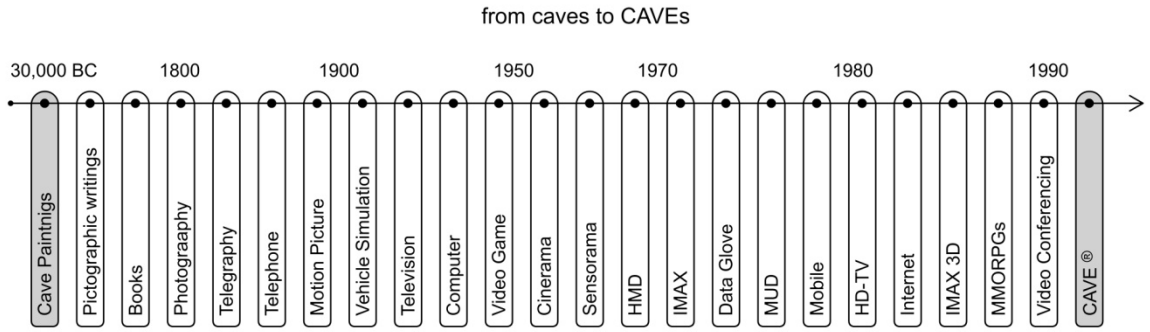


Figure 12: From caves to CAVEs - Evolution of media [source: Pillai et al., 2013a]

3.1.2 Media-Evoked Reality

As a step towards measuring presence evoked by media, in a study by Kim (1996), subjects (after watching television) were asked to report how often they had had the following perceptions: ‘I felt I was in the world the television created’, ‘the television-generated world seemed to me to be more like somewhere that I visited rather than something that I saw’, and ‘my body was in this room, but my mind was inside the world created by the television’ (Lombard and Ditton, 1997). In a focus group study designed to investigate viewers’ experiences of stereoscopic television, Freeman and Avons (2000) found that observers used terms commonly associated with virtual environment display systems, such as ‘being there’. Lessiter et al. (2001) proposed that presence may be evoked by a range of media to varying degrees. They suggested that displays that support a high degree of photorealism may compensate for an absence of control and interactivity typically supported in virtual reality environments. According to Gerrig (1993), a reader of a book can be phenomenally transported to the narrative environment created by the medium. Gerrig's theory of ‘being transported’ included the following propositions:

(1) Someone is transported (The reader becomes the traveller)
(2) by some means of transportation (Medium)
(3) as a result of performing certain actions. (Effect of mediation)
(4) The traveller goes some distance from his or her environment of origin (High accessibility to Evoked Reality)
(5) that makes some aspects of the environment of origin inaccessible. (Low accessibility to Primary Reality)
(6) The traveller returns to the environment of origin, somewhat changed by the journey. (Return to the Primary Reality)
- (Gerrig, 1993, pp.10-11)

With respect to Gerrig's view, Kim (1996) had identified two factors of presence as 'departure' and 'arrival'. Furthermore, Kim and Biocca (1997) compared Gerrig's theory of 'being transported' to the concept of telepresence, as they describe the same psychological phenomenon. In fact, the users of today's mass media, such as books, newspapers, magazine, and television can feel present in the remote or artificial environment created by the mediated information (Kim and Biocca, 1997).

Here are few examples given by Steuer (1992; 2006) that illustrate the sense of presence with respect to different media:

- *Reading a letter from a distant friend or colleague can evoke a sense of presence in the environment in which the letter was written, or can make the distant party seem locally present. This feeling can occur even when one is unfamiliar with the remote physical surroundings.*
- *When people telephone an airline using a toll-free number to make reservations for a flight, they often ask the operator where he or she 'really is.' They do this because they are uncomfortable interacting in a virtual reality that has no other contextual clues, and I therefore wish to create a background into which to place the operator's character.*
- *Users of multiple online systems (such as bulletin boards, conferencing systems, etc.) report that each system provides a distinct 'sense of place.'*
- *Listening to live recordings of music (recordings made during a performance) gives the listener a sense of presence in the room (e.g. concert hall) in which the recording was made. However, recordings made in a studio can also evoke such feelings, even though there was no single 'performance' at which a listener could have been present.*
- *Nuclear power plant operators observe the inside of the reactor by means of a remotely mounted moveable camera and handle radioactive chemicals by means of remotely controlled mechanical 'hands.'*
- *Video game players describe the experience of moving an animated car on the screen as 'driving.'*

Steuer (2006) presented a graph [updated from Steuer (1992)] representing a wide range of media technologies, (both real and fictional) in terms of their vividness and interactivity (**Figure 13**). He also noted that the areas that remain blank are for the media for which the appropriate technologies have not yet been developed.

> *"The blocking of sensory impressions from physical reality is a crucial part of the most compelling VR experiences. The senses are immersed in the virtual world; the body is entrusted to a reality engine. The eyes are covered by a head-mounted display; the real world is invisible. The ears are covered by headphones; ambient sound is muffled. The hands are covered by gloves or props: "touch only the virtual bodies." Virtual reality may share common elements with reading a book in a quiet corner, but this book has stretched in all directions and wrapped itself around the senses of the reader - the reader is swallowed by the story."*
> - (Biocca and Levy, 1995, p. 135)

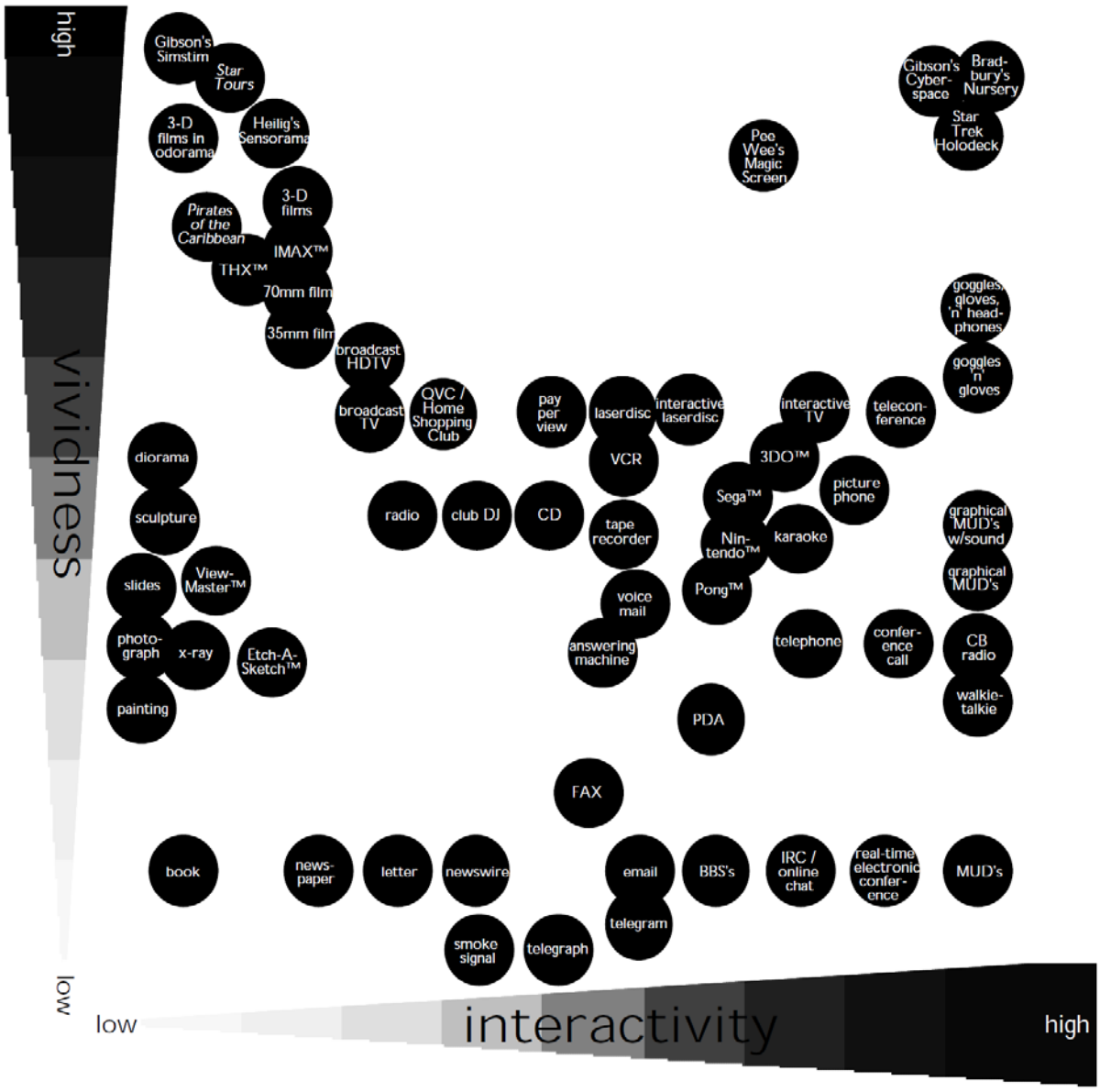


Figure 13: Various media technologies classified by Vividness and Interactivity [source: Steuer, 2006]

In the case of excellent virtual reality systems, the Perceptual Illusion is exceptionally strong leading to stronger Psychological Illusion. As we saw before, Evoked Reality is a momentary subjective reality created in our mind due to the Perceptual and Psychological Illusion imposed by a media. It is clear that in an Evoked Reality formed with the help of media (like Virtual Reality) we experience a sense of presence. This illusion of reality evoked through media, we would like to refer to as *'Media-Evoked Reality'* or Media-ER.

3.1.3 Self-Evoked Reality

As mentioned earlier, it's not just through the media that one can evoke an illusion of reality. The illusion can as well be endogenously created by our mind evoking a seemingly perceivable reality; whether merely observable or amazingly deformable; extremely detailed or highly abstract; simple and familiar or bizarrely uncanny. Thus to fully comprehend the nature of presence, we must study this category of Evoked Reality that does not rely on media. In fact, we

always or most often undergo different types of presence without mediation. Sanchez-Vives and Slater (2005) proposed that the concept of presence is sufficiently similar to consciousness and that it may help to transform research within domains outside Virtual Reality. They argue that presence is a phenomenon worthy of study by neuroscientists and may help towards the study of consciousness.

Baños et al. (2005) Point out that a one could experience presence in different kinds of spaces: real, imaginary, dreamed, hallucinated, or virtual spaces. They note that although recent possibility of creating virtual spaces has increased the interest for studying the sense of presence, presence in non-real spaces was studied before virtual worlds (using virtual reality or similar media) were created. As rightly put by Biocca (2003), where do dream states fit in the two pole model of presence (Reality-Virtuality Continuum)? The psychological mechanisms that generate presence in a dream state have to be at least slightly different than psychological mechanisms that generate presence in an immersive, 3D multimodal virtual environment. Dreaming, according to Revonsuo (1995) is an organized simulation of the perceptual world and is comparable to virtual reality. During dreaming, we experience a complex model of the world in which certain types of elements, when compared to waking life, are underrepresented whereas others are over represented (Revonsuo, 2000). According to LaBerge (1998), theories of consciousness that do not account for dreaming must be regarded as incomplete. LaBerge adds, 'For example, the behaviourist assumption that "the brain is stimulated always and only from the outside by a sense organ process" cannot explain dreams; likewise, for the assumption that consciousness is the direct or exclusive product of sensory input'. It is very clear that one can think, imagine, or dream to create a reality in his mind without the influence of any media whatsoever. This reality evoked endogenously, without the help of an external medium, we would like to refer to as *'Self-Evoked Reality'* or Self-ER (implying that the reality evoked is initiated internally by the mind itself).

Ground-breaking works by Shepard and Metzler (1971) and Kosslyn (1980; 1983) in the area of Metal Imagery provide empirical evidence of our ability to evoke images or imagine stimuli without actually perceiving them. We have seen that Perceptual and Psychological Illusion are factors that affect Media-ER and corresponding EP. We consider that Self-ER essentially has Psychological Illusion for which the Perceptual element is generated internally by our mind. By generally overlooking or occasionally completely overriding the external perceptual aspects (sensorimotor cues), our mind endogenously creates the Perceptual Illusion required for the ER. It's evident in the case of dreaming which according to LaBerge (1998), can be viewed as the special case of perception without the constraints of external sensory input. Rechtschaffen and Buchignani (1992) suggest that the visual appearance of dreams is practically identical with that of the waking world. Moreover, Kosslyn's (1994; 2005) work show that there are considerable similarities between the neural mappings for imagined stimuli and perceived stimuli.

Similar to Media-ER, one may feel higher or lower levels of presence in Self-ER, depending on the reality evoked. A person dreaming at night may feel a stronger presence than a person who is daydreaming (perhaps about his first date) through an on-going lecture with higher possibilities of distractions. According to Ramachandran and Hirstein (1997) we occasionally have a virtual reality simulation like scenario in the mind (although less vivid and generated from memory representations) in order to make appropriate decisions in the absence of the

objects which normally provoke those qualities. However, the vividness, strength and quality of this internally generated illusion may vary significantly from one person to another. For example, the intuitive 'self-projection' phenomenon (Buckner and Carroll, 2007) (personal internal mode of mental simulation, as they refer to it) that one undergoes for prospection will certainly differ in experience and *qualia* from another person. It is a form of Self-ER that may not be as strong or prolonged as a picturesque dream, but strong enough to visualize possible consequences. It is clear that ER is either the result of media or induced internally. This dual (self and media evoking) nature of ER directs us towards a fresh perceptive - three poles of reality.

3.1.4 Definition of 'Self-Evoked' and 'Media-Evoked'

'Mediation' in the Media-ER context denotes a reasonably uninterrupted source of external perceptual input from the Primary Reality. The sensory stimuli should be illusive enough to represent an object (whether known or unknown, whether abstract or detail) which is in fact not there in the Primary Reality. It would also mean that at least one of our senses should be affected by the deceiving sensory stimuli. The mediation should be continuous, especially in order to sustain Media-ER for higher amount of time without breaking the spell.

'Self-Evoked' denotes that the reality experienced is generated within. Both Perceptual and Psychological Illusions are endogenously evoked in the mind, without the help of an external mediation or perceptual input. There would be mental representation or essence of external perceptual inputs that evoked the sense of presence. Self-ER can be triggered voluntarily or involuntarily with respect to our experiences in the Primary Reality. In fact Self-ER can also be triggered by Media-ER (which will be discussed in **3.6** below). Our everyday experiences, with respect to various types of Media-ER and Self-ER (and their sources in daily life) will also be discussed in **3.6**.

"Evoked Reality (ER) is an illusion of reality, different from our Primary Reality." Different kinds of external mediations and internal sensations can evoke illusions of reality of different qualities and strengths in our minds, for different amount of time. It's an illusion of space or events, where or during which we experience a sense of presence. Thus, it is this Evoked Reality in which one may experience Evoked Presence.

3.2 Evoked Presence

Depending on the characteristics of ER, an experience of presence is evoked. To be more specific this illusion of presence created by ER, we would like to refer to as Evoked Presence (EP). In this document, the term 'Evoked Presence' would imply the illusion of presence experience (the sense of presence), while the term 'presence' would be reserved for experience of presence in its broad sense (real presence and the sense of presence). "*Evoked Presence is the spatiotemporal experience of an Evoked Reality."* We could say that so far it's through the media like highly immersive virtual reality systems, that we were able to create ER that could evoke significantly strong EP.

The concept that *"presence is an experience of reality"* is the simplest way to explain presence. **Figure 14** shows the phenomenon of how presence is associated with reality. The different but

analogous terms (from multiple domains) in fact point to the 'sense of presence', which is what is referred to as 'Evoked Presence'.

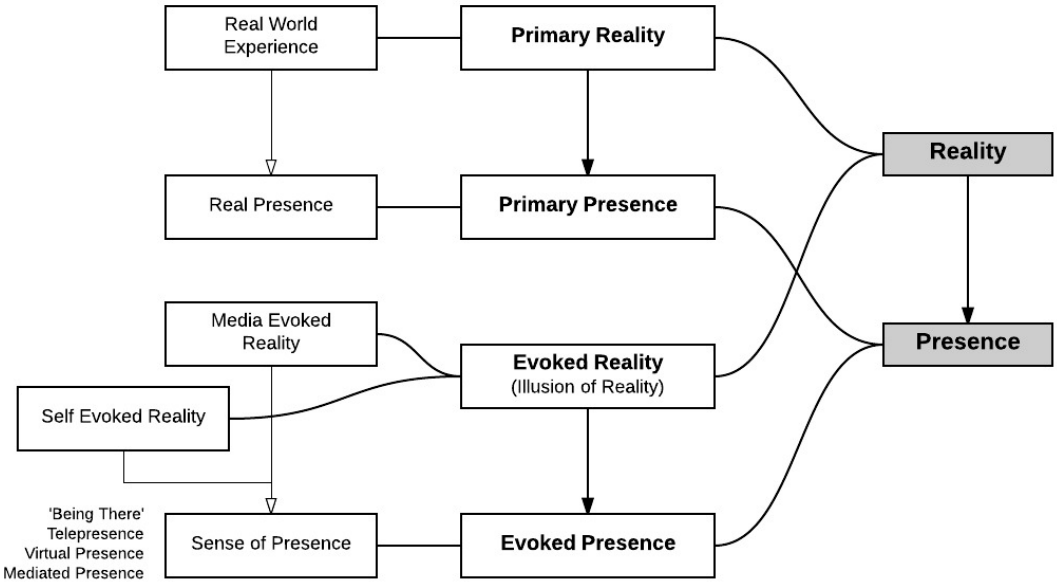


Figure 14: Presence is the experience of Reality [source: author]

3.2.1 Break in Reality to Break in Presence

According to Ijsselsteijn et al. (2000), to create and sustain the illusion (Media-ER), distractions and negative cues to presence should be avoided. An awkward interface will stress the mediated nature of the experience and may diminish the sense of presence. Examples of such negative cues include: bad stereoscopic alignment (causing eye strain), coding distortions in the image (e.g. visibility block or noise), weight of a head-mounted display, process interruptions (e.g. 'new mail has arrived', malfunctions, error notices), noticeable tracking lags, low update rates, stereo/occlusion conflicts, etc. They noted that distractions that draw the user's attention from the mediated environment to the real world diminish the user's sense of presence. In other words, anomalies that draw the user's attention from the ER (Media-ER in this context) to the Primary Reality would break the user's Evoked Presence.

Similarly in the case of Self-ER, when we are temporarily cut off from Primary Reality, we undergo scenarios where certain distractions bring our attention from the mentally evoked world back to the real world (if we do not voluntarily come back). For instance, similar to the example that was given earlier, let's say, there is an ongoing lecture and you are daydreaming about your 'loved one'. You are having a special candle light dinner together in a restaurant, at a very romantic corner. There is a soothing music in the background. You are looking deep into her eyes. And she calls out your name loudly, in a rather manly voice (sounding like your lecturer), and you are right back in the lecture room. Of course the shift is fast and with less disorientation or confusion compared to waking up from a stronger Self-ER (like a dream).

ER is a transient subjective reality created in our mind. In the case of Media-ER, the illusion persists until an uninterrupted input of perceptual stimuli (primarily causing Perceptual Illusion) and simultaneous interactions within the ER (affecting Perceptual and Psychological Illusion) continue to remain. In the case of Self-ER, the illusion persists until an uninterrupted internal Perception (Perceptual Illusion) and simultaneous (mental) interactions within the Self-ER (facilitating Perceptual and Psychological Illusion) continue to remain. In fact the moment at which this illusion of Evoked Reality breaks due to an anomaly is when we experience what is called a 'Break in Presence' (BIP) (Slater and Steed, 2000; Brogni et al., 2003). Thus a BIP is simply an immediate result of the 'Break in Reality' (BIR) experienced.

3.3 THREE POLES OF REALITY: From Dreams to Simulations

As we move further into the concept of ER and EP, we would like to define the three poles of reality to be clearer and more objective in the explanations that follow. Reality, as discussed earlier, has always been a term interpreted with multiple meanings and theories. To avoid confusion we would like to use an impartial term - 'Primary Reality', which would refer to the 'experience' of the real world (or what we call physical world). It is the spatiotemporal reality in our mind when we are completely present in the real world. It would mean that any reality other than Primary Reality is an illusion (mediated or non-mediated) of reality, or more precisely - Evoked Reality.

3.3.1 Presence and Poles of Reality

Inherited from early telerobotics and telepresence research, the two pole model of presence (**Figure 15**) suggests that presence shifts back and forth from physical space to virtual space. Research on presence has been dominated ever since by this standard two pole psychological model of presence which therefore requires no further explanation.

Figure 15: The standard two pole model of presence [source: author]

Biocca (2003) took the study of presence model one step further. He proposed a three pole model of 'shifts in presence' (**Figure 16**) as an attempt to resolve the problems associated with the presence conceptualizations found in the standard two pole model. According to this model, one's spatial presence shifts between three poles of presence: mental imagery space, the virtual space and the physical space. In this three pole graphic model, a quasi-triangular space defined by three poles represented the range of possible spatial mental models that are the specific locus of an individual user's spatial presence. His Model of presence attempted to offer a parsimonious explanation for both the changing loci of presence and the mechanisms driving presence shifts.

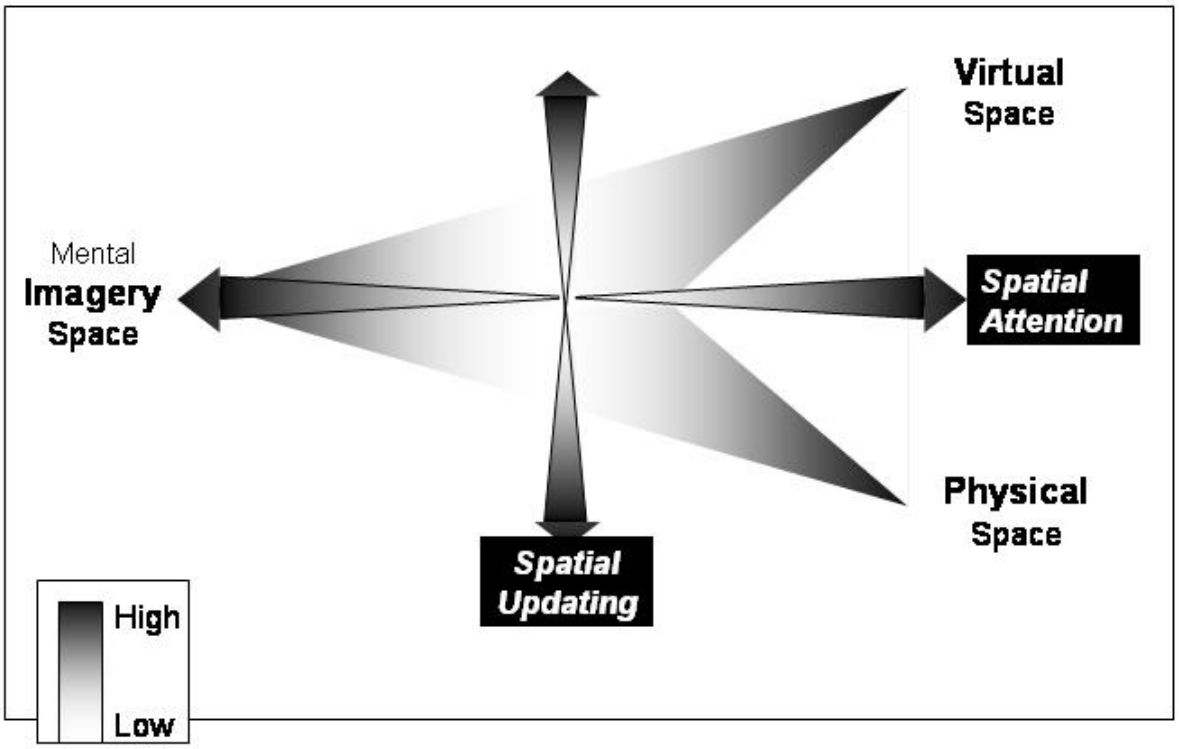


Figure 16: Three pole model of 'shifts in presence' [source: Biocca, 2003]

Though the model explained the possibilities of presence shifts and varying levels of presence, it is vague about certain aspects of reality. It did not clarify what happens when we experience an extremely low level of presence (at the center of the model). Although he suggested, "in cases where the physical environment is not demanding of spatial attention, individuals may experience low spatial attention to the physical environment and become disengaged. A mental imagery space may dominate leading to an oscillation or division of presence across two spatial models the physical and the imagery space." Moreover, how or why do we instantly return to our Primary Reality (in this model - Physical Space) as soon as a mediated reality or a dream reality is disrupted (Even though we may have entirely believed to be present in the reality evoked during a vivid dream)? Nevertheless, we were fascinated with his theory, of presence shifting between three poles (Biocca, 1997; Biocca, 2003). Also, as he suggested we agree to the fact that attention plays a great role in where and when we experience presence. In fact it helped greatly in our proposition, although we approach it through a different point of view with respect to the experience of reality.

We would like to define *'three poles of reality'* from the perspective of Evoked Reality. The Three Pole Reality Model (**Figure 17**) may help overcome the theoretical problems associated with presence in the standard two pole model of presence as well as reorganize the model proposed by Biocca. According to us it's the shifts in the type of reality evoked that create respective shifts in the level of presence evoked. For example if one experiences a highly convincing Evoked Reality during a virtual reality simulation, he/she would experience an equivalently strong Evoked Presence until a BIR occurs. The 3 Poles of reality that we define are:

- Dream Reality (Threshold of Self-ER)
- Primary Reality (No ER)
- Simulated Reality (Threshold of Media-ER)

Figure 17: Three Pole Reality Model [source: Pillai et al., 2013a]

3.3.2 Primary Reality

It has been suggested by Loomis (1992) that our contact with the real world itself may perhaps be mediated.

> *"The perceptual world created by our senses and the nervous system is so functional a representation of the physical world that most people live out their lives without ever suspecting that contact with the physical world is mediated; moreover, the functionality of perception impedes many reflective individuals from appreciating the insights about perception that derive from philosophical inquiry. Oddly enough, the newly developing technology of teleoperator and virtual displays is having the unexpected effect of promoting such insight, for the impression of being in a remote or simulated environment experienced by the user of such systems can be so compelling as to force a user to question the assumptions that the physical and perceptual world are one and the same."*
> - (Loomis, 1992, p. 113)

He pointed out that the mediation of virtual environments and the study on virtual reality experiences lead us to reconsider how our body mediates our mental construction of the real world. To this Biocca (1997) added: "We have been present in this environment for so long and it is so natural, that the idea that presence might be a psychological construct is only raised by philosophers and perceptual psychologists". In fact there are researchers who consider calling the real world experience as 'first order mediation' (ISPR, 2000), which we would like to refer to as our Primary Reality.

Primary Reality refers to the reality of our Real World. In Primary Reality, the experience evoking stimulation arrives at our sensory organs directly from objects from the real world. We maintain this as an ideal case in which the stimulus corresponds to the actual object and does not deceive or misinform us. For instance, imagine yourself on the terrace of a skyscraper. You are running furiously as you are being chased by a stranger. You reach an end of the terrace. You have no choice but to surrender or somehow jump to the next building nearby. Although scared, in an attempt to save yourself, you take a giant leap, but fail to make it to the other end and you fall. The display flashes on you: 'game over' with the options: 'resume from saved point' or 'exit', and you realize about the real world outside the simulation. Consider another example; imagine yourself running from a tiger that is chasing you. It's very near and is about to pounce on you. You scream in fear and wake up to realize that you are safe in your bed, like every morning. You know for sure that this is the real world and the chasing tiger was just a part of the dream reality that your mind was in, some time before.

So, *Primary Reality is our base reality to which we return when we are not in any Evoked Reality.* In other words, when a BIR occurs, we come back to Primary Reality. Thus, as we can see in

Figure 18, any point of reality other than Primary Reality is an Evoked Reality. We could say that it's this Primary Reality that we rely on for our everyday activities. It's the reality in which we believe that we live in. Our experiences in this Primary Reality may form the basis for our experiences and expectations in an Evoked Reality. For example, our understanding of the real world could shape how we experience presence in an immersive virtual reality environment, or even in a Dream. We could suppose that it's the Primary Reality in which one believes this document exists, or is being read.

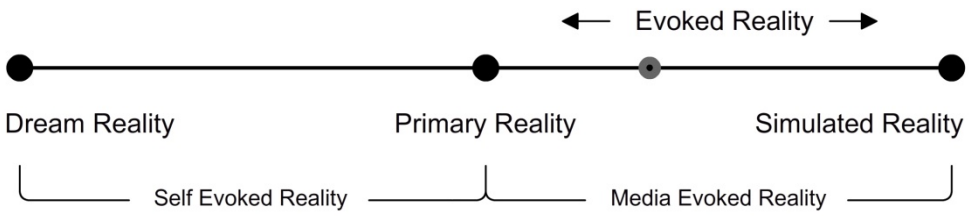


Figure 18: Three Poles of Reality: Evoked Reality constantly shifts between them [source: Pillai et al., 2013a]

3.3.3 Simulated Reality

In the case of Media-Evoked Reality, an experience similar to Primary Reality is attempted to be achieved by interfering with the stimulus field, leading to an illusion of reality. For example virtual reality uses displays that would entirely mediate our visual perception in a manner that our head or eye movements are tracked and updated with appropriate images to maintain this illusion of receiving particular visual stimuli from particular objects. Simulated Reality would be the most compelling and plausible reality that could ever be achieved through such mediations. It would be the reality evoked in our mind under the influence of a perfectly simulated virtual reality system. It's the ultimate level that virtual reality aims to reach someday. At the moment an immersive virtual reality system, like flight simulators would be able to create ER considerably close to this pole. Its effectiveness is evident in the fact that pilots are able to perfectly train themselves being in that ER created by the simulator, helping them eventually to directly pilot a real plane. Lombard and Ditton (1997) noted that the illusion of non-mediation does not represent a perceptual or psychological malfunction or psychosis, in which the mediated experience is consciously confused with what is non-mediated or 'real.' In fact as they noted, when it comes to present virtual reality systems, when asked, users would accurately report that they are using a medium.

However, in the hypothetical condition of a perfectly Simulated Reality our mind would completely believe the reality evoked by the simulation medium and have no knowledge of the parent Primary Reality (Putnam, 1982; Bostrom, 2003). In this state, it would be necessary to force a BIR to bring our mind back to Primary Reality. *A Perfect Simulated Reality is the Media-ER with strongest presence evoked and will have no BIRs.*

3.3.4 Dream Reality

In the case of Self-Evoked Reality, the external perceptual stimuli are imitated by generating them internally. Dream Reality is an ideal mental state in which we almost entirely believe in the reality experienced and accept what is happening as real. It does not return to the Primary

Reality unless a BIR occurs. For instance, in the case of our regular dreams, the most common BIR would be 'waking up'. Although internally generated, dream states may not be completely divorced from sensorimotor cues. There can be leakage from physical space into the dream state (Biocca, 2003). "That we may at any time be awakened by intense stimuli should prove to us that the mind has remained in constant communication with the external world even during sleep. The sensory stimuli that reach us during sleep may easily become the source of dreams" (Freud, 1913, p.19). The experienced Evoked Presence during a strong Dream can be so powerful that even the possible anomalies (causing BIRs) like external noises (an alarm or phone ringing) or even elements from physical disturbances (blowing wind, temperature fluctuations) may be merged into the dream reality, so as to sustain this ER for as long as possible. *A Perfect Dream Reality is a Self-ER with the strongest presence evoked and will have no BIRs* (similar to Simulated Reality with respect to media-ER).

3.4 REALITY-PRESENCE MAP

3.4.1 Presence Shifts and Presence Threshold

> *"Shifts in presence probably predate the arrival of all media. As a psychological process, the ability to shift ones sense of spatial presence was not created for virtual environments. Clearly, the ability to shift ones spatial presence must be based on mechanisms that most likely served some evolutionary value. We can conceive of situations when our ancestors needed to phenomenally experience presence in a place other than the one the body was located, for example in action planning. Furthermore, the mental image of oneself in another place may have been critical to the emergence of representation and self-consciousness."*
> - (Biocca, 2003) [with reference to (Donald, 1991)]

Biocca suggests how the phenomenon of 'shifts in presence' may predate evolution of media; which would be why we experience such shifts in mediated or non-mediated conditions. In fact we are often under the effect of either Media-ER or Self-ER. Imagine that we are not influenced by any mediation, nor any kind of thoughts, mental imagery or dreams and our mind is absolutely and only conscious about the Primary Reality; a state of 'flow' entirely dedicated to the Primary Reality. In such an exceptional situation we would supposedly feel complete presence in the Primary Reality. Thus we presume that this perfect Primary Presence (or "real presence" as some may call) is the threshold of presence one's mind may be able to experience at a point of time. It is clear that we can experience presence either in Primary Reality or in an Evoked Reality. We cannot consciously experience presence in two or more realities at the same time, but our mind can shift from one reality to another voluntarily or involuntarily, thus constantly shifting the nature and strength of the presence felt. As pointed out by Biocca (1997; 2003), presence is not a stable experience and varies temporally. They explain how even BIPs could be of varying intensities. Garau et al. (2008) illustrated using different presence graphs the phenomenon of shifting levels of presence with the course of time and how subjective the experience is for different participants. Media like virtual reality aims to achieve the Presence Threshold at which one's mind might completely believe the reality evoked. Though we have not however achieved it, or may never do, theoretically it's possible to reach such a level of Simulated Reality. Similarly if one experiences a Perfect Dream without any BIR, he/she would be at this threshold of presence exactly like being in the Primary Reality. In other words,

Simulated Reality and Dream Reality are the two extreme poles of reality at which the Evoked Presence is at its threshold. These presence shifts due to the shifting of reality between these poles is something that we seldom apprehend, although we always experience and constantly adapt to them. In the sections that follow, we attempt to represent this phenomenon with a coherent schematic model that would help us examine presence and reality from a clearer perspective.

3.4.2 The Reality–Presence Map

Based on the three poles of reality and Presence Threshold we would like to propose the Reality-Presence Map (**Figure 19**). This map is a diagram of the logical relations between the terms herein defined. At any point of time one's mind would be under the influence of either a Media-ER or a Self-ER when not in the Primary Reality (with no ER at all). Between the poles of reality, ER would constantly shift evoking a corresponding presence (EP). As we can see in the map there is always a sub-conscious Parent Reality Presence corresponding to the EP. This Parent Reality Presence is very important as it helps our mind to return to the Primary Reality once the illusion of ER discontinues (or a BIR occurs). For a weaker EP, the Parent Reality Presence is stronger (although experienced sub-consciously). When the ER manages to evoke very strong presence, the strength of Parent Reality Presence drops very low (almost unconscious) and we start to become unaware of the existence of a Primary Reality; which is what an excellent immersive virtual reality system does. The shifting of presence is closely related to our attention. As soon as our attention from the Evoked Reality is disrupted (predominantly due to interfering external perceptual elements), our attention shifts to the parent reality presence sliding us back to Primary Reality (thus breaking our Evoked Presence).

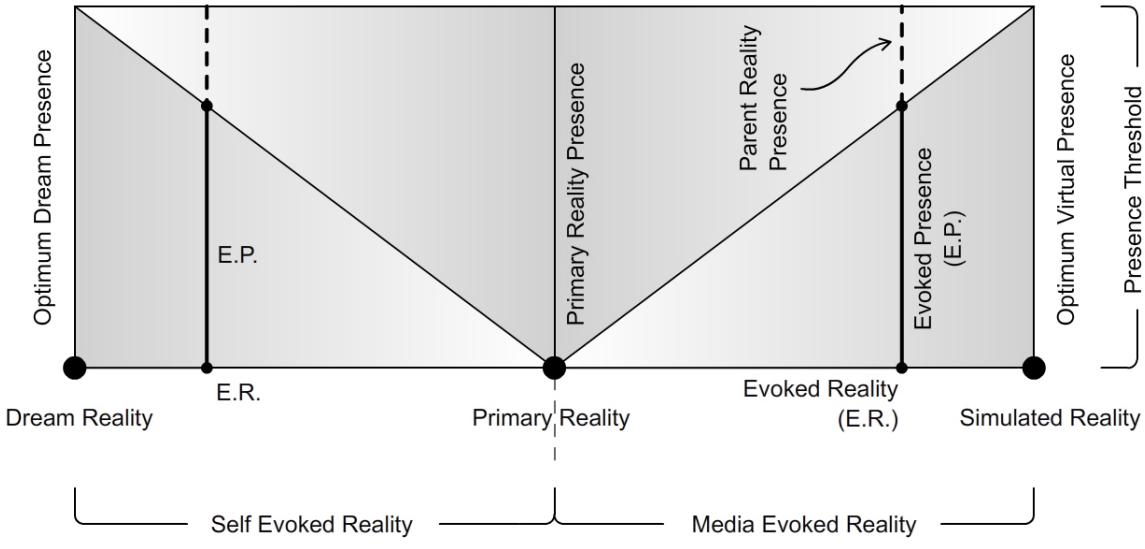


Figure 19: Reality-Presence Map [source: Pillai et al., 2013a]

At the extreme poles, we would experience an Optimum Virtual Presence in a Simulated Reality and similarly an Optimum Dream Presence in a Dream Reality. At these extreme points one may completely believe in the illusion of reality experienced almost or exactly like it is our Primary Reality, unbeknownst an existing Parent Reality. At such a point, possibly a very strong BIR should be forced to bring one back to the parent Primary Reality. Experiencing a strong Dream

Reality is one such example which many would relate to. During a very compelling but frightening dream, 'waking up' acts as a very strong BIR, helping in the desperate attempt to leave the Dream Reality. After such a sudden and shocking change in reality most often our mind takes time to adjust back to the Primary Reality where everything would slowly turn normal and comforting.

A major task for empirical consciousness research is to find out the mechanisms which bind the experienced world into a coherent whole (Revonsuo, 1995). This map provides a framework where the various experiences of Evoked Reality could be mapped. Note that this map is not a 'graph' that shows the strength of EP as directly proportional to the strength of ER. In fact it would help us represent every possible kind of ER as a point fluctuating between the two extreme poles of reality, with its respective strength of EP. We may refer to ER as stronger or weaker, when its *qualia* evoke stronger or weaker EP respectively. The Reality-Presence Map shows that if we can skilfully manipulate these *qualia* of Evoked Reality (although subjective to each individual) bringing it closer to either of the two extreme poles, we may be able to evoke higher levels of Evoked Presence. We should mention that, in order to understand its basic concept, the Reality Presence Map introduced here is a flattened two-dimensional version of the map. In the next part of this chapter and the later chapters we see how this map tries to account for different experiences which were not able to be mapped by previous presence models.

Since ER is a subjective feeling, it can never be measured or even compared truthfully. This is to some extent the reason why we depend on the measurement of presence (EP) to determine if a system creates a stronger ER. Since amount of presence itself is relative, the best way to measure is to compare between systems in similar context. 'The illusion of presence does not refer to the same *qualia* across different levels of immersion. The range of actions and responses that are possible are clearly bound to the sensorimotor contingencies set, that defines a given level of immersion. It may, however, make sense to compare experience between systems that are in the same immersion equivalent class' (Slater, 2009).

RÉSUMÉ DU CHAPITRE 3-A: LE CONCEPT DE LA RÉALITÉ ÉVOQUÉE

Dans cette première partie du chapitre 3, nous introduisons le concept de « Réalité Évoquée » (Pillai et al., 2013a). Nous présentons toutes les propositions qui sont faites dans cette thèse. Nous définissons clairement en quoi la Réalité Média-Évoquée se distingue de la Réalité Auto-Évoquée. Nous démontrons dans quelles mesures les différentes expériences de réalité virtuelle, de réalité simulée ou de rêves tombent dans le vaste éventail de nos expériences. Nous présentons ensuite le modèle tripolaire de la réalité qui nous conduira à un modèle schématique que nous appelons la Reality-Presence Map (la Carte Réalité-Présence).

La Réalité Évoquée

Même si les termes de « téléprésence » et de « réalité virtuelle » sont très récents, leur origine date de l'antiquité. La volonté d'évoquer la réalité différente de notre réalité primaire (réalité du monde réel) n'est pas du tout nouvelle et a pu être observée à travers l'évolution des médias artistiques et scientifiques tout long des siècles passés. D'après Blascovich et Bailenson (2011), nous voyageons virtuellement à travers les médias en permanence et depuis toujours, nous avons utilisé les médias pour explorer des mondes virtuels et nous y promener. Biocca et al. (1995) soulignent que la « réalité virtuelle » est un groupe hétérogène de technologies de simulation qui tend à se diffuser lentement depuis des décennies. Ils constatent qu'en fait il n'y a pas de point de départ particulier, mais la réalité virtuelle a été une partie intégrante de la grande évolution technologique des médias au travers de la réalisation du désir ancestral de «transcendance physique» et de l'idée d'échapper aux limites du monde physique.

Depuis la nuit des temps, l'homme a toujours essayé d' « exprimer ses sentiments », de « transmettre des idées », de « raconter des histoires » ou tout simplement de « communiquer » par l'intermédiaire de nombreux médias différents. Par exemple, les peintures rupestres et les symboles qui remontent aux temps préhistoriques peuvent être considérés comme une des premières formes de médias. On pourrait avancer, par exemple, que les peintures des grottes Chauvet constituent l'une de ces toutes premières tentatives connues qui ont finalement ouvert la voie au système extrêmement immersif qui prévaut à l'heure actuelle - Cave Automatic Virtual Environments - CAVEs (cf. Figure 10). Le progrès technologique a accompagné l'évolution des médias (cf. Figure 11), et actuellement nous sommes au point où les possibilités de la médiation sont infinies. Toute forme de médiation évoque une sorte différente de réalité illusoire et donc des différents degrés de présence. Dans les premiers exemples de recherches sur la présence, des études ont été menées sur la base des expériences de télévision avant que la réalité virtuelle ne suscite autant d'intérêt pour la recherche (Hatada et Sakata, 1980). Bien que certains types de médias évoquent l'illusion de la présence douce, des médias très hautement élaborés, tel que la réalité virtuelle, peuvent évoquer une présence plus forte. En résumé, *la réalité est une illusion spatio-temporelle de la Réalité Évoquée dans notre esprit.*

La Réalité Média-Évoquée

Dans une étude de Kim (1996) pour mesurer la présence telle qu'elle est évoquée via des médias, les sujets, après avoir regardé la télévision, ont été invités à indiquer à quelle fréquence ils avaient eu les perceptions suivantes : « J'avais l'impression d'être dans le monde créé par la télévision » ; « le monde généré par la télévision me semblait plus être comme un endroit que

j'ai visité, plutôt que comme quelque chose que j'ai vu » ; « mon corps était dans cette salle, mais mon esprit était à l'intérieur du monde créé par la télévision » (Lombard et Ditton, 1997). Dans une étude avec un panel de participants visant à étudier les expériences des spectateurs de la télévision stéréoscopique, Freeman et Avons (2000) ont constaté que les observateurs utilisaient des termes couramment associés aux systèmes de réalité virtuelle, tels que «être là». Lessiter et al. (2001) ont soutenu que la présence pouvait être provoquée par n'importe quel type de médias à des degrés variables. Ils ont suggéré que les écrans qui supportent un haut degré de photoréalisme peuvent compenser une absence de contrôle et d'interactivité habituellement constatés dans les environnements de réalité virtuelle. D'après Gerrig (1993), le lecteur d'un livre peut être transporté de fait à l'environnement narratif suggéré par le livre.

Dans le cas des systèmes de réalité virtuelle de qualité supérieure, l'Illusion Perceptive est exceptionnellement forte, ce qui conduit à renforcer l'Illusion Psychologique. Comme nous l'avons vu précédemment, la Réalité Évoquée est une réalité momentanée subjective créée dans notre esprit par l'Illusion Perceptive et psychologique imposée par les médias. Il est évident que dans une Réalité Évoquée formée avec l'aide de médias (comme la réalité virtuelle) nous éprouvons un sentiment de présence. Cette illusion de la réalité évoquée par les médias renvoie à la « Réalité Média-Évoquée » ou Media-ER.

La Réalité Auto-Évoquée

Ce n'est pas seulement à travers des médias que l'on peut évoquer une illusion de la réalité. L'illusion peut aussi être créée de manière endogène par notre esprit en évoquant une réalité qui semble perceptible ; qu'elle soit plutôt observable ou incroyablement déformable ; extrêmement détaillée ou très abstraite, simple et familière ou bizarrement troublante/mystérieuse. Ainsi, pour bien comprendre la nature de la présence, nous devons étudier cette catégorie de Réalité Évoquée qui ne repose pas sur des médias. En fait, la plupart du temps ou même presque toujours, nous avons éprouvé différents types de présence sans médiation. Sanchez-Vives et Slater (2005) ont proposé que le concept de présence ait des traits plus ou moins communs avec celui de conscience et qu'il puisse aider à transformer la recherche dans des domaines qui sortent du cadre de la réalité virtuelle. Ils soutiennent que la présence est un phénomène digne d'une étude neuroscientifique et qu'elle peut aider à l'étude de la conscience.

Baños et al. (2005) soulignent que l'on peut éprouver une présence dans différents types d'espaces : réels, imaginaires, rêvés, hallucinés, ou virtuels. Ils constatent que, bien que la possibilité de créer des espaces virtuels soit somme toute récente, l'intérêt pour l'étude du sens de la présence a fortement augmenté ; la présence des espaces a été étudiée avant que les mondes virtuels (utilisant la réalité virtuelle ou les médias similaires) ne soient créés. Comme l'a judicieusement remarqué Biocca (2003), dans quelle mesure les états de rêve doivent-ils s'inscrire dans le modèle à deux pôles de présence (Continuum Réalité-Virtuel) ? Les mécanismes psychologiques qui génèrent la présence dans un état de rêve doivent être légèrement différents de ceux des mécanismes psychologiques qui génèrent la présence dans un environnement virtuel 3D, immersif et multimodal. Rêver, selon Revonsuo (1995), est une simulation organisée du monde sensible et est comparable à la réalité virtuelle. Pendant le rêve, nous faisons l'expérience d'un modèle complexe du monde dans lequel certains types d'éléments, par rapport à la vie éveillée, sont sous-représentés alors que d'autres sont sur-

représentés (Revonsuo, 2000). D'après LaBerge (1998), les théories de la conscience qui ne tiennent pas compte des rêves doivent être considérées comme incomplètes. Il est évident que chacun peut penser, imaginer ou rêver de créer une réalité dans son esprit sans l'influence de n'importe quel média. Cette Réalité Évoquée de façon endogène, sans l'aide d'un support externe, nous voudrions la désigner comme « Réalité Auto-Évoquée » ou Self-ER (ce qui implique que la Réalité Évoquée est initiée en interne par l'esprit lui-même).

La Présence Évoquée

« Médiation » dans le cadre de la Réalité Média-Evoquée (Media-ER) désigne une source raisonnablement ininterrompue de saisies perceptives externes de la réalité première. Les stimuli sensoriels doivent être suffisamment illusoires pour représenter un objet ou un espace ou un événement qui est en fait absent dans la réalité primaire. Cela signifie également qu'au moins un de nos sens doit être affecté par les stimuli sensoriels trompeurs. La médiation doit être continue, en particulier en vue de soutenir la Media-ER pour un certain laps de temps sans rompre le mécanisme.

« Auto-Évoquée » indique que la réalité expérimentée est générée de l'intérieur. Les illusions, qu'elles soient à la fois perceptives et/ou psychologiques, sont évoquées de manière endogène dans l'esprit, sans l'aide d'un médiateur externe ou d'une entrée perceptive. Il y aurait une représentation mentale ou l'essence d'une perception externe qui déclenche le sentiment de présence. Self-ER peut être déclenchée volontairement ou involontairement d'après nos expériences dans la réalité primaire. En effet la Self-ER peut également être déclenchée par la Media-ER (idée qui sera approfondie ultérieurement). Nos expériences quotidiennes en relation avec les différents types de Media-ER et de Self-ER (et leurs sources dans la vie quotidienne) seront également approfondies par la suite.

Différents types de médiations externes et de sensations internes peuvent évoquer les illusions de la réalité sous différents aspects et différentes intensités dans nos esprits pour des laps de temps différents. C'est une illusion d'espace ou d'événements, pendant laquelle nous éprouvons un sentiment de présence. Pour être plus précis, cette illusion de la présence créée par la ER est désignée comme la Présence Évoquée (EP). Dans ce document, le terme « Présence Évoquée » implique l'illusion de l'expérience de la présence (le sentiment de présence), tandis que le terme « présence » est réservé à l'expérience de la présence dans un sens large (la présence réelle et le sens de la présence). En bref, la Présence Évoquée (EP) est l'expérience spatio-temporelle d'une Réalité Évoquée. On pourrait dire que, jusqu'à présent, c'est à travers les médias, comme (par exemple) des systèmes très immersifs de réalité virtuelle, que nous avons été en mesure de créer le concept de Réalité Évoquée (ER) susceptible de décrire/d'évoquer de manière significative le concept de Présence Évoquée (EP).

La ER est une expérience passagère. Dans le cas de la Media-ER, l'illusion persiste tant qu'une entrée ininterrompue de stimuli perceptifs et des interactions simultanées dans la ER perdurent. Dans le cas de la Self-ER, l'illusion persiste tant qu'une perception ininterrompue interne et des interactions mentales simultanées perdurent. En fait, le moment où cette illusion de Réalité Évoquée se brise à cause d'une anomalie, est désigné par le concept : «Break in Presence» (BIP) (« cassure dans la présence ») (Slater et Steed, 2000; Brogni et al., 2003.). Ainsi,

un BIP est tout simplement le résultat immédiat d'une «Break in Reality» (BIR) (« cassure dans la réalité ») expérimentée.

Trois Pôles de la Réalité

Nous définissons les trois pôles de la réalité de manière à nous montrer le plus clair et le plus objectif possible dans les explications qui suivent. La réalité, comme indiqué précédemment, a toujours été un terme à interpréter avec des significations et des théories diverses. Pour éviter la confusion, nous voudrions utiliser un terme impartial : «Réalité primaire», qui se réfère à l'expérience du monde réel (ou ce que nous appelons le monde physique). C'est la réalité spatio-temporelle dans notre esprit quand nous sommes complètement présents dans le monde réel. Cela signifie que toute autre réalité que la réalité primaire est une illusion (médiatisée ou non-médiatisée) de la réalité.

Hérité des premières recherches sur la télérobotique et la téléprésence, le modèle à deux pôles de présence (Figure 14) suggère que la présence se déplace d'avant en arrière de l'espace physique à l'espace virtuel. La recherche sur la présence a été dominée depuis par ce modèle psychologique à deux pôles de la présence qui ne nécessite aucune explication supplémentaire. Biocca (2003) a poussé l'étude du modèle de la présence un peu plus loin. Il a proposé un modèle à trois pôles de «déplacement de présence» (Figure 15) comme une tentative de résoudre les problèmes liés à la conceptualisation de la présence correspondant au modèle classique à deux pôles. Selon ce modèle, la présence spatiale (de chacun) se déplace entre les trois pôles de présence : l'espace imaginaire, l'espace virtuel et l'espace physique. Dans ce modèle tripolaire visuel, un espace quasi-triangulaire défini par trois pôles représente la gamme des modèles mentaux et spatiaux envisageables qui constituent le lieu précis de la présence spatiale d'un utilisateur individuel. En fait, sa théorie nous a beaucoup aidés dans notre réflexion, même si nous l'avons appréhendée d'un point de vue différent de celui de l'expérience de la réalité.

Nous définissons «trois pôles de la réalité» du point de vue de la Réalité Évoquée. Le modèle tripolaire de la réalité (Figure 16) peut aider à triompher des problèmes théoriques liés à la présence dans le modèle standard à deux pôles de « la présence » ainsi qu'à réorganiser le modèle proposé par Biocca. D'après nous, ce sont les déplacements dans le type de Réalité Évoquée qui créent des déplacements respectifs dans le niveau de Présence Évoquée. Par exemple, si on expérimente une réalité très convaincante, évoquée lors d'une simulation de réalité virtuelle, on expérimentera une présence équitablement forte jusqu'à ce qu'un BIR (Break in Reality) survienne. Les 3 pôles de la réalité que nous définissons sont les suivants :

- Dream Reality (seuil de Self-ER)/Réalité onirique ou Réalité Rêvée
- Primary Reality (pas de ER)/Réalité primaire
- Simulated Reality (seuil de Media-ER)/Réalité Simulée

Primary Reality : La Réalité Primaire correspond à la réalité de notre monde réel. En réalité primaire, la stimulation évoquant l'expérience arrive à nos organes sensoriels directement à partir d'objets du monde réel. Nous maintenons qu'il s'agit d'une situation idéale dans laquelle le stimulus correspond à l'objet réel et ne peut pas nous tromper ni nous induire en erreur. *Donc, la Réalité Primaire est notre réalité de base sur laquelle nous revenons quand nous ne sommes pas dans une Réalité Évoquée.*

Simulated Reality: (Réalité Simulée) Dans le cas des Réalités Médias-Évoquées, une expérience semblable à celle de la réalité primaire est envisagée interférant avec le champ de stimulus, ce qui conduit à une illusion de la réalité. Par exemple, la réalité virtuelle utilise des affichages qui interviennent dans toute la perception visuelle de façon à ce que les mouvements de la tête ou des yeux sont suivis et mis à jour avec des images appropriées pour maintenir cette illusion de recevoir des stimuli visuels particuliers de certains objets. La Réalité Simulée serait la réalité la plus convaincante et la plus plausible jamais atteinte à travers de telles médiations. Ce serait la Réalité Évoquée dans notre esprit sous l'influence d'un système de réalité virtuelle parfaitement simulé. Cependant, dans le cas hypothétique d'une Réalité parfaitement Simulée, notre esprit serait tout à fait enclin à croire à la Réalité Évoquée par le support de simulation et n'aurait aucune connaissance de la réalité primaire correspondante. Dans ce cas, il serait nécessaire de faire intervenir un BIR afin de ramener notre esprit à la réalité primaire. *Une Réalité Simulée parfaite est le Media-ER avec la plus forte Présence Évoquée et n'aura pas des BIRs.*

Dream Reality : (Réalité Rêvée) Dans le cas de la Réalité Auto-Évoquée, les stimuli externes perceptifs sont imités en étant générés en interne. La Réalité Rêvée est un état idéal mental dans lequel nous sommes entièrement disposés à croire à la réalité expérimentée, et à accepter que ce qui se passe est réel. Il n'y aucune possibilité de revenir à la réalité primaire à moins qu'un BIR ne se produise. La présence expérimentée évoquée lors d'un rêve intense peut être si puissante que même les éventuelles anomalies (qui donneraient lieu à des BIRs), tels que des bruits externes (une sonnerie d'alarme ou de téléphone) ou même des éléments de perturbations physiques (souffle du vent, changements de température) peuvent être fusionnées avec la réalité du rêve, de façon à maintenir cette ER aussi longtemps que possible. *Une Réalité Rêvée parfaite est une Self-ER avec la plus forte Réalité Évoquée et n'aura pas de BIRs* (même chose que la Réalité Simulée par rapport au Media-ER).

Reality-Presence Map (Carte Réalité-Présence)

Nous sommes souvent sous l'emprise soit des Media-ER, soit de la Self-ER (« Réalité Évoquée », « *par soi* »). Imaginez que nous ne soyons influencés par aucune médiation, ni aucune sorte de pensées ou d'imagination ou de rêves et que notre esprit soit absolument et seulement conscient du monde réel, un état d'esprit entièrement dédié à la réalité primaire. Dans une telle situation exceptionnelle, nous pourrions nous sentir complètement en présence dans la réalité primaire. Ainsi, nous supposons que cette parfaite «présence primaire» (ou présence réelle, comme certains peuvent l'appeler) est le seuil de présence que l'esprit peut être en mesure d'expérimenter à un moment donné. En outre, le fait que la présence se déplace en raison du déplacement de la réalité entre les trois pôles est quelque chose à laquelle nous sommes rarement confrontés, même si nous devons nous y adapter le cas échéant. Nous essayons de représenter ce phénomène avec un modèle schématique cohérent qui nous permettra d'étudier la présence et la réalité à partir d'une perspective qui soit la plus claire possible.

S'appuyant sur les trois pôles de la réalité et sur le Seuil de Présence, nous proposons la Reality-Presence Map (la Carte Réalité-Présence) (Figure 18). Il s'agit d'un diagramme qui met en relation de manière logique les termes cités. Au travers des pôles de la réalité, la ER serait constamment en mouvement (déplacement du point sur la carte) évoquant une présence correspondante (EP). Comme nous pouvons le voir sur la carte, il y a toujours une Présence subconsciente de la Réalité Apparente correspondant à la EP. Cette Présence de la Réalité

Apparente est très importante car elle permet à notre esprit de revenir à la réalité primaire quand l'illusion de l'ER est discontinue (ou lorsqu'un BIR se produit). Pour une plus faible EP, la Présence de la Réalité Apparente est plus forte (bien qu'expérimentée de manière subconsciente). Quand la ER réussit à induire une très forte présence, la force de la Présence de la Réalité Apparente tombe à un niveau très bas (presque inconscient) et nous commençons à perdre conscience de l'existence d'une Réalité Primaire ; c'est ce que parvient à faire un système de réalité virtuelle immersive de qualité excellente. Le déplacement de la présence est étroitement lié à notre attention. Dès que notre attention de la Réalité Évoquée est perturbée (principalement à cause des interférences externes d'éléments perceptifs), notre attention se déplace vers la présence de la réalité apparentée, nous ramenant, de fait, à la réalité primaire (brisant ainsi notre Réalité Évoquée, EP).

Aux pôles extrêmes, on va éprouver une présence virtuelle optimale dans une Réalité Simulée et même une présence de rêve optimale dans une Réalité Rêvée. À ces points extrêmes, on serait enclins à croire à l'illusion de la réalité expérimentée, presque ou exactement comme s'il s'agissait de notre réalité primaire, à l'insu d'une Réalité Apparente existante. A un tel niveau, il est possible qu'un BIR de très forte intensité puisse contraindre un individu à revenir à la Réalité Primaire Apparente. L'expérience d'une Réalité Rêvée de forte intensité est un exemple significatif auquel chacun se plait à se référer. Au cours d'un rêve puissant mais effrayant, «se réveiller» fonctionne comme une BIR de très forte intensité, permettant de quitter la Réalité Rêvée. Après un tel changement brusque et choquant de la réalité, notre esprit, le plus souvent, prend le temps de se réadapter à la Réalité Primaire où tout redeviendra lentement normal et rassurant.

CHAPTER 3: PROPOSITION

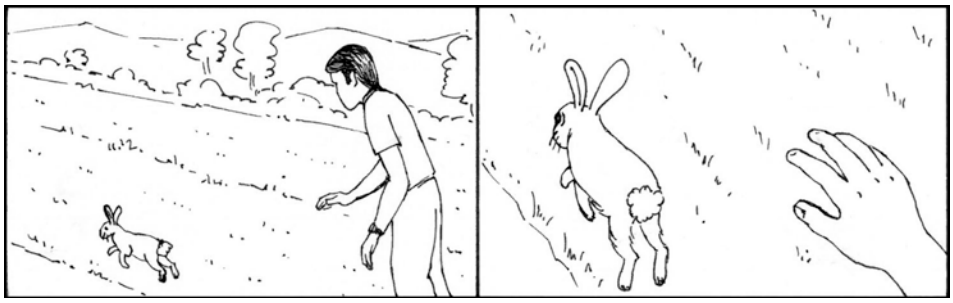
B. MUSINGS ON EVOKED REALITY

As we have covered the basic definitions and the proposed model, in this part of the chapter we would like to go deeper into the concept of Evoked Reality. In the first section, we will try to explicate ER with respect to our everyday life experiences. Second section investigates the Reality-Presence map, especially attempting to answer what is sometimes referred to as the 'Book Problem' (Schubert and Crusius, 2002; Biocca, 2003). The last section is dedicated to exploring the *qualia* of our ER experiences. However, it should be noted that we examine the subjectivity of ER experiences throughout these sections.

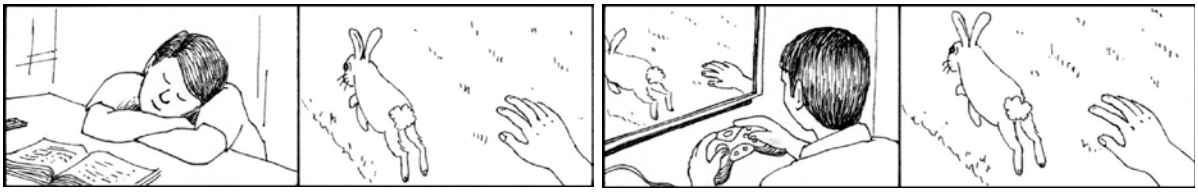
3.5 EVOKED REALITY: EVERYDAY VIRTUALITY IN THE MIND

3.5.1 Distinguishing Primary Reality with Evoked Reality

To begin with, let us first distinguish Primary Reality with Evoked Reality (Self-ER and Media-ER), using few examples. Primary Reality, as described before relates to the experience in the real world with respect to perception of real (physical) objects and environments. Although, some may refer to as 'first order mediation', the notion is that the perceived objects are actually there, for instance, the perception of a real white rabbit in the Primary Reality. **Figure 20** attempts to demonstrate the distinction between this scenario and the experience of Evoked Reality. Note that in the following few sections, the examples will be illustrated in two part images. The left part of each image is a third person view showing the experiencer in the real world while the right part shows the probable Evoked Reality experience from that individual's (first person or subjective) point of view.



Primary Reality: The real white rabbit



Self-ER: Imagination of the white rabbit

Media-ER: The white rabbit in a game

Figure 20: Distinguishing Primary Reality, Media-ER and Self-ER [source: author]

In the case of Media-Evoked Reality, it is always a 'representation' of objects or environments, which evoke the illusion of our presence beside or inside them respectively. It could be an image or a video representing a scenario, a 3D avatar corresponding to a person, or an interactive environment imitating the real world. The media always exists in our Primary Reality and attempts to evoke at least partially the essence of objects or environments that are in fact not there. For instance, an image or a video of the same white rabbit that was in the Primary Reality

or a representation of it in a virtual environment or a video game (**Figure**). Self-Evoked Reality is the internal experience of objects or environments in the mind. It could be an experience of entirely imaginary worlds or be a mental representation of objects or environments that were formerly experienced in the Primary Reality. In this case also, the perceived objects are in fact absent in the Primary Reality. For example, imagination of the white rabbit (**Figure**). Self-Evoked Reality may be a simple thought, a voluntary imagination or a daydream, or an involuntary experience of a highly vivid dream.

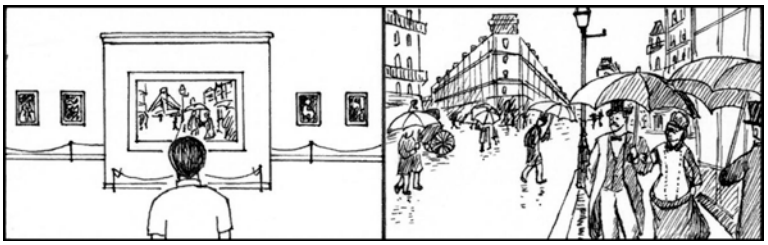
3.5.2 Examples of Evoked Reality

Here, we present different kinds of ER, from our everyday life experiences. Our mind undergoes these experiences so constantly that we are most often unaware of our shifts in ER and EP.

Types of Media-Evoked Reality

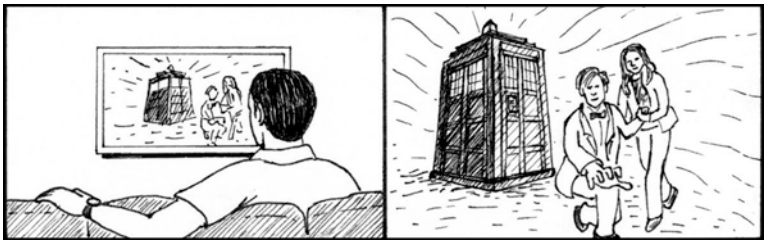
Media-ER is primarily affected by our external perception. The Perceptual Illusion that they evoke depends of various factors, like perceptual frame and field of vision (Sutherland, 1965; Hatada and Sakata, 1980; Milgram et al., 1994; Hendrix and Barfield, 1996; Kim and Biocca, 1997), quality of visual realism (Bishop, 1994; Christou and Parker, 1995; Slater et al., 1995; Rademacher et al., 2001; Vinayagamoorthy et al., 2004; Slater et al., 2009a), or interactivity and multisensory immersion with media updating and feedback (Heilig, 1962; Krueger, 1985; Krueger et al., 1985; Zimmerman et al., 1987; Biocca, 1997; Usoh et al., 1999; Biocca et al., 2002; Bailenson et al., 2006; Bruder et al., 2009; Astrinaki, 2012). Although the Psychological Illusion is evoked due to the Perceptual Illusion, it is largely affected by the conceptual part of the media, like the context of the mediation (Mantovani and Riva, 1999; Biocca, 2002; Grau, 2004; Waterworth and Waterworth, 2006), contents of the scenario represented (Usoh et al., 1999; Ijsselsteijn, 2003; Seyama and Nagayama, 2007; 2009; Pena et al., 2010), voluntary or involuntary suspension of disbelief (Steuer, 1992; Slater and Usoh, 1993) or emotional and social attributes (Bailenson et al., 2006; Ravaja et al., 2006; Llobera et al., 2010; Geslin et al., 2011; Richir et al., 2011).

The different kinds of mediation that induce Media-ER experiences may range from visual arts and representation (simple sketches, illustrations, drawings, paintings, sculptures, prints, graphic design, photographs), literary arts and narratives (books, stories, plays, novels), radio broadcasts and narratives, telephones and mobile phones, online interactions (e-books, digital images, instant messaging, audio and video chats), television programs (live shows, reality shows, scripted reality shows, soap operas), movies and videos (2D movies, IMAX movies, 3D movies, online videos, interactive non-linear videos), performing arts (theatre, opera, magic, spoken word, dance and music, musical theatre), video games (2D, 3D, first-person, multiplayer, MMORPGs), online virtual worlds and communities, Augmented and Mixed Reality applications (mobile and iPad apps, AR projections, AR glasses), Teleoperation (telecommunication, telerobotics, remote manipulation, tangible interactions), Human-in-the-loop simulators (flight simulators, driving simulators, outer space simulators) to Virtual Reality (simple VR systems to highly immersive and multimodal interactive VR environments, beyond head-mounted displays, data gloves or CAVE systems). **Figure 21** attempts to visually illustrate a range of Media-ER experiences.



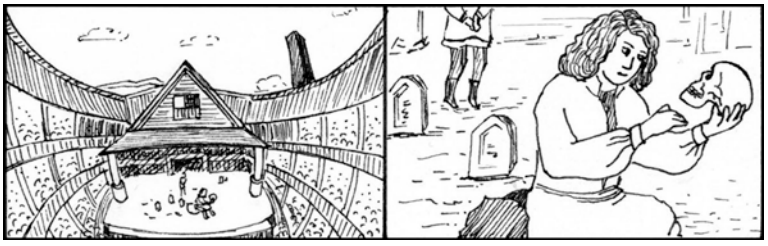
Visual arts and representation (simple sketches, illustrations, drawings, paintings, sculptures, prints, graphic design, photographs)

Literary arts and narratives (books, stories, plays, novels)
Radio broadcasts and narratives, telephones and mobile phones.



Television programs (live shows, reality shows, scripted reality shows, soap operas)

Movies and videos (2D movies, IMAX movies, 3D movies, online videos, interactive non-linear videos)



Performing arts (theatre, opera, magic, spoken word, dance and music, musical theatre)

Online interactions (e-books, digital images, instant messaging, audio and video chats)

video games (2D, 3D, first-person, multiplayer, MMORPGs), online virtual worlds and communities

Augmented and Mixed Reality applications (mobile and iPad apps, AR projections, AR glasses)

Teleoperation (telecommunication, telerobotics, remote manipulation, tangible interactions)

Human-in-the-loop simulators (flight simulators, driving simulators, outer space simulators)

Virtual Reality (simple VR systems to highly immersive and multimodal interactive VR environments)

Figure 21: A range of Media-ER experiences that induce different levels of Evoked Presence [source: author]

Types of Self-Evoked Reality

When we have Perceptual Illusion evoked internally, with the corresponding Psychological Illusion, we experience Self-ER. It may be voluntary or involuntary. The illusion of Self-ER persists until our attention is drifted from it (voluntarily or involuntarily) (Baars, 1993) towards the Primary Reality or a Media-ER. The difference sources of Self-ER may range from simple thoughts, retrospection (primarily relating to memory), imagination and fantasizing, ideation (idea generation), visualization (conceptualizing or mentally designing), prospection

and planning, mind-wandering, daydreams, lucid dreams, dreams (with faint or vivid recollections), hallucinations to highly 'altered states of consciousness' (ASC will be discussed in **Chapter 5**). **Figure 22** shows a range of Self-ER experiences.

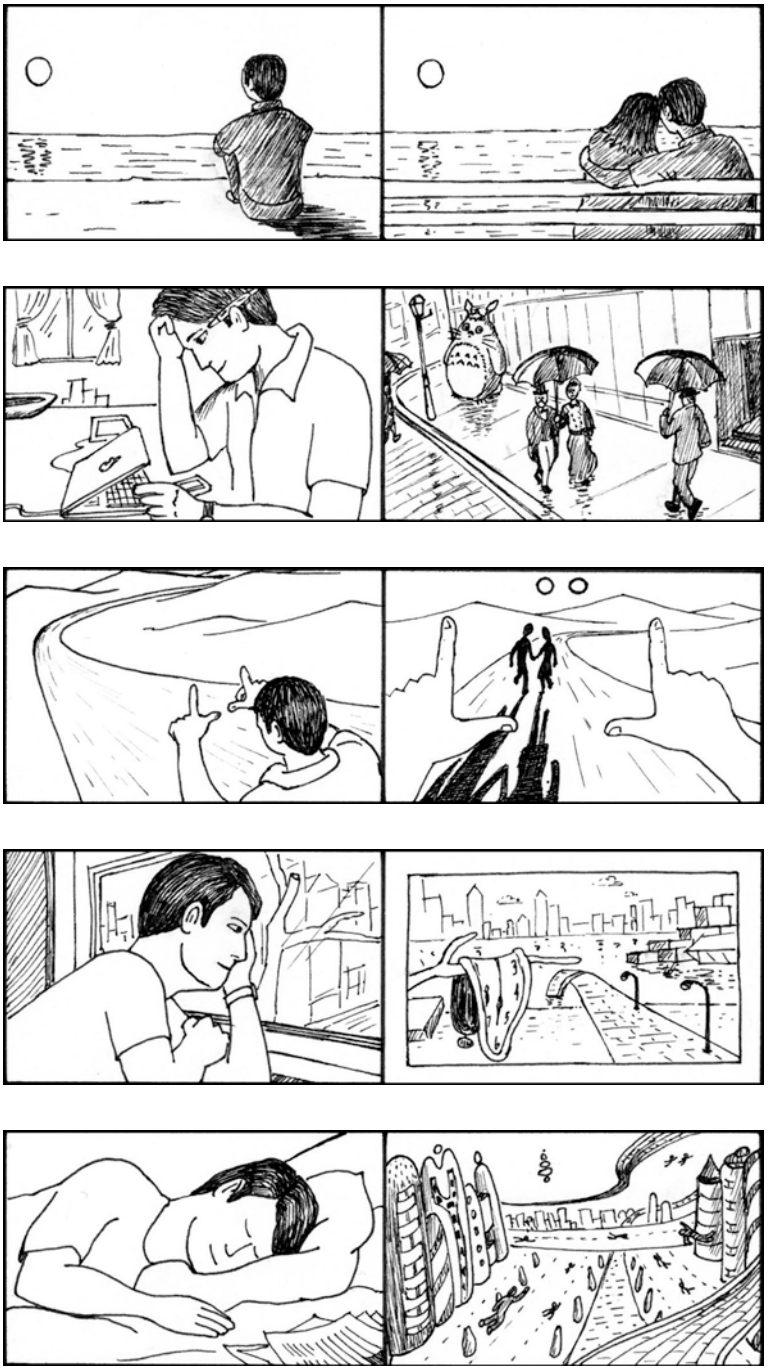


Figure 22: A range of Self-ER experiences that induce different levels of Evoked Presence [source: author]

3.6 EXPLORING THE REALITY-PRESENCE MAP

Below is an example range of ER experiences positioned roughly on the Reality-Presence Map, with respect to an individual's mind (**Figure 23**). We should note that the positions of ER suggested here are subjective to each individual. Furthermore, for an individual the point of ER

experience with respect to a particular source is not stable and may differ with time (we may not undergo a movie or a game ER with the same quality, every time we experience it), or even fluctuate with time during a single continuous mediation (during a movie or a game, we may have fluctuating levels of ER based on its content). We maintain that Evoked Reality has *qualia* of experience (which cannot be objectively measured) and higher the strength of Evoked Presence farther the position of Evoked Reality from the Primary Reality.

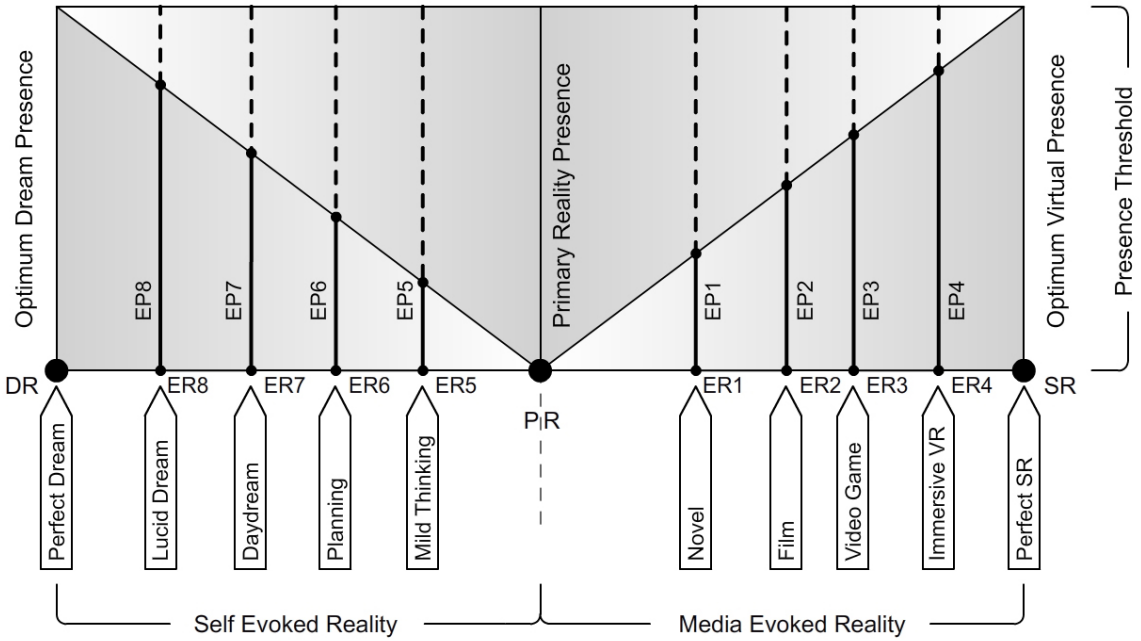


Figure 23: An example range of Media-ER and Self-ER experiences, on Reality-Presence Map [source: Pillai et al., 2013a]

Note that (1) the positions of ER suggested here are subjective to each individual and (2) for an individual itself, the point of ER experience with respect to a particular source is not stable and may differ every time or even fluctuate within the same time.

3.6.1 Shifts in Presence from Shifts in Attention

Although shifts in presence have been studied by many virtual reality researchers, they often ignore presence shifts experienced without mediation. Similar to Media-ER, presence shifts can be noticed in Self-ER as well. Biocca (2003) proposed how shifts in presence may predate evolution of media.

> *"If shifts in presence predate media, then we should be able to explain the shifts of presence without any reference to a medium. Cognitive processes that initiate presence shifts must serve cognitive functions that are independent of media. All representation must engage the processes activating a presence shift, although they may do so with different strength and with slightly different mechanisms."*- (Biocca, 2003)

Presence shifts are important to study as they are closely related to attention allocation. When we experience reality, we selectively allocate our attention on one or few aspects of our environment while ignoring the other aspects. Either our attention is directed towards the most

relevant aspects, or as our attention shifts towards certain aspects, they become relevant. This process of continuous attention shifts is either voluntary or involuntary (automatic) (Baars, 1993).

How our attention allocation is primarily responsible for the presence shifts is clear from our daily life experiences. For instance, consider the example presented in **3.2.1**, of you daydreaming during a lecture. As long as certain aspects of the Self-ER environment are under attention, the illusion of being in the imaginary restaurant continues. When we encounter an anomaly in the Evoked Reality, it shifts our attention back to Primary Reality (and a BIR occurs). To consider another example, we often think or drift into thoughts while walking on a very familiar or regular route. Let's say you were on such a route and were lost in thoughts till you reached your destination point. It is probable that even though your external perception was active all the while, you may remember more about the elements from your mental imagery during the walk, rather than the people or things (in the Primary Reality) that you passed by on your way. Your conscious attention was strongly focused on the Evoked Reality rather than the Primary Reality during that time, especially as you required attention only on a sub-conscious level on the path you took. Such cases of mind-wandering are sometimes referred to as 'perception without awareness'. In fact Merikle et al. (2001) suggested from a cognitive psychology perspective, that experimental evidence led to the conclusion that in certain situations "stimuli are perceived even when observers are unaware of the stimuli". A similar example with respect to Media-ER is watching a soap opera on TV, while knitting. If you are a skilled knitter, you will be able to allocate more attention to the soap opera while only occasional shifting your attention towards the knitting process. Similar to the previous case, your Evoked reality experience becomes stronger as your attention focuses more on the soap opera, with less number of shifts towards the Primary Reality.

An example with respect to Media-ER where conscious attention is in fact necessary on the Primary Reality is - driving a car while talking on a mobile phone. In such situations our attention shifts constantly between the conversation and driving (making our presence shift between Media-ER and the Primary Reality). It is possible that the Media-ER can become remarkably strong (especially due to the Psychological Illusion with respect to the content of the conversation), that the Evoked Presence may temporarily sustain without shifting to the Primary Reality. This is clear from the fact that there have been many cases of accidents due to this phenomenon.

3.6.2 Social and Co-Presence

Where does social presence or co-presence (the feeling of being with another being) fall into place within the concept of Evoked Reality and Evoked Presence? In the Primary Reality, social presence is simply the experience of being with or interacting with another person. Similarly in Evoked Reality, social presence is the experience of an illusion of being with or interacting with another person (especially with the help of pre-programmed avatars or real-time avatars controlled by others in another location).

The experience of co-presence through media is evident in today's world of online social networks. The illusion of interacting personally or on a social level is evoked through these media by giving one a sense of conceptual space for interaction and an avatar that would

represent oneself. An experiment by Ito (2005) showed how even a simple photo-sharing technique could lead to intimate visual co-presence. He suggested that the relational outcome of an ongoing intimate exchange of visual information was that the users had an ambient, shared visual context that they were jointly aware of, even when they were physically apart. In fact co-presence is one of the factors that strengthen the Psychological Illusion, engaging the users even in media with the weakest Perceptual Illusions (cf. **3.6.3** below). It is indeed intriguing to observe how one reacts to virtual avatars. For instance Llobera et al., (2010), who studied proxemics in virtual environments, noticed that people exhibit heightened physiological arousal the closer they were approached by virtual characters. Virtual Reality is being used to treat social phobias and aid in cognitive re-education as well (Klinger et al., 2004; Klinger et al., 2005). Furthermore, it has been suggested that immersive virtual environment technology would become an effective methodological tool for studying social psychology (Loomis et al., 1999; Blascovich et al., 2002).

> *". . . experiencing presence and telepresence does not depend so much on the faithfulness of the reproduction of 'physical' aspects of 'external reality' (which is also a social production, and not a primitive or 'natural' fact), as on the capacity of simulation to produce a context in which social actors may communicate and cooperate."* - Mantovani and Riva (1999)

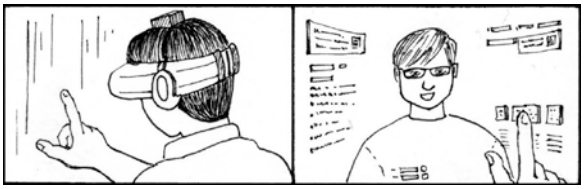
The sense of co-presence or social presence is well explored by many virtual reality researchers. Heeter (1992) suggested that placing more than one person in a virtual world may be an easy way to induce a sense of social presence regardless of the other perceptual features of the

Primary Reality: Having a talk with your friend

Self-ER: Imagination of the friend talking to you

Media-ER: Video chat with the friend

Self-ER: Dream of the friend talking to you



Media-ER: Simulated interaction with the friend

Figure 24: Examples of co-presence in Primary Reality, Media-ER and Self-ER [source: author]

world. According to Bailenson et al. (2006), both avatar form as well as behaviour realism are important in inducing co-presence. Although co-presence and social presence are usually considered synonymous, Lee (2004) differentiates these terms in this way - "Social presence is defined as 'a psychological state in which virtual (para-authentic or artificial) social actors are experienced as actual social actors in either sensory or non-sensory ways.' Social presence occurs when technology users do not notice the para-authenticity of mediated humans and/or the artificiality of simulated non-human social actors. Social presence is different from co-presence - the feeling of being in a virtual world with other people."

With the advancements in robotics and enhanced humanoid machines, the concepts regarding co-presence and social presence are constantly evolving, even with respect to our Primary Reality (Schmidt, 2005). In fact some researchers argue that in order to avoid ethical and emotional dilemmas regarding social presence in the future, we must have improved monitoring of technological progress and perhaps implement weaker techniques in order to tweak down robotic intelligence (Schmidt, 2007).

A simple example of co-presence in Primary Reality would be - a friend standing next to you and talking to you. In which case, co-presence in Media-ER would be for instance - a video chat with the same friend. It could also be his 3D avatar talking and reacting to you with respect to his actions in another location. An example of co-presence in Self-ER would be for instance - the thought or a dream of the friend talking to you. Illustrated here, are few examples of co-presence (**Figure 24**).

3.6.3 Perceptual Illusion and Psychological Illusion in Media-ER

In the case of Media-ER, as we can clearly distinguish Perceptual and Psychological Illusions, let us now observe how they come into play. An obvious example of the role of Perceptual Illusion would be the effect it has on the presence evoked during a movie - using a classical 2D display compared to using a stereoscopic display (commonly referred to as '3D movie'). For instance, the recent live action movies like 'Avatar' and 'Inception' or animated movies like 'The Adventures of Tintin' and 'Polar Express' were found by viewers to be particularly immersive in the stereoscopic format when compared to the classical (**Figure 25**). Whether a viewer prefers the former or latter formats, is entirely a subjective choice. In this case the Evoked Presence is improved by the 'visual immersion' which is just one of the aspects of Perceptual Illusion.

As mentioned earlier, the strength and quality of mediation depends highly on the link between ER and the 'context' of mediation. This is exactly why Psychological Illusion is particularly important and crucial for Media-ER. Two similar types of mediation, for example two video games (with similar Perceptual Illusion) with different contexts (content, stories, styles, genres) can produce different levels of Evoked Presence in the mind of the same user (**Figure 26**). These aspects point towards few interesting remarks. *Although Perceptual Illusion affects Psychological Illusion to a great extent, it could be vice-versa as well. When Psychological Illusion is exceptionally high in mediation, a low external Perceptual Illusion could be overlooked.* This is precisely what happens in Narration Evoked Reality - while reading a novel or listening to a narration (explored in the subsection **0** below)

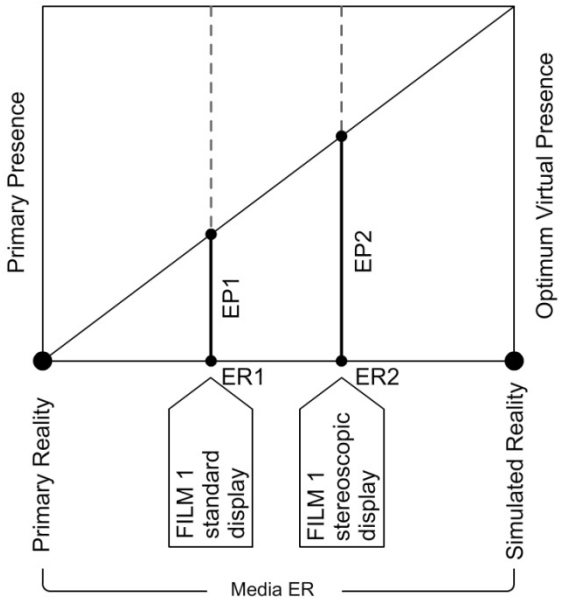


Figure 25: Effect of Perceptual Illusion on Media-ER [source: author]

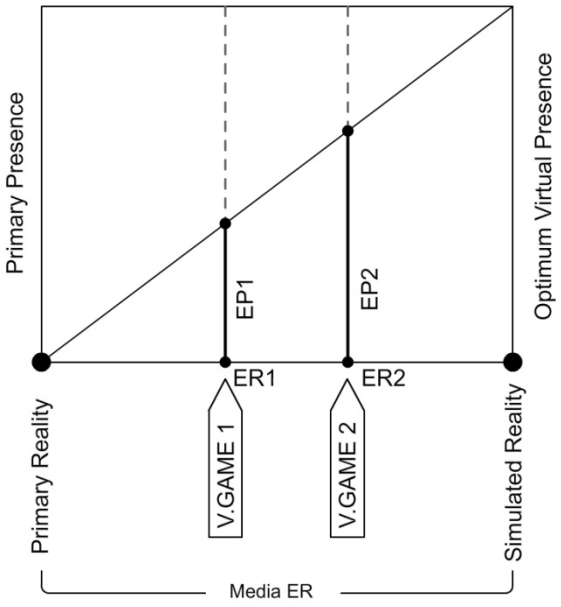


Figure 26: Effect of Psychological Illusion on Media-ER [source: author]

Right blend of Perceptual Illusion and Psychological Illusion

Some may argue that they experienced higher levels of presence when they read a particular book, compared to when they watched a movie or played a video game (especially of not their taste). Here it furthermore reinforces the importance of the relation between Perceptual and Psychological Illusions. For e.g. compared to a book, a movie can be considered perceptually higher in mediation (i.e. immersion due to visual and auditory perception). However if the user does not relate to its contents (the story or the concept), the Psychological Illusion is not well evoked in the mind. **Figure 27** shows such an example of Media-ER induced by a movie and a novel for a user. Compared to a movie, a video game has the advantage of additional interactivity that contributes to enhancing the Psychological Illusion.

This phenomenon provides an important observation for the designers of future mediated systems, especially virtual reality systems, that the consistency between Perceptual and Psychological Illusions is a particularly significant factor to be considered. This idea supports the conclusion by Tromp et al. (1998) that higher visual realism in characters (avatars that interact with you) may lead to a heightened expectation for their behavioural realism as well. According to Vinayagamoorthy et al. (2004), even though it is possible to generate visually realistic virtual environment and characters, one of the main constraints preventing the usage of highly realistic models is the higher expectations of participants leading to increased sensitivities to inconsistencies in the virtual environments. Thus, understanding the relationship between form and behavioural realism (of interacting avatars and environments) is critical to exploring the use of the new forms of media (Bailenson et al., 2006).

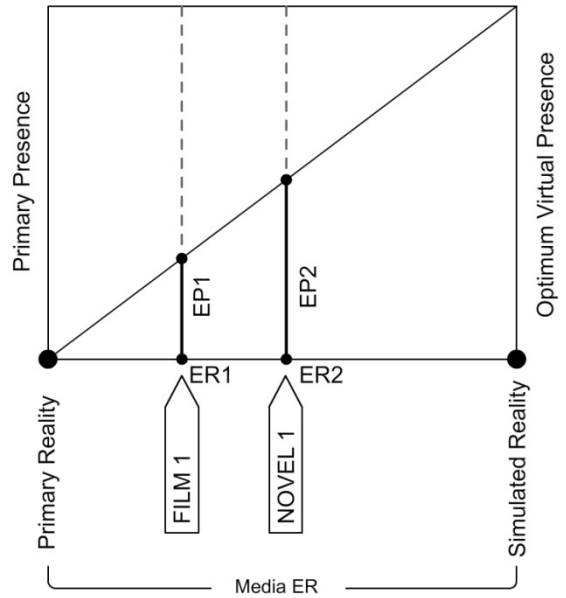


Figure 27: Combined effect of Perceptual and Psychological Illusion on Media-ER [source: author]

3.6.4 Self-ER within Media-ER

There is an important question that arises now. How can we account for our thoughts or mental imagery experiences during VR simulations, games, movies or most importantly books? It is true that we can have Self-ER experiences during a Media-ER experience.

"Imagine you are inside a first-person VR simulation game. At the end of the corridor, there is a door that you have to open. As you approach nearer, you hear a strange humming noise from the other side and you are afraid that there might be someone or something behind that door. However, in order to reach your destination (or perhaps save someone), you have to investigate whatever is behind that door. So similar to a real world scenario, your imagination runs wild. Your mind fills up with images and possible scenarios, with gruesome monsters; resembling the ones you encountered few minutes before in the previous rooms, or perhaps even scarier. Though you are sweating and your heart is beating high, gathering courage and with a rough strategy in mind, you go ahead and open the door."

The indication here is that whenever we experience an Evoked Reality, our mind is capable of temporarily presuming it as the Primary Reality and reacting accordingly. The better the ER and stronger the EP, the easier it is for our mind to maintain the illusion as if you were experiencing the Primary Reality. Even emotional and physiological changes are brought about, as observed in the experiments conducted as part of this thesis (discussed in the next Chapter). In such states where Media-ER is temporarily experienced as the Primary Reality, we are able to experience Self-ER within it. In fact that is the primary reason why virtual reality systems and virtual environments work. This phenomenon is clearly displayed in virtual reality experiences (as in the example scenario above), where the users require thinking, planning and imagination in order to navigate in the virtual world, just like they would do in the real world. Below, it is demonstrated how this phenomenon is represented on the Reality-Presence Map (**Figure 28**).

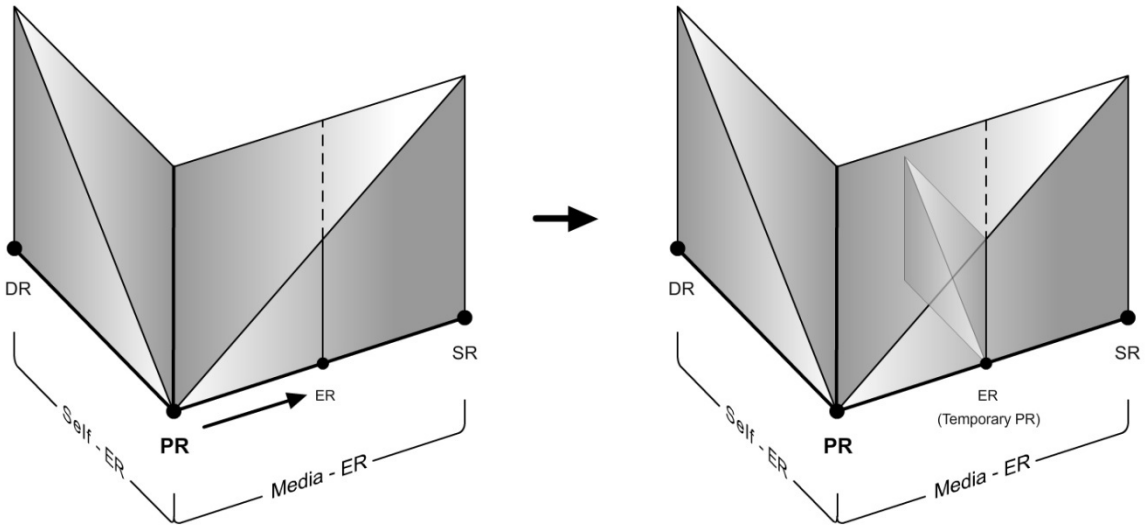


Figure 28: An Example of how Media-ER would temporarily act as Primary Reality [source: Pillai et al., 2013a]

Narration Evoked Reality

Another case of Self-ER within Media-ER is the 'book problem'. When it comes to the study of presence with respect to virtual reality, there have always been comparisons with presence in narratives. As discussed earlier, narratives can be powerful enough to transport the reader to a different world (Gerrig, 1993). These comparisons led Biocca (2003) to put forward what he called 'the book problem'. This problem, in his words, is "If sensorimotor immersion is the key variable that causes presence, then how do we explain the high levels of presence people report when reading books? Books are very low fidelity, non-iconic media and are extremely low on all sensorimotor variables identified as causing presence: extent of sensory data, control of sensors, and ability to modify the environment." (Biocca, 2003).

According to our definition of 'mediation', there should be a continuous stream of perceptual input that primarily evokes Perceptual Illusion and hence book is definitely one. Although here the perceptual input is through narrative textual content (letters, words, sentences, symbols) that has to be continuously read and interpreted to maintain and update the illusion of reality. In fact this is applicable to any kind of narration. For example, the famous radio broadcast of 1938 that was directed and narrated by Orson Welles, as part of an anthology series (Mercury Theatre on the Air). This radio drama was presented as a series of simulated news bulletins, which suggested an alien invasion by Martians. It created panic among many listeners and many even tried to flee their homes hoping to escape. The narration was in fact an adaptation of H. G. Well's novel, 'The War of the worlds' (1898), which appeared realistic also because it ran without commercial breaks. This shows how the oral narratives or storytelling can be powerful enough to create the illusion provided by the contents of the story. In comparison with interactive non-linear narrative technologies, Biocca (2002) pointed out that although books and portable radios are ubiquitous, they have minimal intelligence and are not social; as they are unaware of their setting in the real world and are non-interactive. The phenomenon of Narration ER is indicated here, on the Reality Presence Map (**Figure 29**). Further propositions on reality within reality are discussed in **Chapter 5**.

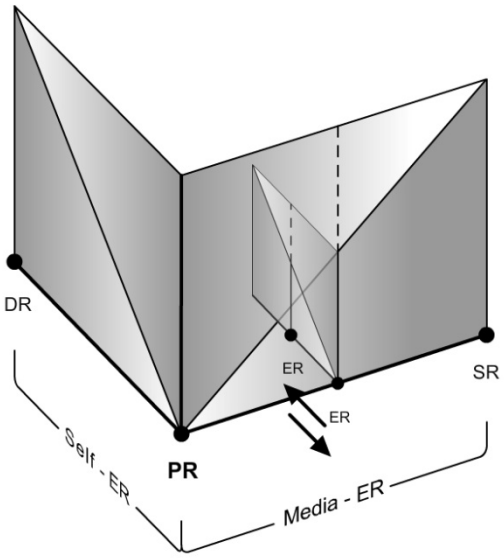


Figure 29: An Example of Presence shift due to Self-ER within Media-ER (for e.g. Narration ER) [source: Pillai et al., 2013a]

3.6.5 Self-ER triggered during Media-ER

We saw 'Self-ER within Media-ER'. We should note that, it should be distinguished from the phenomenon of 'Self-ER triggered during Media-ER'. For example, let's take the same VR simulation game scenario mentioned above. You just opened the 'scary door' and found a totally empty room, with no furniture. There is a humming bird trying to fly out through the glass window. In one of the corners of the room, is lying a shining key. As you notice it on the floor, it reminds you that you may have forgotten to lock the entrance door of your house, when you left home early this morning. It worries you as there have been some break-ins recently in your neighbourhood.

This is similar to a well-known case of Self-ER - the phenomenon of mind-wandering that temporarily detaches us from the Primary Reality. It is otherwise known as 'task unrelated thought', especially with respect to laboratory conditions. Smallwood et al. (2003) defined it as the experience of thoughts directed away from the current situation. It is in fact a part of (and closely related to) our daily life experiences (Smallwood et al., 2004; McVay et al., 2009). Although studies on mind-wandering are principally focused on shifts between Self-ER and tasks relating to Primary Reality (falling under usual case of Self-ER experience - **Figure 30**), we propose that they are applicable to similar cases in Media-ER as well. It has been suggested that this involuntary experience may be both stable and a transient state. That means we can experience a stable Evoked Presence during mind-wandering or an Evoked Presence oscillating between the Self-ER, Media-ER and the Primary Reality.

Therefore, when an unrelated Self-ER is triggered while experiencing a Media-ER (or when Self-ER within Media-ER traverse the presence threshold and becomes unaware of the Media-ER itself), it should be considered under the classic case of Self-ER. We will certainly have external perception from the mediation, but without awareness. Referring again to the example above, let's say that the virtual 'key' triggers worrisome thoughts and you begin mentally tracing back

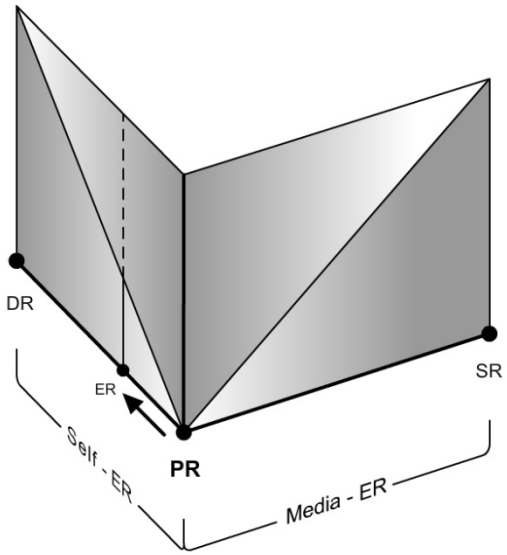


Figure 30: The usual case of presence shift from Primary Reality to Self-ER [source: Pillai et al., 2013a]

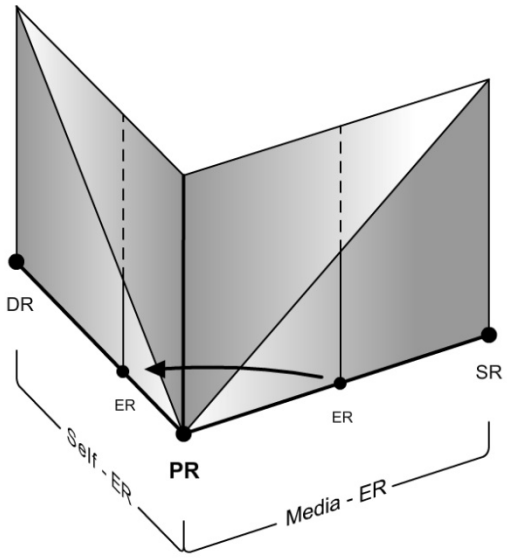


Figure 31: An Example of Presence shift due to the Self-ER triggered during Media-ER [source: Pillai et al., 2013a]

your steps, thinking about all the things you did before leaving home. During this time, if the mediation is interrupted, it will not affect your Self-ER, although in the case of mediation like virtual reality it may break the Self-ER due to the sudden significant changes in external perception. But, if Self-ER was triggered while watching a movie on a television, and during the Self-ER experience if the electricity went off (or the movie was over and the next one started), it would have comparatively lesser chances of breaking your Self-ER (and you would continue thinking without being aware of the interruption or the change in mediation). This phenomenon of Self-ER triggered during Media-ER is shown below, with the help of the Reality Presence Map (**Figure 31**).

A classic scenario that everyone would admit to have experienced would be the effect of an unrelated Self-ER triggered while reading a book. McVay et al. (2009) referring to this 'zoning out' phenomenon, noted that "the commonplace experience of moving one's eyes across a page without comprehending a thing suggests the startling conclusion that we are sometimes unaware of our own conscious experience; if we 'knew' our thoughts were elsewhere, we would return to reading or drop the charade". Here is an extract from Schooler et al. (2004) that explains it well:

> *"As you begin this chapter* [referring to their chapter]*, you are probably paying at least some attention to the words you are reading. After a page or two, however, there is a real possibility if not likelihood, that your attention may wander. Should that happen, your eyes may continue moving across the page, the phonology of the words may continue sounding in your head, yet your mind will be elsewhere. This phenomenon of 'zoning out' while reading is ubiquitous. Whenever we ask people about it, their response is almost invariably the same: a sheepish grin and the confession 'Well, yes, this happens all the time.'"*
> - (Schooler et al., 2004)

3.7 *QUALIA* OF EVOKED REALITY (SUBJECTIVITY)

The same mediation can create different subjective ER for different users depending on their personal traits. For example, two users reading the same book, or playing the same video game, or using the same virtual reality system would experience presence in an entirely different manner (e.g. **Figure 32**). Evoked Presence (especially evoked by a medium) may be affected by one's knowledge related to the context, degree of interest, attention, concentration, involvement, engagement, willingness, acceptance and emotional attributes making it a very subjective experience. This is precisely why it is difficult to evaluate the efficiency of a particular Virtual Reality system by means of presence questionnaires. In fact many researchers confuse few of these terms above, with the concept of presence.

In virtual reality, distinction between 'presence' and 'immersion' has been made very clear previously in Slater (1999; 2003). Though immersion (which is discussed extensively in the domain of virtual reality) is one of the significant aspects of Evoked Presence, it falls under the technical faculty of a mediated system. 'Immersion (in perceptual sense) provides the boundaries within which Place Illusion can occur' (Slater, 2009). Detailed aspects of presence related to immersive virtual reality were also discussed in Slater et al. (2009b). The characteristics like involvement, engagement, degree of interest, emotional response, may seem similar to presence, but are in fact different elements that may influence or be influenced by Evoked Presence.

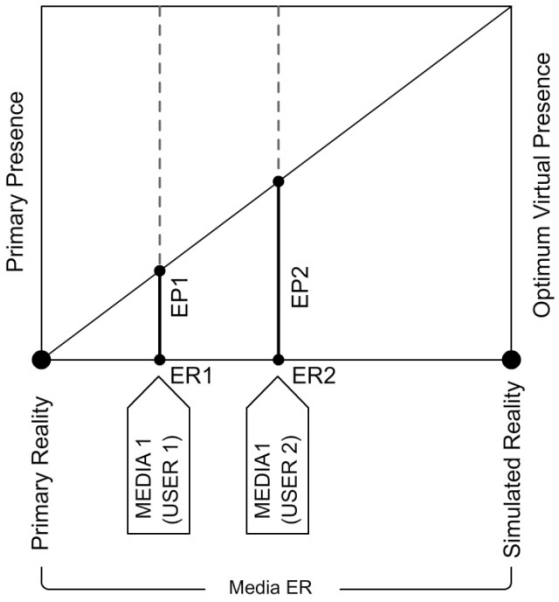


Figure 32: Subjectivity of Media-ER [source: author]

The psychological impact of content, i.e. good and bad, exciting and boring, depends to a large extent on the form in which it is represented (Ijsselsteijn, 2003). Thus, one of the most important aspects of Media-ER is its context. In most cases it forms a reference in one's mind to how they may experience ER and hence the presence evoked. For example, in some contexts, especially in art and entertainment, it would invoke a 'genre' that plays a major role in its communication. The context (whether artistic expression, communication, entertainment, medical application, education or research) should be a core concern while designing a Virtual

Reality System, in order to bring about a subjectively higher quality of ER. A descriptive account on the importance of context in Self-ER was given by Baars (1993). With examples of different sources and types (perceptual and conceptual) of contexts, he demonstrated how unconscious contexts shape conscious experience. In addition, he explained the importance of attention, which acts as the control of access to consciousness. Attention (in both Media-ER and Self-ER) can direct the mind towards or away from a potential source of *qualia*. The experience of an Evoked Reality therefore depends also on the voluntary and involuntary characteristics of one's attention.

Although media experiences require certain amount of voluntary attention, in the contemporary world of overpopulated media platforms, our attention may frequently shift involuntarily to different types of media. This is another reason why we are in a state of constant shifts between Evoked Reality and Primary Reality as part of our daily life experiences. That brings us to another interesting question regarding the real-virtual transition and the transition time. As Steinicke et al. (2009) inquired, "does a gradual transition to the virtual world increase Presence?" (Ijsselsteijn et al., 2000) noted that a seamless continuity between the real and the mediated environment is likely to add to a more convincing illusion of non-mediation. The presence measuring technique using 'Breaks in Presence' was indeed developed with respect to this concept of our constant real-virtual transitions (Slater and Steed, 2000). In that case, what about our experience of time within an Evoked Reality?

> *"When experienced presence is high, and working memory is heavily loaded (so that time seems to fly) this may correspond to what has been called "the flow experience". A literally ecstatic state (out from the internal, into the external), in contrast, may refer to a combination of external focus and low memory load, when presence is high and time seems to stand still. When low presence and high working memory load are combined, a state of absent-mindedness with automatized actions prevails; attention is directed almost exclusively to the internal and time passes quickly. And when low presence is combined with low working memory load, the individual may be experiencing a trance-like state, with an internal focus, but processing only the simplest of conceptions perhaps, for example, mentally repeating a simple mantra."*
> - (Waterworth and Waterworth, 2006)

It is observed how we often have subjective perception of time in the real world. One of the best examples would be the Kappa Effect (Jones and Huang, 1982), a psychological temporal illusion related to our perception of time, distance and speed. When we observe a sequence of stimuli in which the temporal separation (duration) between each stimulus is constant, but the spatial separation (distance) between each of the stimuli varies, our judgment of time is subjectively altered by the spatial separation. Therefore, a fascinating issue that arises is regarding the subjective temporal aspects of Evoked Reality. We suggest that an Evoked Reality experience may induce a subjective perception of time (different from our real world objective time) in our minds, which we would refer to as *"Evoked Time"*. It is evident in Media-ER as well as Self-ER experiences, how the time intervals are perceived to be longer or shorter than our objective time (Waterworth and Waterworth, 2006) that we regularly observe with the help of clocks or similar time measuring devices. For instance, on waking up after a vivid dream, the time perceived during the dream usually appears to have been either more or less than the time we spent in the real world, dreaming. In order to test this phenomenon in Media-ER, we examined

the subjectivity of time-perception during the media experiences, in our first experiment (**Chapter 4, 4.1.4**).

> *"When the curtain swept up to reveal the now-legendary wide-screen roller coaster ride, I realized that the film's creators were no longer content to have me look at the roller coaster but were trying to put me physically on the ride. The audience no longer surrounded the work of art; the work of art surrounded the audience - just as reality surrounds us. The spectator was invited to plunge into another world. We no longer needed the device of identifying with a character on the other side of the 'window.' We could step through it and be a part of the action!"* - Morton Heilig commenting on his experience with Cinerama in New York, 1952 [quoted in Ijsselsteijn et al. (2000)].

When we explore the subjectivity of our Evoked Reality experiences, we must also consider the extent or the boundary of an illusion. The gestalt effect is evident in our real world experiences, of mentally filling in an incomplete space or an object to create the illusion of a whole. A similar form of filling-in is observable also in human vision. In the blind-spots that every one of us has in our visual field (or in scotomas, in certain patients) the pattern from the rest of the visual field is mentally filled in to occupy the otherwise inaccessible area (Ramachandran and Gregory, 1991). Similar filling-in effect is generated in Media-ER scenarios as well. Slater and Steed (2000) suggested that the set of stimuli of the 'present environment' forms an overall gestalt, providing a consistent believable world in itself.

Every media has a defined boundary, which is one of the primary reasons our mind is subconsciously aware of the real world (enabling faster real-virtual transitions). Whether a painting, a photograph or even a high resolution movie theatre screen, it is boundary frame within which the Perceptual Illusion is maintained. This is the *'perceptual boundary'* of a media. With the help of CAVE systems and HMDs, we attempt to extend this perceptual boundary so as to reduce our mental load of filling-in the illusion of reality. The contents, the story and the attributes that directly affect our cognitive experiences and emotional responses, fill in to contain the virtual universe depicted by the media and form the *'conceptual boundary'*. Perceptual and the conceptual boundaries play an important role in creating stronger or weaker Evoked Reality experiences. In our first experiment, we analysed sketches presented by the subjects, following two different types of media experiences (**Chapter 4, 4.1.4**). We noticed that at least in a few subjects, the visual memory of the space evoked by the video-game contained elements of the rectangular boundary of the monitor that displayed the game. However, the visual memory of a short story exhibited no visual boundaries as the spatial elements were evoked by the Narration-ER. Although the video-game evoked strong external Perceptual Illusion, the perceptual boundary was confined, whereas the narration internally evoked a strong conceptual boundary.

RÉSUMÉ DU CHAPITRE 3-B: EXPLORATION DE LA RÉALITÉ ÉVOQUÉE

Dans cette partie du chapitre 3, nous approfondissons le concept de la Réalité Évoquée et nous étudions la Reality-Presence Map (la Carte Réalité-Présence) en détail, en montrant comment elle peut s'appliquer à n'importe quel type d'expérience de la présence dans notre esprit. Ensuite, nous explorons les *qualia* de l'expérience de la Réalité Évoquée. Nous nous

interrogeons sur la subjectivité de nos expériences et nous tentons d'analyser comment et pourquoi nous les ressentons quand il s'agit de Réalité Évoquée.

La Réalité Évoquée : l'esprit à l'épreuve des expériences quotidiennes

D'abord, nous établissons une distinction entre la réalité première et la Réalité Évoquée (Self-ER ou Media-ER) à l'aide de quelques exemples. Comme décrit précédemment, la Réalité primaire se rapporte à l'expérience dans le monde réel de la perception des objets ou des environnements réels (physiques). Bien que certains la considèrent comme une «médiation de premier ordre», l'idée est que les objets perçus sont réellement là ; par exemple la perception d'un lapin blanc réel dans la Réalité Primaire. La Figure 19 tend à mettre en évidence la distinction entre l'expérience de la Réalité Primaire et l'expérience de la Réalité Évoquée. Notez que, dans cette partie du chapitre, les exemples sont illustrés dans des images en deux parties. La partie gauche de chaque image est la vision d'une tierce personne montrant le sujet dans le monde réel, tandis que la partie droite montre l'expérience pouvant éventuellement être vécue de la Réalité Évoquée, du point de vue de cet individu (ou du point de vue de la première personne, soit d'un point de vue subjectif).

Dans le cas de la Media-ER, il y a toujours une «représentation» des objets ou des environnements qui évoquent l'illusion de notre présence soit à côté des objets, soit à l'intérieur des environnements. Ce pourrait être une image ou une vidéo représentant un scénario, un avatar 3D correspondant à une personne, ou un environnement interactif qui imite le monde réel. Les médias existent toujours dans notre réalité primaire et tentent d'évoquer au moins partiellement l'essence des objets ou des environnements absents. Par exemple, imaginons une image ou une vidéo du même lapin blanc qui était dans la Réalité Primaire ou la représentation de ce même lapin blanc dans un environnement virtuel ou un jeu vidéo (Figure 19). La Self-ER est l'expérience interne des objets ou des environnements dans l'esprit. Ce pourrait être une expérience de mondes entièrement imaginaires ou une représentation mentale des objets ou des environnements qui étaient précédemment expérimentés dans la Réalité Primaire. Même dans ce cas, les objets perçus sont absents de la Réalité Primaire. Par exemple, l'imagination du lapin blanc (Figure 19). La Self-ER peut être une simple pensée, une imagination volontaire, une rêverie, ou une expérience involontaire d'un rêve très vif.

Les différents types de médiation qui induisent des expériences de Media-ER peuvent varier depuis les arts et les représentations visuelles (croquis simples, illustrations, dessins, peintures, sculptures, imprimés, représentations graphiques, photographies…), jusqu'aux arts littéraires et des narrations (livres, contes, pièces de théâtre, romans), aux émissions et des récits radiophoniques, aux téléphones et des téléphones mobiles, aux interactions en ligne (e-books, images numériques, messagerie instantanée, chats audio et vidéo), aux programmes de télévision (émissions en direct, téléréalité, téléréalité scénarisé, feuilletons), aux films et des vidéos (films 2D, films IMAX, films en 3D, vidéos en ligne, vidéos interactives et non linéaires), aux spectacles vivants (théâtre, opéra, magie, « *spoken word* », danse et musique, théâtre musical), aux jeux vidéo (2D , 3D, en solo, multi-joueurs, MMORPG - *Massively multiplayer online role-playing game*), aux mondes virtuels et des communautés en ligne, aux applications réalité augmentée (AR) et réalité mixte (applications mobiles et iPad, des projections AR, lunettes AR), aux téléopérations (télécommunications, télérobotique, manipulation à distance, interactions physiques), aux simulateurs *Human-in-the-loop* (simulateurs de vol, simulateurs de conduite,

simulateurs spatiaux) à la réalité virtuelle (des simples systèmes aux environnements virtuels très immersifs, multimodaux, en passant par les visiocasques, les gants interactifs ou les systèmes de CAVE). La figure 20 vise à donner un aperçu d'un éventail d'expériences de la Media-ER.

Quand nous évoquons l'Illusion Perceptive interne, couplée à l'Illusion Psychologique qui lui correspond, nous faisons l'expérience de la Self-ER. Elle peut être volontaire ou involontaire. L'illusion de la Self- ER persiste jusqu'à ce que notre attention dérive (volontairement ou involontairement) (Baars, 1993) vers la Réalité Primaire ou vers une Media-ER. Les différentes sources de la Self-ER varient de simples pensées, de la rétrospection (principalement liée à la mémoire), de l'imagination et des fantasmes, des pensées (génération d'idées), de la visualisation (conceptualisation mentale), de la prospection et de la planification, de l'errance de l'esprit, des rêveries, des rêves lucides, des rêves (accompagnés de souvenirs lointains ou vifs), des hallucinations à des «états modifiés de conscience». La figure 21 montre un éventail d'expériences ayant porté sur la Self-ER.

L'exploration de la « Carte Réalité-Présence »

Dans la figure 22, on découvre un éventail d'expériences se rapportant à la ER inscrites sommairement sur la « Reality-Presence Map » (la Carte Réalité-Présence) relative à l'esprit d'un individu. Il faut noter que les positions des ER proposées ici sont subjectives et propres à chaque individu. En outre, pour un individu, le point de l'expérience ER par rapport à une source particulière n'est pas stable et peut varier avec le temps (on ne peut pas subir une ER d'un film ou d'un jeu de la même façon et avec la même intensité à chaque fois que nous la vivons), et même changer avec le temps, au cours d'une médiation unique et continue (pendant un film ou un jeu, on peut avoir des niveaux fluctuants de ER dépendants de son contenu). Nous soutenons que la Réalité Évoquée a le *qualia* de l'expérience (qu'on ne peut pas objectivement mesurer) et plus la Réalité Évoquée est forte, plus la position de la Réalité Évoquée est éloignée de la Réalité Primaire.

Bien que les déplacements au sein de la présence aient été étudiés par de nombreux chercheurs en matière de réalité virtuelle, ces derniers négligent souvent les déplacements expérimentés sans médiation. Comme pour la Media-ER, les déplacements au sein de la présence peuvent être tout aussi bien remarqués dans la Self-ER. Biocca (2003) a soumis l'idée selon laquelle les déplacements dans la présence peuvent précéder l'entrée en scène des médias. Les déplacements au sein de la présence sont importants à étudier car ils sont étroitement liés au fait que nous y portions ou non notre attention. Lorsque nous expérimentons la réalité, nous choisissons de porter notre attention sur un ou quelques aspects de notre environnement tout en ignorant les autres aspects. Soit notre attention se porte vers les aspects les plus pertinents, soit c'est parce que notre attention se déplace vers certains aspects qu'ils deviennent pertinents. Ce processus de déplacement continu de l'attention est soit volontaire, soit involontaire (automatique) (Baars, 1993).
Un autre aspect important de l'expérience de la présence est la présence sociale ou la co-présence. Dans quelle mesure vont-elles s'inscrire dans les concepts de Réalité Évoquée et de Présence Évoquée? Dans la réalité première, la présence sociale est l'expérience d'être ou d'interagir avec une autre personne. De même, concernant la Réalité Évoquée, la présence sociale est l'expérience de l'illusion d'être ou d'interagir avec une autre personne (en particulier

avec l'aide d'avatars pré-programmés ou d'avatars en temps réel contrôlés par d'autres dans un autre endroit). Un exemple simple de co-présence dans la Réalité Primaire serait : un ami est à côté de vous et il est en train de vous parler. Dans ce cas, la co-présence dans la Media-ER serait par exemple : un chat vidéo avec le même ami. Ce pourrait tout aussi bien être son avatar en 3D qui vous parle et réagit tout en continuant à agir dans un autre endroit. Un exemple de co-présence dans la Self-ER serait : la pensée ou le rêve qu'un ami vous parle (Figure 23).

Dans le cas de Media-ER, on peut clairement distinguer les Illusions Perceptives des Illusions Psychologiques. Un exemple évident du rôle de l'illusion perceptuelle serait l'effet qu'elle a sur la présence évoquée pendant un film utilisant un affichage classique 2D par rapport à un film utilisant un affichage stéréoscopique (communément appelé "film en 3D"). Par exemple, de nombreux films récents en format stéréoscopique ont été perçus par les spectateurs comme particulièrement immersifs comparés à des films en format classique (Figure 24). Que le spectateur préfère les formats anciens ou récents est un choix tout à fait subjectif. Dans ce cas, la Présence Évoquée est améliorée par une «immersion visuelle» qui n'est qu'un des aspects de l'Illusion Perceptive. La force et la qualité de la médiation dépendent en grande partie du lien entre la ER et le «contexte» de médiation. C'est exactement pourquoi l'Illusion Psychologique est particulièrement importante pour la Media-ER. Deux mêmes types de médiation, par exemple deux jeux vidéos (avec la même Illusion Perceptive) avec des contextes différents (contenu, histoires, styles, genres) peuvent produire différents niveaux de Présence Évoquée dans l'esprit du même utilisateur (Figure 25). Ces aspects soulèvent des remarques intéressantes. Bien que l'Illusion Perceptive affecte l'Illusion Psychologique dans une grande mesure, la réciproque se vérifie aussi. Quand l'Illusion Psychologique est exceptionnellement élevée dans la médiation, une faible Illusion Perceptive externe peut être ignorée. C'est précisément ce qui se passe dans la Réalité Narrative Évoquée, lors de la lecture d'un roman ou l'écoute d'un récit.

Certains pourraient soutenir qu'ils éprouvent des niveaux plus élevés de présence quand ils lisent un livre particulier que quand ils regardent un film ou jouent à un jeu vidéo (en particulier quand ni l'un ni l'autre n'est à leur goût). Ce qui tend à confirmer l'importance de la relation entre les Illusions Perceptives et les Illusions Psychologiques. Par exemple, par rapport à un livre, un film peut être considéré comme supérieur en médiation du point de vue de la perception (immersion à cause de la perception visuelle et auditive). Toutefois, si l'utilisateur ne porte pas son attention sur le contenu (l'histoire ou le concept), l'Illusion Psychologique n'est pas bien évoquée dans son esprit. La figure 26 illustre un exemple de la Media-ER induite par un film et un roman. Comparé à un film, un jeu vidéo a l'avantage de l'interactivité qui contribue à renforcer l'Illusion Psychologique.

La Self-ER dans la Media-ER

II y a une question importante qui se pose à présent. Comment pouvons-nous rendre compte de nos pensées ou de nos expériences imaginaires qui ont lieu au cours de simulations VR, des jeux, des films et surtout des livres? Il est vrai que nous pouvons avoir des expériences de la Self-ER au cours d'une expérience de la Media-ER. *L'indication ici est que quand nous éprouvons une Réalité Évoquée (ER), notre esprit est capable de la considérer comme la réalité première et de réagir en conséquence.* Meilleure est la ER et plus forte est la EP, plus il est facile pour notre esprit de maintenir l'illusion de ce que nous éprouvons dans la réalité première. Même les

changements émotionnels et physiologiques sont provoqués, comme on l'observe dans les expériences réalisées dans le cadre de cette thèse (expériences présentées dans le chapitre suivant). Dans ces cas-là, où la Media-ER est temporairement vécue comme la réalité première, nous pouvons éprouver la Self-ER en son sein. En fait, c'est la raison principale pour laquelle les systèmes de réalité virtuelle et les environnements virtuels fonctionnent. Ce phénomène est clairement visible dans les expériences de réalité virtuelle, où les utilisateurs ont besoin de réfléchir, de planifier et d'imaginer pour naviguer dans le monde virtuel, tout comme ils le feraient dans le monde réel. La figure 27 montre comment ce phénomène est représenté sur la Carte Réalité-Présence.

Un autre cas de la Self-ER dans les Media-ER est le « problème du livre » (ou de la lecture d'un texte imprimé). Quand on parle de l'étude de la présence par rapport à la réalité virtuelle, on évoque toujours des comparaisons avec la présence dans les récits (narrations). Comme indiqué précédemment, les récits peuvent être assez puissants pour transporter le lecteur dans un monde différent (Gerrig, 1993). Ces comparaisons ont amené Biocca (2003) à proposer ce qu'il appelle le «book problem». Ce problème, selon ses termes, est que "Si l'immersion sensori-motrice est la variable principale qui provoque la présence, alors comment pouvons-nous expliquer les niveaux élevés de présence dont témoignent les gens lorsqu'ils lisent un livre ? Les livres sont des médias de très faible intensité (au sens où ils ne sollicitent pas la plupart de nos sens primaires) et ne contiennent pas d'images ; leurs variables sensori-motrices identifiées comme étant les cause de la présence se situent à un niveau très faible : l'étendue des données sensorielles, le contrôle des capteurs, et sa capacité à modifier l'environnement "(Biocca, 2003)

Selon notre définition de la «médiation», il devrait y avoir un flux continu d'entrées perceptives qui évoque principalement l'Illusion Perceptive, dont le livre fait partie. Mais ici l'entrée perceptive est obtenue grâce à un contenu narratif textuel (des lettres, des mots, des phrases, des symboles) qui doit être lu et interprété continuellement pour maintenir et mettre à jour l'illusion de la réalité. En comparaison avec les technologies narratives qui sont interactives et non linéaires, Biocca (2002) a souligné que, bien que les livres et les radios portables soient omniprésents, ils ne sont pas dotés d'intelligence et ne sont ni sociaux - ils n'ont pas conscience de leur environnement tel qu'il se manifeste dans le monde réel - ni interactifs. Le phénomène de Narration ER est indiqué sur la Carte Réalité-Présence à la Figure 28.

La Self-ER déclenchée pendant la Media-ER

Il convient de préciser que « la Self-ER dans la Media-ER » doit être distinguée de « la Self-ER déclenchée pendant la Media-ER ». La première se rapporte à un cas bien connu de la Self-ER : le phénomène de l'errance de l'esprit, qui nous extrait temporairement de la réalité primaire. Elle est aussi sous la forme de « task unrelated thought » («pensée sans correspondance »), en particulier dans un contexte expérimental. Smallwood et al. (2003) la définissent comme l'expérience de pensées dirigées loin de la situation actuelle. Elle est étroitement liée à nos expériences de la vie quotidienne (Smallwood et al., 2004; McVay et al., 2009). Bien que les études sur l'errance de l'esprit concernent principalement les déplacements entre les Self-ER et des tâches liées à la réalité primaire (relevant de cas habituels de l'expérience de la Self-ER - Figure 29), nous avançons qu'elles sont applicables également à des cas se rapportant à la Media-ER. Cette expérience involontaire peut être à la fois durable et transitoire. Cela signifie que nous pouvons expérimenter une Présence Évoquée durable lors d'une errance de l'esprit ou

d'une Présence Évoquée oscillant entre la Self-ER, la Media-ER et la Réalité Primaire. Par conséquent, lorsqu'une Self-ER sans correspondance est déclenchée tout en éprouvant une Media-ER (ou quand la Self-ER dans la Media-ER traverse le seuil de présence et devient inconsciente dans la Media-ER), elle doit être envisagée et étudiée dans le cadre du cas classique d'une Self-ER. Nous aurons certainement la perception externe de la médiation, mais sans prise de conscience. Ce phénomène de la Self-ER déclenchée pendant la Media-ER est illustré à l'aide de la Reality-Presence Map (la carte Présence-Réalité) (cf figure 30).

Qualia de la Réalité Évoquée (Subjectivité)

Une même médiation peut créer différentes ER subjectives sur différents utilisateurs en fonction de leurs caractéristiques personnelles. Par exemple, deux utilisateurs qui lisent le même livre, jouent au même jeu vidéo, ou utilisent le même système de réalité virtuelle, vont expérimenter la présence d'une manière tout à fait différente (cf Figure 31). La Présence Évoquée (notamment celle évoquée par les médias) peut être affectée par la connaissance du contexte, le degré d'intérêt, l'attention, la concentration, l'implication, l'engagement, la volonté, l'acceptation et les attributs émotionnels, qui en font une expérience très subjective. C'est précisément pourquoi il est difficile d'évaluer l'efficacité d'un système de réalité virtuelle au moyen de questionnaires de présence. En fait, de nombreux chercheurs confondent certains des termes cités précédemment avec le concept de présence.

Dans la réalité virtuelle, la différence entre «présence» et «immersion» avait déjà été clairement définie dans Slater (1999, 2003). Bien que l'immersion (qui est largement débattue dans le domaine de la réalité virtuelle) soit l'un des aspects les plus importants de la Présence Évoquée, elle correspond à la faculté technique d'un système de médiation. « L'immersion (au sens perceptif) fournit le cadre dans lequel la « Place Illusion » (l'illusion de l'endroit) peut se produire » (Slater, 2009). Les aspects détaillés de présence liée à la réalité virtuelle immersive ont également été discutés dans Slater et al. (2009b). Les caractéristiques comme la participation, l'engagement, le degré d'intérêt, la réponse émotionnelle, peuvent être comparées à la présence, mais sont en fait des éléments différents qui peuvent influencer ou être influencés par la Présence Évoquée. L'impact psychologique du contenu, c'est à dire le bien et le mal, passionnant et ennuyeux, dépend dans une large mesure de la forme dans laquelle il est représenté (Ijsselsteijn, 2003). Ainsi, l'un des aspects les plus importants de la Media-ER est son contexte. Dans la plupart des cas, elle constitue une référence dans l'esprit de chacun à la façon dont on peut éprouver la Réalité Évoquée et donc la Présence Évoquée. Par exemple, dans certains contextes, en particulier dans ceux touchant à l'art et au divertissement, elle se réfère à un «genre» qui joue un rôle majeur dans sa communication. Le contexte (que ce soit l'expression artistique, la communication, le divertissement, les applications médicales, l'éducation ou la recherche) est au centre des préoccupations lors de la conception d'un système de réalité virtuelle afin de parvenir à une qualité subjectivement supérieure à celle de la ER. Un rapport descriptif sur l'importance du contexte dans la Self-ER a été rédigé par Baars (1993). Avec des exemples de contextes de types et de sources différents (perceptifs et conceptuels), il a démontré comment des contextes inconscients façonnent l'expérience consciente. En outre, il a expliqué l'importance de l'attention, qui agit comme le contrôle de l'accès à la conscience. L'attention (à la fois dans la Media-ER et la Self-ER) peut diriger l'esprit vers ou depuis une source potentielle de *qualia*. L'expérience d'une Réalité Évoquée dépend donc également des caractéristiques volontaires ou involontaires de l'attention.

CHAPTER 4: EXPERIMENTATION

4.1 EXPERIMENT 1: PRESENCE IN MEDIA-EVOKED REALITY

During this research work we have performed few experiments that can be categorized simply into two parts: Experiment-1 on Media-ER and Experiment-2 on Self-ER. Experiment-1, a detailed set of experiments, based on Media-ER was conducted at Arts et Métiers ParisTech, France, while exploring and comparing presence experiences between virtual worlds evoked by a video game (audio-visual and interactive) and a short story (simple textual narrative).

4.1.1 Background

The sense of presence in Media-Evoked Reality (VR and different communication media) is already established. Presence in video games has always been compared to presence in VR experiences [for instance, (Lécuyer et al., 2008; Geslin et al., 2011; Richir et al., 2011)]. In this study, we propose that presence can be experienced in media with lower levels of perceptual immersion as well; however it may not be as strong as in the case of VR. Biocca (2003) rightly pointed towards this concept by suggesting the 'Book Problem'. How can we explain our experience of sense of presence even while reading a book? Why should we consider book as falling under Media-ER, was discussed earlier (in the last chapter). We suggest that Narration Evoked Reality should be classified under Media-ER. In fact there are similarities in presence experience when considering any media, but is difficult to analyse presence over different immersion equivalent class' (Slater, 2009). Experiement-1 sheds light on these areas.

4.1.2 Research Questions

The main research questions that we attempted to address in this experiment are:

1. Do all media (especially ones with lower levels of immersion) evoke an illusion of reality?
2. How can we study and compare presence evoked by different media with the help of Reality-Presence Map?
3. How can physiological data contribute to the understanding and comparison of presence evoked by these different types of Media-ER?

Additionally, we also analysed how efficient the presence questionnaires are, by comparing their scores. In terms of the game experience, we also examined whether previous knowledge of the interface or interaction may affect presence in a new game environment. The experiments were devised in such a manner that we could explore these research questions, without seeking out for a specific answer. These experiments were conducted with the help of a colleague who was interested in exploring the emotional and attentional aspects of presence (specifically in Game-ER).

4.1.3 Experimental Procedure

Experiment Tasks

For the entire experiment, the participants had to experience two types of media:

1. Game Evoked Reality (Audio-Visual Interactive Media-ER): A first-person view, survivor horror video game called "Amnesia: The Dark Descent" was chosen for this task.

2. Story Evoked Reality (Textual Narrative Media-ER): A French horror short story called "Boum Boum Boum" was chosen for this task. It is presented a first person narrative, spanning 3 pages.

Experimental Setup

In both cases the participants had to experience the media under similar laboratory conditions. The experiment room consisted of a triple-screen display and headphones for the game experience. The centre screen was used for the story, with white text on a black background (see **Figure 33** & **Figure 34**)

Figure 33: Triple screen display for the game [source: author]

Figure 34: Text on the monitor for the story [source: author]

Along with the display and the headphones, the participant area consisted of a keyboard and a mouse for interaction, instructions for the game and a wireless pulse oximeter for recording physiological data (pulse rate and breathing) (**Figure 35**). The experimental setup was designed in such a manner that the experimenter was able to observe the participants' reactions during the experiments, without being visible to them. During the tasks all the lights were switched off, and only the display screens were visible to the participants. Thus, we were able to monitor the physiological responses in real-time as well (**Figure 36**). The experiment room was used for the main tasks, while an adjacent room was where they answered the different questionnaires. During the experiment task, the participants underwent the entire experience inside the dark room, so as to minimize any visual distractions and wore headphones in order to reduce external audio distractions.

Figure 35: Experimental Setup - triple-screen display, instructions to read and the wireless pulse oximeter [source: author & Erik Geslin]

Figure 36: The monitoring area (the participant area in the background) [source: author & Erik Geslin]

Experiment Stages

Stage 1: The participants were asked to respond to questionnaires before the tasks started (outside the experiment room). The questionnaires included: General Information, Gaming Experience and Immersive Tendencies Questionnaire (ITQ) (Witmer and Singer, 1998).

For the first task (game), there were 2 stages in the experiment process:
Stage 2: Game experience in the experiment room. The participants were asked to read the instructions for the game, to be clear about the interactions (**Figure 37**). The pulse oximeter was connected to their right hand. When they were ready to begin, they were asked to wear the headphones and the lights were switched off (**Figure 38**). Whenever they reached a particular point in the game environment, they were asked to discontinue.
Stage 3: The participants were asked to respond to questionnaires: Attention Allocation, Presence Questionnaire (PQ) (Witmer and Singer, 1998) and Slater-Usoh-Steed Questionnaire (SUS) (Slater et al., 1994) and Evoked reality Questionnaire (outside the experiment room).

For the second task (story) as well, there were 2 stages:
Stage 4: Story experience in the experiment room. The participants were in the same setup as the game task, however with only the central screen active (displaying the text). The pulse oximeter was connected and they wore headphones to reduce external noises. They were asked to read the entire short story of 3 pages.
Stage 5: The participants were asked to respond to the Evoked reality Questionnaire (outside the experiment room).

Figure 37: Participant going through the guidelines before the experiment task [source: author & Erik Geslin]

Figure 38: Participant during the game experience [source: author & Erik Geslin]

Subjects

For each task, there were 29 subjects (21 male and 8 female) who participated in the experiment. From the information that the participants provided us, we found 16 (55.2%) to be regular gamers (who play video games 3 hours or more per week), while 13 (44.8%) to be non-gamers (who play less than 3 hours a week or do not play at all). The game dialogues, story and all the questionnaires were in French, as all the participants were natively French-speaking.

They had no knowledge of the primary objectives of our study and only knew that the experiments were related to media experience.

Analysis Method

Along with the physiological data recorded during the tasks, for the analysis, we depended on pre- and post-experiment questionnaires. The presence questionnaires were the existing and well explored ones by Witmer and Singer, and Slater et al., while the other questionnaires were devised by us with respect to our research questions. Here is a summarised list of responses that helped us in the analysis:

- Questionnaires before the experiment
    1. General Information and Gaming Experience
    2. Immersive Tendencies Questionnaire (ITQ) (Witmer and Singer, 1998)

- Physiological Response - pulse rate and breathing (during game experience)
- Questionnaires after game experience
    1. Attention Allocation and Emotion Questionnaire
    2. Presence Questionnaire (PQ) (Witmer and Singer, 1998)
    3. Slater-Usoh-Steed Questionnaire (SUS) (Slater et al., 1994)
    4. Evoked Reality Questionnaire (Game)

- Physiological Response - pulse rate and breathing (during story experience)
- Questionnaire after story experience
    1. Evoked Reality Questionnaire (Story)

4.1.4 Results and Analysis

4.1.4.1 Media-Evoked Reality: Video Game vs. Textual Narration

Evoked Reality Response

To begin with, we analysed the ER Questionnaire responses. We studied earlier that Perceptual Illusion is one of the main components of ER that evoked presence. The goal here was to show that Perceptual Illusion is not an experience created just by highly immersive media, but also lower ones like a video game on 2D screens or even lower immersive media like a textual narrative (short story).

The video game was audio-visual, with interactive navigation in first person, while the story was purely textual with first person narrative. It was interesting to notice that the responses to visual Perceptual Illusion were unanimously equal for both media. Participants admitted that the narrative formed visual spaces and elements in their mind. For auditory illusion, story scored lower to that of the game, although showing that illusion of sounds were also evoked while reading. Depending on the nature of visual and auditory illusions evoked by the narrative, few participants also experienced a sense smell in the mind. It was interesting to note that this was observed especially in the case of story than in the game.

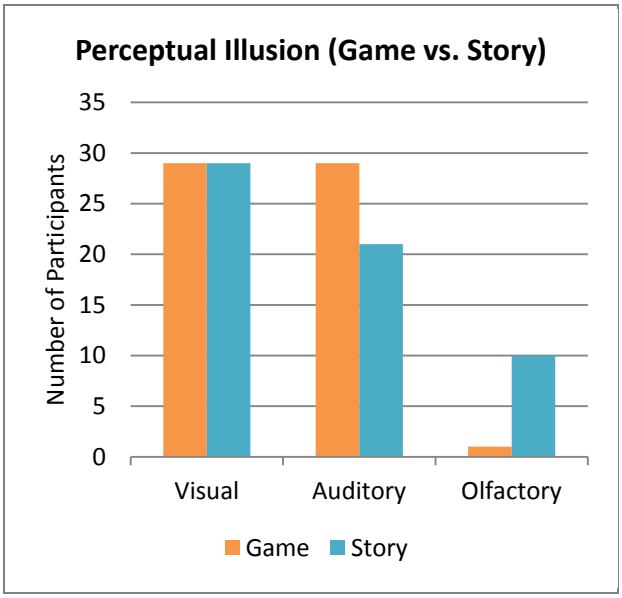


Figure 39: Perceptual Illusion based on ER Questionnaire (Game vs. Story) [source: author]

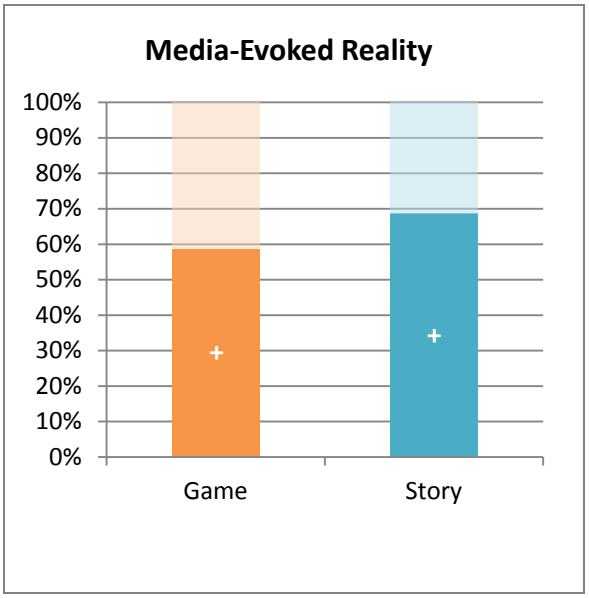
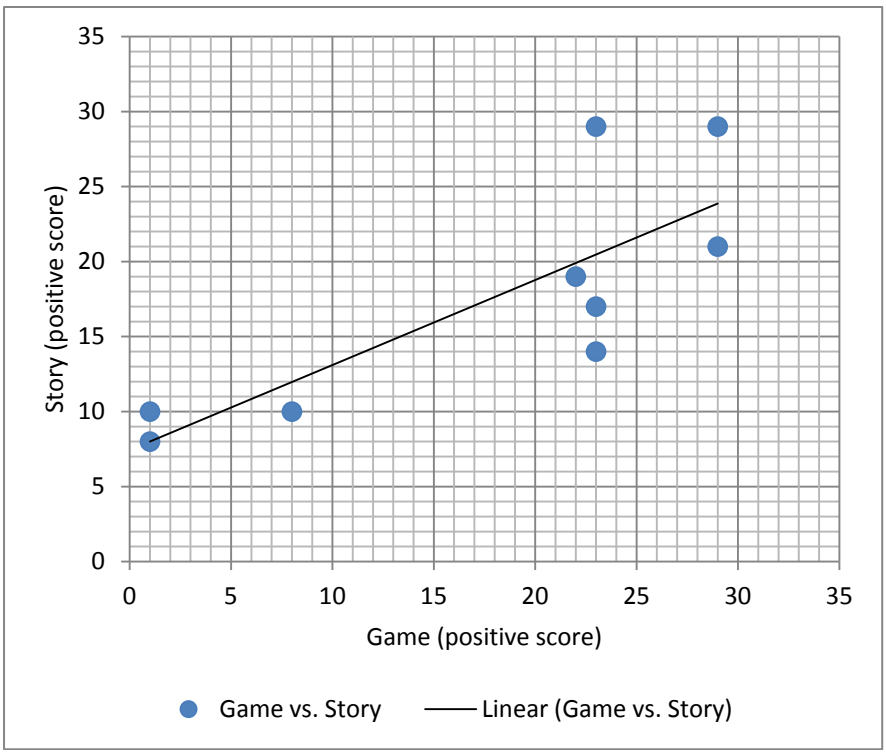


Figure 40: Media-Evoked Reality - Percentage distribution of positive and negative responses to ER Questionnaire (Game vs. Story) [source: author]

We also analysed Perceptual Illusion, according to the participants' responses (9 questions from the ER Questionnaire) to how realistic it was to them these different experiences. Based on the positive responses for game and story, it was observed that there was a positive correlation (Pearson correlation coefficient r=0.8101, p-value=0.00812, n=9). This helps us clarify that Perceptual Illusion can occur in a media like video game (audio-visual and interactive) as well as in a very low-end immersive media like a short story (simple textual narrative).

Remark: *In both game and story, the ER questionnaire showed comparable scores for combined Perceptual Illusion.*



(r = 0.8101,
p-value = 0.00812)

Figure 41: Scatter plot showing positive correlation for ER (Perceptual Illusion) scores – Game vs. Story [source: author]

Visual Representation of the Media-Evoked Reality

A part of the ER Questionnaire consisted of visual representation of what they remembered from the imagery evoked during the media experiences. The task was to sketch after each media experience, an image of what they remembered well. For example, **Figure 42** shows an example sketch by the participant 11 after game and story experiences respectively. Images sketched by all the participants can be found in **Appendix 4**.

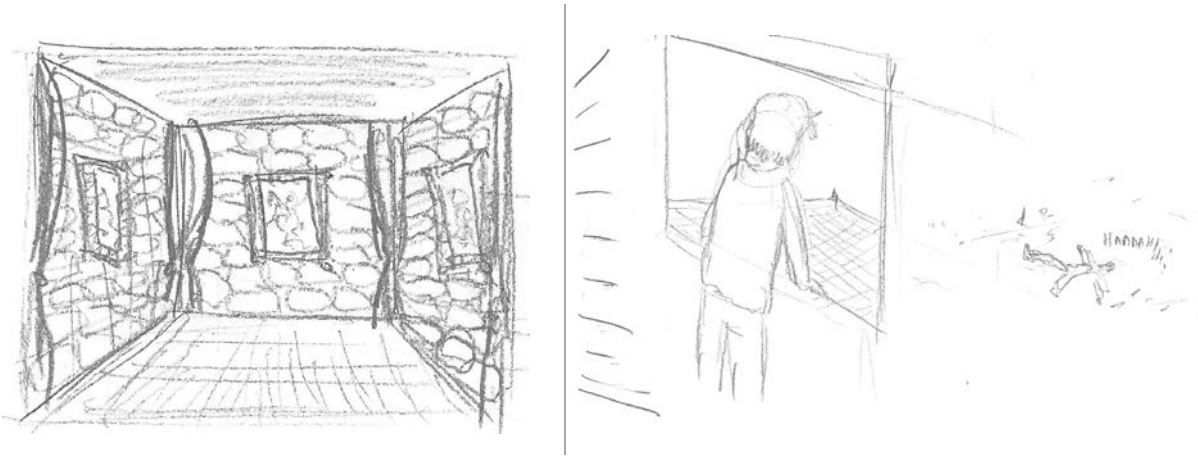


Figure 42: Sketches by a participant after the Game (left) and after the Story (right) [source: author]

We analysed these sketches and searched for common elements that may provide us with further insights on the visual Perceptual Illusion. Based the common visual elements found in the images, we divided them according to the following categories: Space/Objects, Characters, Point of View, Game Level, Representation (for game - see **Table 2**) and Space/Objects, Events, Characters, Point of View, Representation (for story - see **Table 3**).

Examining these commonalities helped us better understand the nature of visual Perceptual Illusion evoked in their minds and how it may have shaped their Psychological Illusion during that time. It was noted that all the participants were not talented artists. So, in order to examine objectively (regardless of their sketching talents) the elements in the images, we first compared their sketching styles in both cases (game and story) before coming to conclusions. Below, we can observe in the graph (**Figure 43**), the number of participants with the representation techniques and points of view they adopted in their sketches. We can see that for both game and story, many sketches indicated perspective views. The game environment was in fact presented in a perspective view (with 3D real-time rendering), but interestingly the story also evoked spaces with perspective views; or at least when they attempted to reproduce the evoked space, they remembered it like a real world spaces in memory. This again points to the fact that even a textual media can evoke a strong (illusion of) reality in the mind.

Remark: *Yes, different kinds of media, including textual narratives evoke illusion of reality.*

Space / Objects	Walls
	Wall Texture
	Arch Opening
	Opening / Door
	Boxes / Crates
	Barrel
	Water
	Splashes
	Lantern / Candle
	Steps
	Table / Shelf / Artifact
	Web / Slime
	Blood Spots
	Corridor
	Paintings on walls
	Torch on wall
	Pulley / Handle
Characters	Monster
	Player Himself
Point of View	First Person View with Player
	First Person View
	Third Person View
	Ambiguous View
Game Level	Level 1
	Level 2
	Level 3
Representation	Dialogue / Label
	Perspective view
	Frame / Boundary

Table 2: Elements from the sketched images (After Game) [source: author]

Space / Objects	Door
	Window
	Walls
	Bed
	Carpet
	Table
	Chair
	Roof Below
	Shelf
	Lawn Outside
	Monster Hand
Events	Talking
	Sitting
	Standing
	Knocking
	Facial Expressions
	Falling / Fallen
Characters	Arnaud
	David
	Narrator Himself
Point of View	First Person View with Narrator
	First Person View
	Third Person View
	Ambiguous View
Representation	Dialogue / Label
	Perspective view
	Frame / Boundary

Table 3: Elements from the sketched images (After Story) [source: author]

The game being of a first-person view, naturally reflected those characteristics in visual representation, compared to the story. Although the story was first-person narrative, it was visualised by the participants in different ways - the narrator's point-of-view, a first-person like view with the narrator present in front (like in certain video games), a third-person view or even omnipresent multiple views (according to their responses). This was also reflected in their sketches as we can see in the graph (**Figure 43**). It was also interesting to observe that the media boundary was reflected in their memory in the case of post-game sketches, which is a clear indication of an apparent reason why highly immersive virtual reality systems like CAVEs evoke stronger illusions and thus higher presence. The media boundary always makes us realise at a sub-conscious level, that it is in fact not real. But in the case of post-story sketches this wasn't reflected, especially because the entire Perceptual Illusion was evoked in the mind and had no restricting visual boundaries. Whether the mental images were as realistic as the game images is an entirely different question to be explored in future.

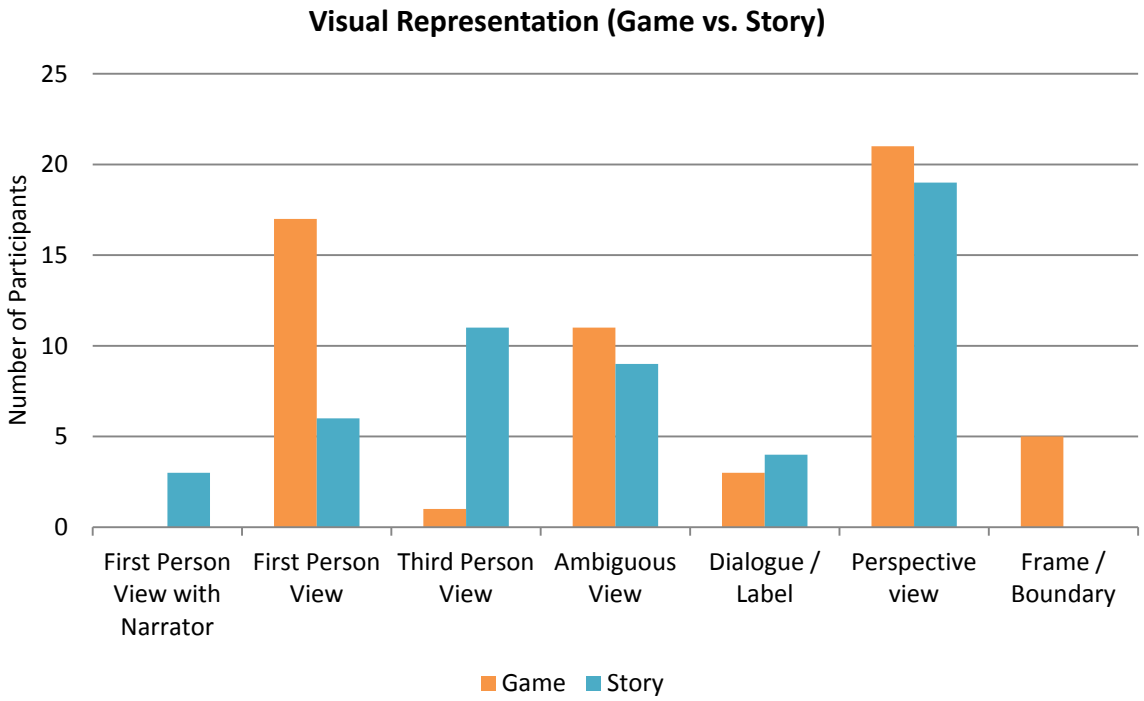


Figure 43: Visual Representation and Point of View noted from the sketches (Game vs. Story) [source: author]

Here below, we can see a summary of distribution of common visual elements that were reflected, when all the post-game sketches were compared (**Figure 44**). As we can clearly notice, the major references that were found were spatial elements like walls, wall texture, arch openings, doors, table, shelves and artefacts. Other than the spatial elements the monster character from the game was also represented. In the case of post-story sketches (**Figure 45**) the major references reflected the spatial elements and a very strong memory of the main event of the story. That shows why the three characters and the door are the most represented.

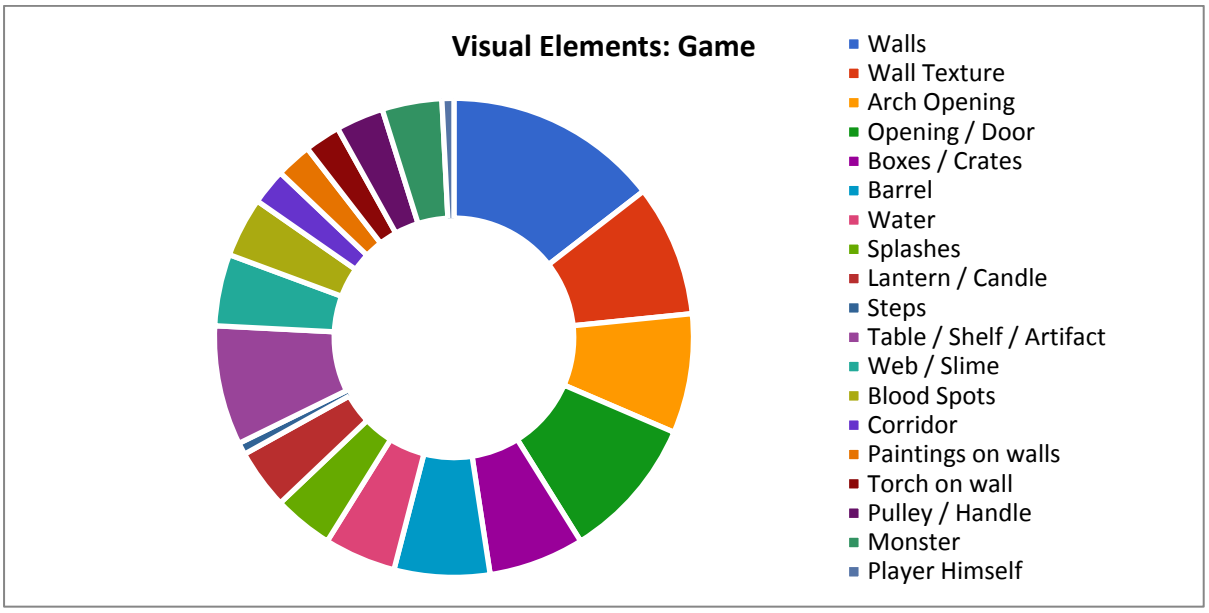


Figure 44: Visual Elements depicted in the sketches: Game [source: author]

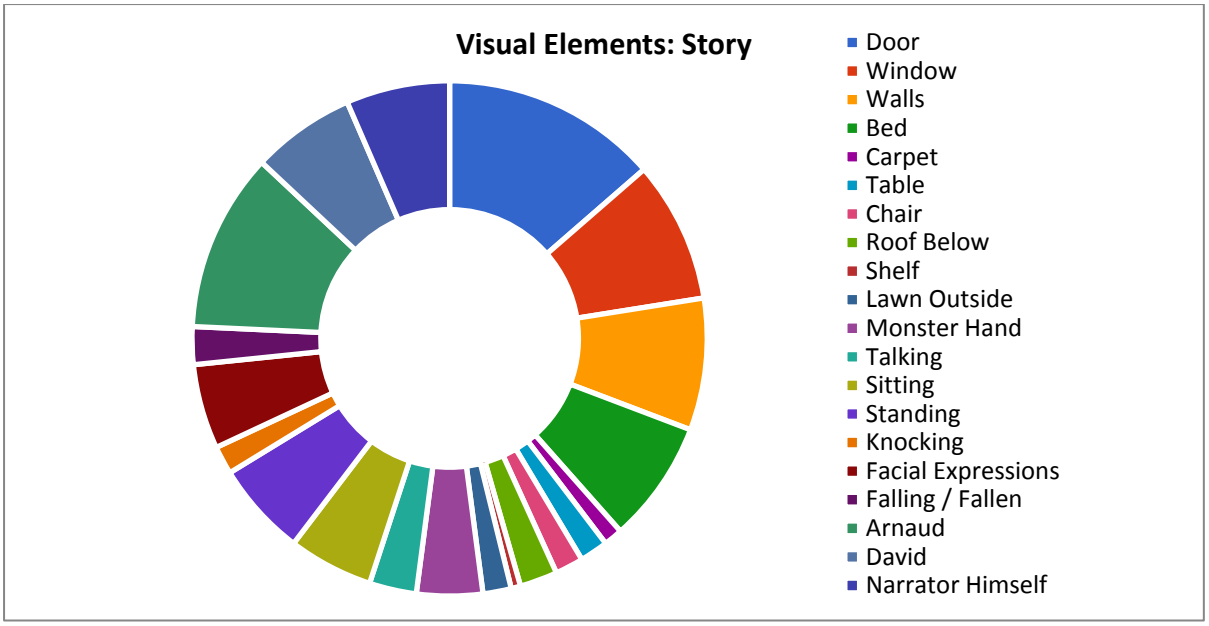


Figure 45: Visual Elements depicted in the sketches: Story [source: author]

Evoked Time

Apart from the perceptual part of the Media-ER, we also studied the time taken by each participant to examine the sense of time they experienced in their minds during each media experience. It is intriguing to notice how Media-ER can create an illusion of not just space but also time - different to that of the real world time.

First, the participants were asked to guess the time they spent in the experiment room. As we had recorded the actual time every participant took for the experiments, we were able to compare them with their responses. This helped as form a baseline for their perception of real world time. As we can see (**Figure 46** and **Figure 47**), for the game and the story the responses to the time they thought they spent in the experiment room was quiet close to the actual time they took.

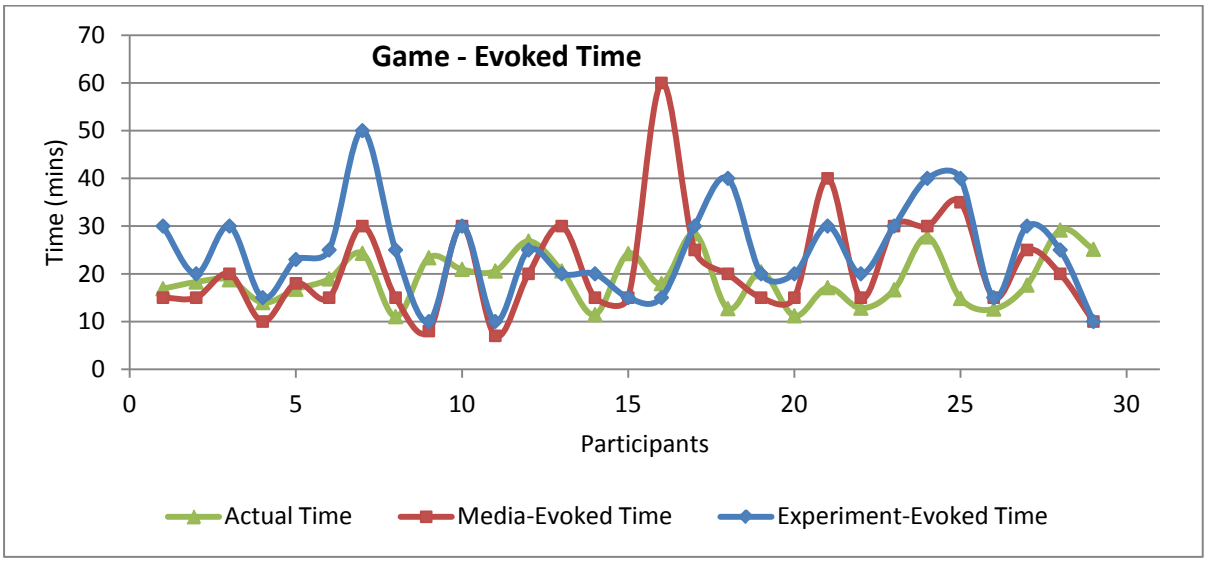


Figure 46: Comparison between Actual Time and Evoked Time (Game) [source: author]

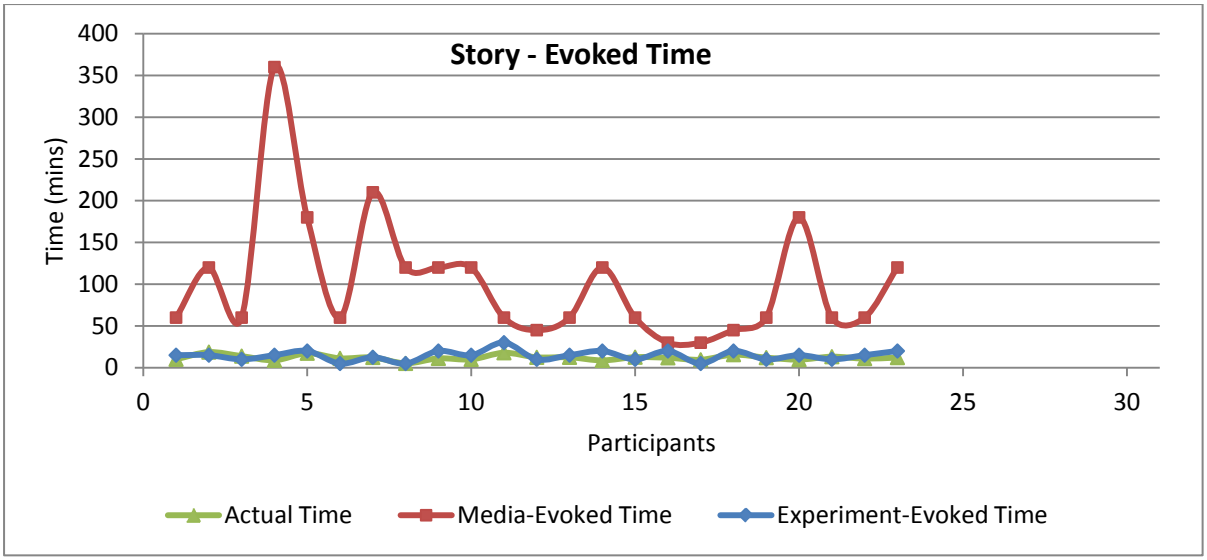


Figure 47: Comparison between Actual Time and Evoked Time (Story) [source: author]

Then they had to respond to how much time they thought the scenario represented by the media took. For the game the responses were very close to the experiment time itself, as it was a real-time scenario (exploring by walking or running), with transition points in order to go to a next level. It was fascinating to see the responses for the story, as most of the participants (23 out of 29, 79.3%) responded as if the event took place for few hours while the reading lasted only about 10 to 20 minutes.

Remarks: *Media-ER can evoke not just an illusion of space but an illusion of time as well. Evoked reality is a combined spatio-temporal illusion of reality.*

4.1.4.2 Presence: Measurement and Schematic Representation

Presence Questionnaires

In order to test the validity of the presence scores, we decided to compare two well-known presence questionnaires that researchers use - Presence Questionnaire (PQ) (Witmer and Singer, 1998) and Slater-Usoh-Steed Questionnaire (SUS) (Slater et al., 1994). Both the questionnaires are analysed with the help of responses in Likert Scale with a range of 7. PQ has 24 questions while SUS has only 6. As these questionnaires were designed for higher immersive media experiences like virtual reality applications, it was not applicable for the story. So we used this questionnaire only for the post-game responses. The presence score for PQ was m = 4.14 (out of 7), while for SUS was m = 4.76 (out of 7). As we compared the scores individually for both questionnaires, we noticed that there is in fact a positive correlation among them (Pearson correlation coefficient r = 0.481, p-value = 0.0083) (**Figure 48**).

Although this shows that either of the questionnaires can be used to test presence, it needs further evaluation comparing with other forms of media as well. Moreover there is no presence questionnaire designed for lower immersive media like textual narrative. It is reasonable to consider that presence can be compared only within a same immersive class. However, we suggest that researchers should take an effort towards finding solutions for measuring presence objectively over different immersive classes as well, or explore whether it is in fact possible.

This is one of the reasons why we did a physiological analysis comparing the heart rates during game and story (which will be explained in the section **4.1.4.3** below)

Remark: *Both questionnaires gave comparable scores for presence, and show a positive correlation among individual responses (r = 0.481, p-value= 0.0083)*

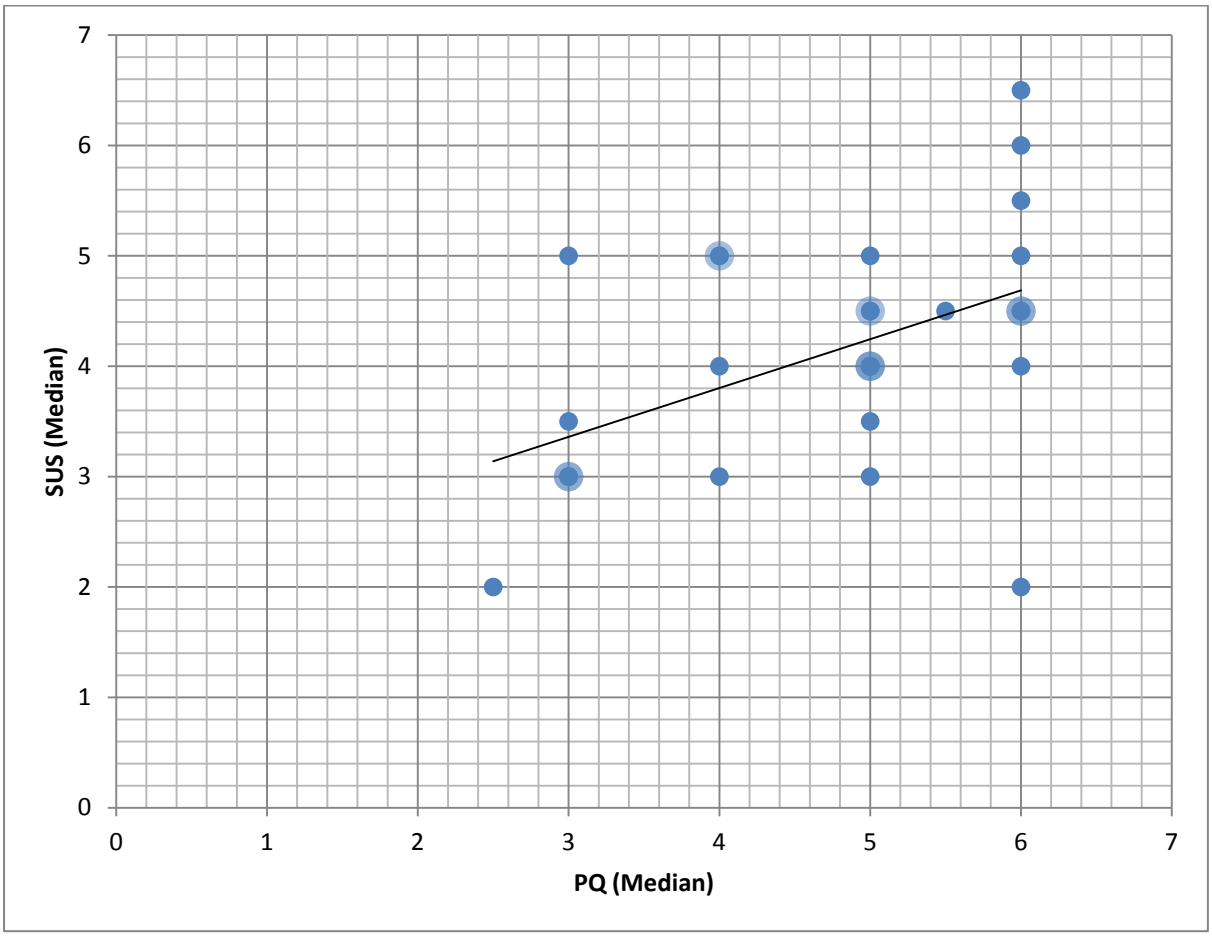
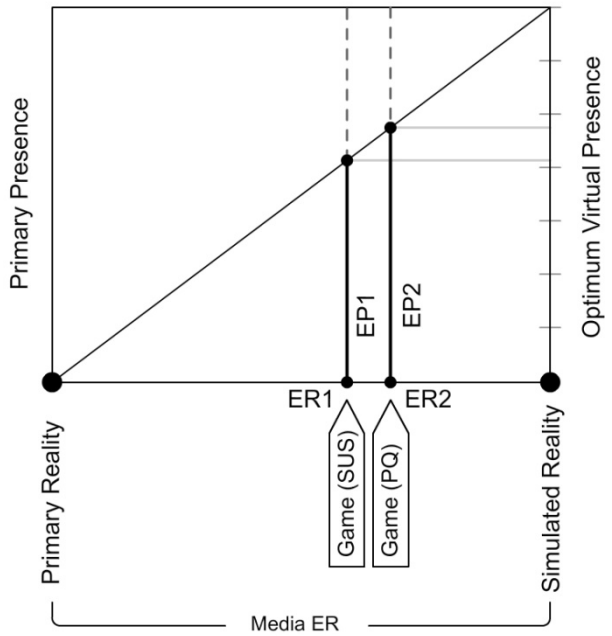


Figure 48: Scatter plot showing positive correlation for presence scores - PQ vs. SUS Questionnaire [source: author]
(r = 0.481, p-value = 0.0083)

Schematic Representation on Reality-Presence Map

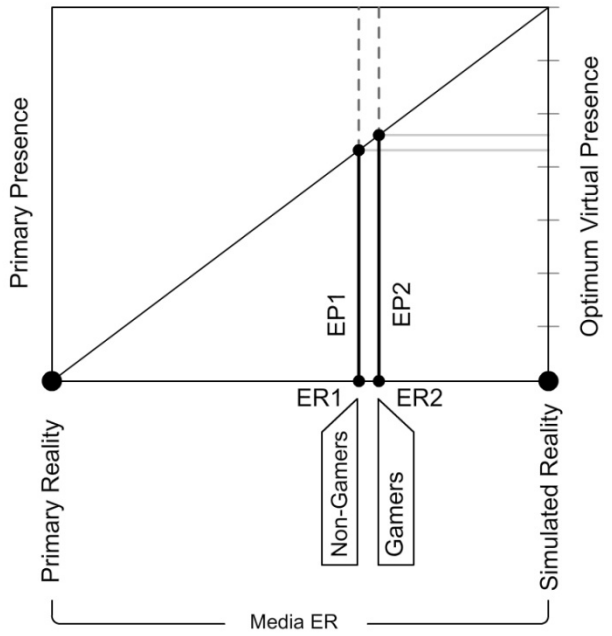
Here we can see how the presence scores could be represented on the Reality-Presence Map. The map could be used to visually examine and compare different experiences of Media-ER and the presence they evoke. For instance, in **Figure 49** we compared presence evoked by the game based on the scores obtained from PQ and SUS. The presence scores were within a scale of 0 to 7, for which we considered 0 as no experience of EP and 7 as an experience of Optimum Virtual Presence, in order to represent them on the map.



PQ: m = 4.76 out of 7 (67.9%)
SUS: m = 4.14 out of 7 (59.1%)

Figure 49: Evoked Presence and corresponding Evoked Reality for the game, represented on the Reality-Presence Map [source: author]

Here is an example of how the presence scores could be compared on the Reality-Presence Map with respect to individual subjective qualities. For instance, in **Figure 50** we compared presence evoked in the minds of subjects who played games regularly, to those of who did not. The scores showed that non-gamers experienced lower level of presence, both in PQ and SUS. Although perceptual immersion was the same for all subjects, the acquaintance with the interactive interface made a difference. We deduced that among non-gamers, adapting to the interface created shifts in attention leading to breaks in presence.



Gamers (avg.) = 4.58
Non-Gamers (avg.) = 4.29

PQ: m = 4.91 (gamers) and 4.58 (non-gamers)
SUS: m = 4.25 (gamers) and 4 (non-gamers)

Figure 50: Evoked Presence in Gamers vs. Non-Gamers according to PQ and SUS presence scores [source: author]

Remarks: *Presence can be visually represented on Reality-Presence Map, to denote the position of ER. However, presence measurement techniques need to be designed to accommodate different forms of media.*

4.1.4.3 Physiological Response and Comparison

In order to analyse presence across different levels of immersive media, we require an objective method, which can be used under deferent media conditions. So, we decided to compare physiological responses; especially changes in heart rate due to emotional arousal. The participants were under the age group 20 to 50 years old, and thus we can consider their average resting heart rate to be 70 bpm (60-80 bpm) (Heart.org, 2012).

We observed that the average heart rate during game was clearly higher compared to the story (**Figure 51**). This appears to be natural as the game had strong graphic elements and sound effects to support the total effect of the scenario presented. Although it was noticeable that story had a lower average heart rate, for each participant there were higher peaks at certain points in the narrative, similar to the game. We can see the average heart rates with their respective ranges for the game and story in **Figure 52**. This implies that it is not just the external Perceptual Illusion that contributes to the overall Evoked Reality. If textual narrative can evoke a strong internal Perceptual Illusion (triggering vivid mental imagery experiences), along with associated Psychological Illusion (targeting powerful emotional responses), the resulting Evoked Reality can be exceptionally strong.

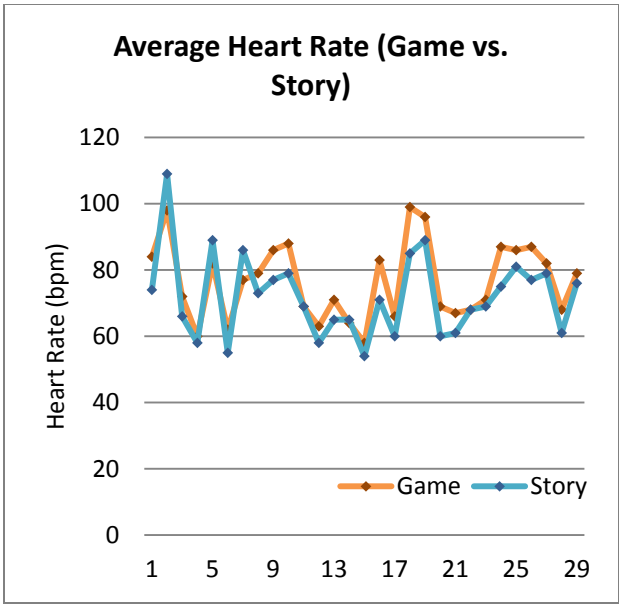


Figure 51: Average heart rate of the participants (Game vs. Story) [source: author]

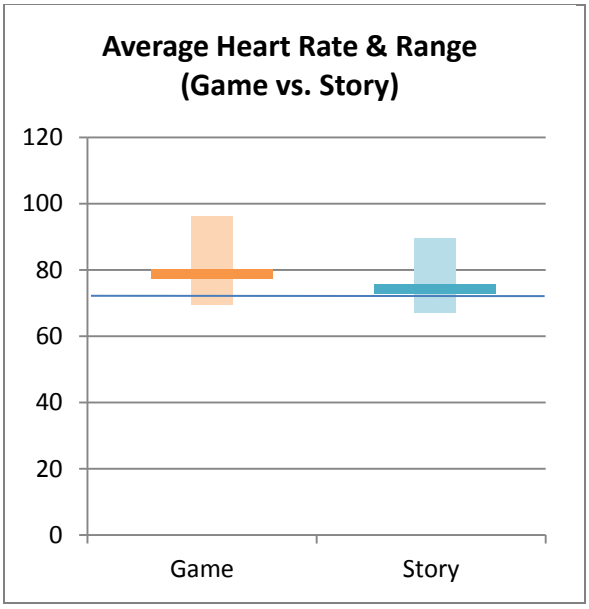


Figure 52: Average heart rate with Range (Game vs. Story) [source: author]
(Average resting heart rate denoted at 70 bmp)

Remarks: *Higher levels of perceptual immersion can evoke higher levels of arousal, which may in turn affect presence. However, strong Perceptual Illusion can be evoked internally as well, which along with a strong Psychological Illusion, can induce a powerful Evoked Reality.*

4.1.5 Inferences and Summary of Results

4.1.5.1 Every Media Evokes Reality

ER Questionnaires helped us examine the illusion of reality evoked in a video game as well as a short story. In both game and story, the ER questionnaire shows comparable scores for combined Perceptual Illusion. It supports our argument that different kinds of media, including textual narratives evoke illusion of reality. We also observed that Media-ER evoke not just an illusion of space but an illusion of time as well. It strengthens our concept that Evoked reality is a combined spatio-temporal illusion of reality. Physiological analysis showed that higher levels of perceptual immersion can evoke higher levels of arousal, which may in turn affect presence. However, even in lower perceptual immersion media like narratives, strong Perceptual Illusion can be evoked internally, which along with strong Psychological Illusion, can induce powerful Evoked Reality.

4.1.5.2 Presence Measurement and Future Possibilities

Presence is an extremely subjective experience and it is noticeable in the individual responses as well. Both the questionnaires PQ and SUS gave comparable scores for overall presence, and show a positive correlation among responses of each individual. With the help of these presence questionnaires, EP can be visually represented on Reality-Presence Map, to denote the position of ER. Although, these questionnaires seem useful, they are designed for media that fall under higher immersion classes, like VR. So, presence measurement techniques need to be further explored and designed to accommodate different forms of media. Concluding remarks on this experiment (as well as the next experiment), its significance and future scope are given in the **Section 4.3.** below.

RÉSUMÉ DU CHAPITRE 4.1 : EXPÉRIENCE 1

LA PRÉSENCE EN RÉALITÉ MÉDIA-ÉVOQUÉE

Au cours de ce travail de recherche, nous avons réalisé quelques expériences qui peuvent être classées en deux parties : l'expérience-1 sur la Media-ER et l'expérience-2 sur la Self-ER. L'expérience-1, qui constitue un ensemble détaillé d'expérimentations basées sur la Media-ER a été menée aux Arts et Métiers ParisTech, en France, et a porté sur l'étude et la comparaison des expériences de la présence entre les mondes virtuels évoqués par un jeu vidéo (audio-visuel et interactif) et une nouvelle (simple narration textuelle).

Contexte

Le sentiment de présence en Réalité Media-Évoquée (RV et différents supports de communication) est déjà établi. La présence dans les jeux vidéo a toujours été comparée à la présence dans les expériences de réalité virtuelle (cf Geslin et al., 2011; Richir et al., 2011). Dans cette étude, nous établissons que la présence peut être expérimentée dans les médias à des niveaux inférieurs de l'immersion perceptive ; cependant, elle ne peut pas être aussi forte que

dans le cas de la RV. C'est ce qu'avait identifié Biocca (2003) en introduisant le concept de «Book Problem» (le problème du livre). Comment peut-on expliquer notre expérience du sens de la présence, alors même que nous lisons un livre ? Les raisons pour lesquelles nous pouvons considérer le livre comme relevant de la Media-ER ont été discutées plus tôt (dans le dernier chapitre). Nous pensons que la Réalité Narrative Évoquée doit être classée dans les médias-ER. En fait, il y a des similitudes dans l'expérience de la présence lorsqu'il est question de n'importe quel média, mais l'analyse se complique quand les classes d'équivalence associées au concept d'immersion auxquelles on a affaire sont différentes (Slater, 2009). L'expérience n° 1 met en lumière ce dernier aspect.

Problématiques de Recherche

Les problématiques de recherche principales auxquelles nous avons tenté de répondre dans cette expérience sont les suivantes :
1. Est-ce que tous les médias (en particulier ceux ayant un niveau d'immersion faible) évoquent une illusion de la réalité ?
2. Comment pouvons-nous étudier et comparer la Présence Évoquée par les différents médias à l'aide de la Reality-Presence Map (Carte Réalité-présence) ?
3. Comment les données physiologiques peuvent-elles contribuer à la compréhension et à la comparaison de la Présence Évoquée par ces différents types de Media- ER ?

Par ailleurs, nous avons analysé l'efficacité des questionnaires sur la présence en comparant leurs résultats. Pour ce qui est de l'expérience se rapportant au jeu, nous avons également examiné si les connaissances antérieures sur l'interfaçage ou sur l'interaction peuvent affecter la présence dans l'environnement virtuel d'un nouveau jeu. Les expériences ont été menées de telle façon que l'on pouvait étudier ces problématiques de recherche sans chercher à obtenir une réponse spécifique. Ces expériences ont été réalisées avec l'aide d'un collègue intéressé par l'étude des aspects émotionnels et attentionnels de la présence (en particulier dans la Réalité Évoquée du jeu ou Game-ER).

Procédure Expérimentale

Pendant toute l'expérience, les participants ont été en présence de deux types de médias :
1. Réalité Évoquée du Jeu (Media-ER, Audio-visuel et interactif) : Pour cette épreuve du jeu vidéo de survie et d'horreur appelé « Amnésia : The Dark Descent », nous avons choisi l'angle de la première personne ;
2. Réalité Narrative Évoquée (Media-ER, narration textuelle): Une courte histoire d'horreur en français intitulée «Boum Boum Boum» a été choisie pour cette épreuve. Il s'agit d'un récit de 3 pages à la première personne.

Dans les deux cas, les participants ont eu à expérimenter les médias dans les mêmes conditions. Le contexte d'expérimentation présentait un affichage de trois écrans accompagnés de casques pour l'expérience de jeu. Le centre de l'écran a été utilisé pour le récit, avec un texte en noir sur blanc (voir Figure 32 et Figure 33). Outre l'écran et le casque, les participants étaient munis d'un clavier et d'une souris pour l'interaction, des instructions pour le jeu et d'un oxymètre de pouls sans fil pour enregistrer les données physiologiques (fréquence cardiaque et respiration) (cf Figure 34). L'installation expérimentale a été conçue de telle manière que l'expérimentateur

a pu observer les réactions des participants pendant les expériences, sans être vu. Au cours des épreuves, toutes les lumières étaient éteintes, et seuls les écrans d'affichage étaient visibles pour les participants. Ainsi, nous avons pu suivre les réponses physiologiques en temps réel (cf Figure 35). La salle d'expérimentation a été utilisée pour les tâches principales et les participants répondaient aux questionnaires dans une autre salle (contiguë à la salle principale). Les participants ont entièrement subi l'expérience à l'intérieur de la chambre noire, de façon à minimiser les distractions visuelles et ils portaient un casque afin de réduire les distractions audio externes.

Les différentes étapes de la procédure expérimentale sont les suivantes :
Étape 1: Les participants ont été invités à répondre à des questionnaires avant que les épreuves ne commencent (en dehors de la salle d'expérimentation). Les questionnaires comprenaient : des informations générales, l'expérience de jeu et un questionnaire de tendances immersives (ITQ) (Witmer and Singer, 1998).

Pour la première épreuve (le jeu), il y avait 2 étapes dans le protocole d'expérimentation :
Étape 2: L'expérience de jeu dans la salle d'expérimentation. Les participants ont été invités à lire les instructions sur le jeu, pour bien comprendre les interactions possibles (cf Figure 36). L'oxymètre de pouls a été connecté à la main droite. Quand ils étaient prêts à commencer, ils ont été invités à porter le casque et les lumières se sont éteintes (cf Figure 37). Chaque fois qu'ils ont atteint un stade particulier dans le jeu, on leur a demandé d'arrêter.
Étape 3: Les participants ont été invités à répondre à des questionnaires : répartition/affectation de l'attention, questionnaire sur la présence (PQ) (Witmer and Singer, 1998), questionnaire Slater-Usoh-Steed (SUS) (Slater et al., 1994) et questionnaire sur la Réalité Évoquée (en dehors de la salle d'expérimentation).

Pour la deuxième épreuve (la nouvelle à lire) il y avait 2 étapes également :
Étape 4: L'expérience du récit dans la salle d'expérimentation. Les participants étaient dans la même configuration que l'épreuve de jeu, mais seul l'écran central était actif (il affichait le texte de la nouvelle). L'oxymètre de pouls a été connecté et ils portaient un casque pour réduire les bruits extérieurs. On leur a demandé de lire entièrement la nouvelle (de 3 pages).
Étape 5: Les participants ont été invités à répondre au questionnaire sur la Réalité Évoquée (en dehors de la salle d'expérimentation).

Les Participants : Pour chaque épreuve, il y avait 29 sujets (21 hommes et 8 femmes) à participer à l'expérience. D'après les informations que les participants nous ont fournies, nous avons répertorié 16 (55,2%) joueurs réguliers (qui jouent aux jeux vidéo 3 heures ou plus par semaine), 13 (44,8%) non-joueurs (qui jouent moins de 3 heures par semaine ou ne jouent pas du tout). Comme tous les participants étaient francophones, les dialogues du jeu, la nouvelle et tous les questionnaires étaient en français. Ils n'avaient aucune connaissance des objectifs principaux de notre étude, ils savaient seulement que l'expérience était liée aux médias.

Analyse et Synthèse des Résultats

Les questionnaires sur la ER nous ont aidés à étudier l'illusion de la Réalité Évoquée au travers d'un jeu vidéo et d'une nouvelle. Que ce soit dans le jeu ou la nouvelle, le questionnaire ER montre des résultats comparables pour l'Illusion Perceptive combinée. Il appuie notre argument

selon lequel les différents types de médias, y compris les récits, évoquent l'illusion de la réalité. Nous avons également observé que la Media-ER évoque non seulement l'illusion de l'espace, mais également l'illusion de temps. Cela renforce notre idée que la Réalité Évoquée est une illusion à la fois spatiale et temporelle de la réalité. L'analyse physiologique a montré que des niveaux plus élevés de l'immersion perceptive peuvent évoquer des niveaux plus élevés d'excitation, qui peuvent à leur tour affecter la présence. Cependant, même dans les médias d'immersion perceptive inférieure comme des récits, une Illusion Perceptive forte peut être évoquée en interne, ce qui, avec l'Illusion Psychologique de forte intensité, peut induire une Réalité Évoquée puissante.

Le fait que la présence soit une expérience extrêmement subjective a été relevé dans les réponses individuelles. Les deux questionnaires PQ et SUS ont donné des résultats comparables pour la présence globale, et montrent une corrélation positive entre les réponses de chaque individu. A l'aide de ces questionnaires de présence, la EP peut être représentée visuellement sur la Reality-Presence Map (La Carte Réalité-Présence) pour indiquer la position de la ER. Bien que ces questionnaires semblent utiles, ils sont destinés aux médias qui relèvent de catégories d'immersion supérieure, comme la réalité virtuelle. Ainsi, les techniques de mesure de la présence doivent être approfondies et conçues pour envisager différents types de médias.

Conclusion : Expérience 1

Nous avons développé trois questions principales de recherche, et nous avons pu y répondre avec nos expérimentations.
1. Oui, les médias ayant un faible niveau d'immersion (même une narration simple) peuvent induire une expérience de la Réalité Évoquée. Nous avons vu que, malgré l'absence d'immersion perceptive dans les médias comme les récits, il est possible d'induire une forte Illusion Perceptive interne. Ceci a été particulièrement visible dans les images qui étaient recréées à partir de la mémoire après que les sujets aient passé l'épreuve de la nouvelle. Il était intéressant de remarquer les similitudes dans la représentation visuelle et les éléments visuels, ce qui nous a donné une idée quant à leur expérience concernant l'Illusion Perceptive interne. Le contenu (de genre, de style, de détails, etc.) et le contexte (environnement physique, moment de la journée, intention, etc.) jouent un rôle très important dans ces médias à des niveaux inférieurs de l'immersion perceptive, afin d'évoquer de plus fortes Illusions Perceptives et Psychologiques. Il a également été observé que les Media-ER évoquaient une illusion d'espace et de temps, ce qui renforce notre idée que la Réalité Évoquée est une illusion spatio-temporelle de la réalité.

2. Les questionnaires sur la présence peuvent donner une idée simple sur la Présence Évoquée (EP) par un système qui peut être représenté visuellement sur la Reality-Presence Map (La Carte Réalité-Présence). Nous pouvons indiquer la position exacte de la ER en fonction du résultat obtenu de la présence, et observer à quelle distance elle se trouve par rapport à la réalité primaire. Si elle est proche du pôle extrême : la Réalité Simulée indique que le système est efficace en évoquant une illusion de la réalité forte. Mais les questionnaires sur la présence existants sont essentiellement destinés à la réalité virtuelle et aux médias qui lui sont associés. Par conséquent, il est nécessaire d'avoir recours à de meilleures techniques de mesure pouvant intégrer les expériences de la présence dans l'analyse de différents types de médias avec différents niveaux d'immersion. C'est la raison pour laquelle nous avons analysé les données physiologiques dans le cas du jeu et de la nouvelle.

3. Les changements physiologiques peuvent en effet nous aider à comparer la présence évoquée par différents types de Media-ER. Il n'était pas surprenant d'observer une augmentation de la fréquence cardiaque au cours de l'expérience de jeu. Le jeu, diffusé dans une pièce sombre, était très réaliste avec des graphismes en 3D troublants et le soutien audio. Il est intéressant de constater que, dans les mêmes conditions d'expérimentation, le récit du même genre (mais sans aucun accompagnement visuel ni audio) a évoqué une ER forte qui a été à l'origine d'une accélération du rythme cardiaque lors d'événements spécifiques dans l'histoire. Bien que les fréquences cardiaques élevées ne fussent pas comparables à celles de l'expérience de jeu, nous avons observé des déviations considérables par rapport à la fréquence cardiaque moyenne au repos. Les analyses de la ER et de l'Illusion Perceptive, évoquée pendant le jeu et la nouvelle vont également dans ce sens.

Significations et Perspectives

Chaque média évoque une illusion de la réalité, y compris ceux caractérisés par des formes plus faibles d'immersion perceptive. Il se trouve que beaucoup de chercheurs s'accordent là-dessus (Burch, 1979; Gerrig, 1993; Lombard and Ditton, 1997; Schubert and Crusius, 2002; Biocca, 2003; Buckner and Carroll, 2007). Mais nous avons été en mesure de remettre en cause le concept commun à certains chercheurs de la réalité virtuelle selon lequel la présence n'est possible que dans des formes supérieures de médias comme la RV. En outre, nous avons observé comment la Reality-Presence Map (La Carte Réalité-Présence) peut aider dans l'analyse de la présence et de la comparaison des médias par la représentation schématique de la ER et la EP. La détermination de la position de la ER peut aider différentes entreprises à décider de l'efficacité d'un média de communication ou d'un système de réalité virtuelle. À l'avenir, avec les améliorations technologiques, la ER dans les systèmes de réalité virtuelle va progressivement devenir de plus en plus proche de la Réalité Simulée. Par conséquent la Reality-Presence Map (La Carte Réalité-Présence) peut aider à étudier notre conscience et à réglementer ou à contrôler les niveaux d'expérience des médias pour différents groupes de personnes ayant tous types de problèmes cognitifs.

Ces expériences ont permis de valider certaines hypothèses sur la ER. Cependant, nous pensons qu'il est possible de pousser plus loin encore ces recherches si l'on veut mieux comprendre l'expérience des ER dans nos esprits. Comment pouvons-nous mesurer la présence dans les formes inférieures de médias (sans immersion visuelle ou audio, ni interactivité) comme les récits lus ou entendus ? On pourrait développer un questionnaire sur la présence générique ou d'autres techniques de mesure qui peuvent aider à comparer la présence dans les médias avec l'immersion inférieure et supérieure. Cela nécessite une étude plus approfondie, de nombreux tests et l'analyse des réponses. Les techniques de mesure comme la conductance de la peau ou l'EEG peuvent aider à définir la mesure de la présence sur des niveaux d'immersion différents. Par ailleurs, il n'existe actuellement aucune technique de mesure dédiée à la présence de la Self-ER bien qu'on trouve un travail de recherche énorme sur la compréhension de la Self-ER en général. C'est l'une des raisons pour lesquelles nous avons essayé quelques techniques objectives pour étudier la Self-ER (l'imagerie mentale en particulier) dans l'expérience-2.

4.2 EXPERIMENT 2: PRESENCE IN SELF-EVOKED REALITY

Presence in Self-ER is seldom well explored. To objectively study and demonstrate that presence can be experienced in Self-ER as well, an experiment on mental imagery was conducted (when no mediation was experienced). Studies on mental imagery already confirm that we can evoke objects and spaces in our minds intuitively without the help of any immediate external mediation whatsoever and even interact with them temporally. In this experiment, verbal expressions, physical movements and gestures were studied, that were exhibited during mental imagery experiences of different subjects in two scenarios - a guiding task and a mental walk exercise. A 'protocol analysis' was performed followed by analysis of time taken and mapping of the physical movements during the mental imagery experience. The results of the experiments evidently point to this spatio-temporal phenomenon of experiencing presence. It also helped us understand how the sense of presence in mental imagery is strongly comparable to the strong sense of presence evoked in virtual reality. This experiment was conducted under the guidance of Prof. Uday Athavankar of IIT Bombay, India.

4.2.1 Background

It is obvious that the easiest way to examine mental imagery is through 'introspection'. But research on mental imagery required objective methods of analysis to support its evidence. It indeed took many years for researchers to come up with a method, which Kosslyn (1980) called 'the quantification of introspection'. This method attempted to externalize mental events and tried to detect and measure the behavioural consequences, often in terms of performance time of internal processing. One of the best examples in this direction was Shepard and Metzler's (1971) experiment on the mental rotation of geometric shapes. Presently mental imagery is studied extensively, through various methods of externalization of mental activities. One such method is protocol analysis with the help of thinking aloud process where the externalization is through real time verbal expressions and associated physical gestures and movements.

This attempt was to study the sense of presence in mental imagery. To begin with, Athavankar et al. (2008) had earlier found the evidence of a sense of presence in mental imagery in the experiments conducted with blindfolded architects. Although the objectives of these experiments were to explore design possibilities, the evidence of presence in the self-evoked space was very clear (Athavankar et al., 2000; Athavankar and Mukherjee, 2003; Athavankar et al., 2008). It was observed that, even though the architects used different strategies as part of their design process, they remained immersed in the (simultaneously being designed) mentally evoked spaces. They acted in the mental space with certain similarities corresponding to the physical world. Those experiments on blindfolded architects also became a motivation for this experiment, to study how people experienced mental imagery (in a non-design situation), with their sense of presence as our primary focus. In this experiment, light is thrown on the experience of presence in voluntarily evoked mental imagery in particular.

4.2.2 Analyzing Presence

As mentioned earlier, analysing and measuring the sense of presence is still an on-going debate, in the field of virtual reality (Slater, 2003; 2009). With respect to Media-ER, different questionnaires have been proposed in order to break down this subjective experience into parameters that can be evaluated objectively (Witmer and Singer, 1998; Slater, 1999; Slater et al., 2003). However, when it comes to mental imagery, the analysis has always been through introspection. With growing interests in the field of mental imagery, experiments were devised to study the properties of mental processes objectively through behaviour analysis (Austin and Delaney, 1998) or the process of thinking aloud (Ericsson and Simon, 1980; 1987). In this experiment a verbal descriptive task was chosen, thus ensuring availability of protocols and later used 'protocol analysis' as the objective method of evaluation. Its effectiveness has already been seen in previous experiments conducted on designers and architects (Suwa and Tversky, 1997; Suwa et al., 1998).

Studies show that although mental transformations could involve the visual system, the operations may perhaps be guided by inputs from the motor system as well [certainly in some situations, according to Zacks (2008)], and thus it may not be difficult to convert them into corresponding physical movements (Kosslyn, 1994; Annett, 1995; Wohlschläger, 1998). Findings from the neuro-physiological experiments that monitored the neural activity in the parietal cortex also suggest that mental transformations may be preceded by motor intentions ahead of the actual transformations (Reisberg and Logie, 1993).

According to Athavankar (1999), the gestures give an impression of naturally complementing the architect's development and manifestation of the spatial ideas in the mind and the production of these gestures do not need any overt attention. Study of gestures and movements along with verbal transcriptions took protocol analysis method one step further, helping in the efficient mapping of various elements of mentally evoked spaces (Athavankar et al., 2008).

4.2.3 Research Questions

The two main questions that were addressed in this experiment are:

1. Does one experience a 'sense of presence' in mental imagery?
2. Can this sense of presence be objectively identified by analysing verbal expressions, gestures and movements?

The experiment concentrated particularly on imagery spaces evoked from memory, i.e. without involving design requirements (since the sense of presence in imagery that is continuously being designed is rather evident in previous blindfolded architects' experiments). While answering these questions through protocol analysis, few additional objective methods to study presence are also put forward. Time-distance correlations and mapping of physical movements were used to explore the externalized aspects of mental imagery in order to effectively confirm the mental activities and the associated sense of presence (which will be explained in **4.2.5** below).

4.2.4 Experimental Procedure

Problem Statement

At first it seemed simple, that we could induce the sense of presence in the participants' minds by making them imagine spaces mentally. But as it is an introspective process, to objectively study its properties, the experiment had to be designed appropriately. We chose to have two scenarios for the experiments - direct and indirect tasks. The indirect task was designed to observe how one would involuntarily place himself/herself in the mental imagery space and interact with it, in order to perform a mental task. Although the direct task automatically made the participants experience mental imagery spaces from their own perspective, it was designed in order to explore further the properties of their sense of presence.

Mental task

As we were interested in presence in particular, we chose tasks that would not necessarily require creativity or design thinking. So we decided on 'way finding' as the means of indirectly studying presence. It did not impose additional mental load on the participants and they could rely principally on their long term memory. The tasks were defined as follows:

Experiment Scenario-1 - Guiding Task: "Your friend is at IDC Entrance, and you are at Nescafe stall. Guide him on phone to reach Nescafe stall."
The participants were asked to guide a friend verbally on mobile phone, from point A to B, while they were themselves at point B. The locations of IDC (commonly used abbreviation of Industrial Design Centre of IIT Bombay) and Nescafe stall were well known to the participants, which were point A and B respectively.

Experiment Scenario-2 - Mental Walk: "Imagine that you are at the IDC entrance, and you have to reach Nescafe stall. You have to think aloud your experience while doing so."
Each participant was asked to think aloud during the second scenario.

In both cases the subjects were blindfolded in order to completely depend on their mental imagery and have minimum interference from external perception during the mental tasks. In both cases they were physically in the experiment hall and had enough space to move around. To be more objective the order of the two tasks were alternatively changed with each subsequent participant.

Experimental Setup

For both the scenarios, there were mainly 3 stages in the experiment process:
Stage 1: The task was given to the participant in writing. They were asked to recall the task once, just before the experiment started.
Stage 2: In the hall, they were given the freedom to choose where to stand and to orient themselves however they preferred to, before starting the experiment. As soon as they did so, they were blindfolded.
Stage 3: They were cued to begin the task. From beginning to the end of the task, Stage 3 session was recorded on video for transcription of verbal expressions and study of gestures and movements.

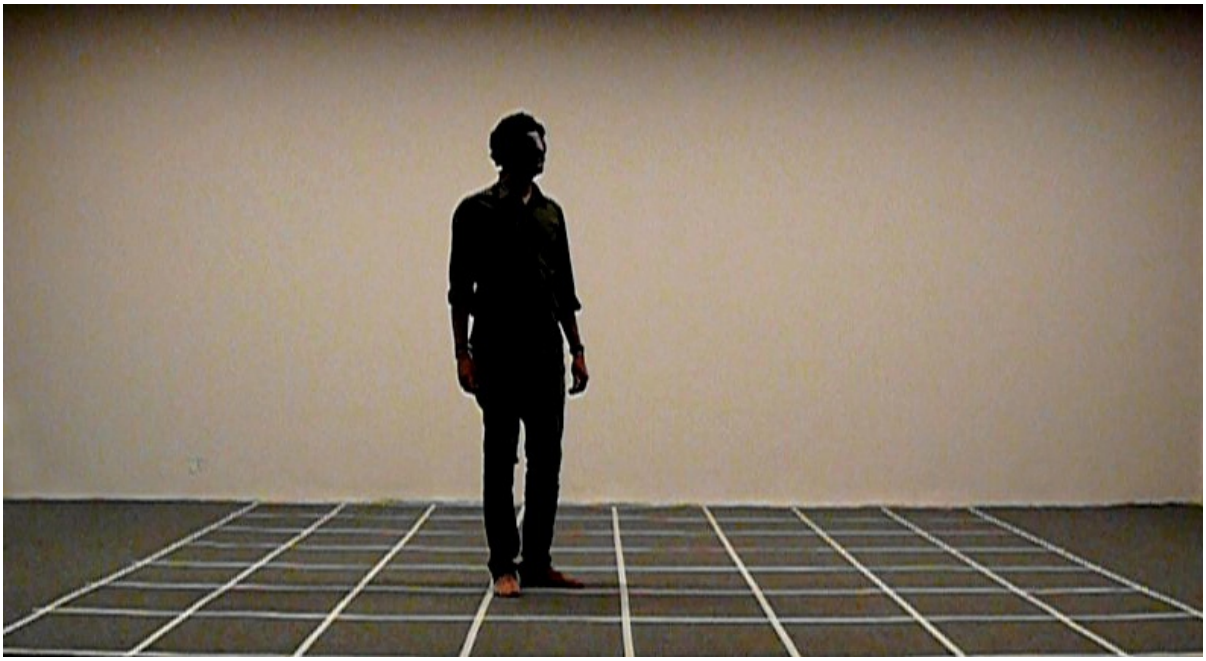


Figure 53: Experimental Setup - Blindfolded subject on the grid floor of the experiment hall [source: author]

Apart from blindfolding them to cut off external visual perception, the hall chosen for the experiment was also sound proof to allow them to better focus on their mental activities. Athavankar et al. (2000) showed that allowing physical movement provided comprehensive data for comparative analysis and helped towards better insight into the mental processes of the blindfolded subjects. Before the task the subjects were given the choice to orient themselves however they wanted and to choose a point to stand. In case they preferred to move around during the experiment (Scenario-2), the floor was marked with grids of 50cm by 50cm size, to map their physical movements (**Figure 53**). After Stage 3, informal post-experiment discussions also took place, which in fact helped us clarify certain aspects of their mental imagery experiences. Although such clarifications are introspective and subjective, they were used only to compare the remarks with what we could objectively deduct from the transcripts and videos.

Subjects

For each task, there were eight subjects (five male and three female) who participated in the experiment. All the participants had a fair knowledge of the locations mentioned in the tasks and had often been using the given route. So the route they took was already available in their memory to be spontaneously evoked in the mind. They had no knowledge of the primary objectives of our study and only knew that the experiments were regarding mental imagery.

Protocol Analysis

Protocol analysis has now come to be an effective method of analysis through transcription of verbal data. As its effectiveness is evident in various experiments relating to mental imagery and blindfolded architects experiments, we considered it for our primary method of analysis. As we had an indirect scenario for assessment of presence, we believed that the contents of the protocols (from the externalised think aloud data) would help us decode the various elements they encountered during the imagery experience. From the recorded videos (Stage 3 sessions),

data was later transcribed and logged in excel sheets for analysis. The information was organized in a tabular form under - Timestamp, Transcripts (Verbal Data), Gestures and Movements (Physical Data). Part samples can be seen in Table.2 and 4 in section 4. In the case of both Scenario-1 and 2, the transcriptions led us to two major information categories - 'Verbal Expressions' and 'Physical Expressions'. These two categories together helped us map the elements of the mental space.

Mapping the Mental Space

While verbal data provided direct information on various aspects such as self-positioning and evoked space in the mental imagery of the subjects, physical movements and gestures helped us in comparing and analysing those. The role of movements and gestures in understanding thinking processes is clearly demonstrated in Athavankar (1999). In the case of Scenario-2, the grids on the floor helped us plot outlines of the physical movements made by the participants with respect to their mental movements. In the case of Scenario-1, as there were no (or inconsiderable) physical changes in positions we had to rely on verbal data and gestures (with orientation) for the analysis. The verbalization was found to be selective as the tasks were movement based and time bound. So apart from comparison, movements and gestures either confirmed what was described or gave clues to additional information which was not evident in the verbal data. Especially aspects like orientation, point of view and self-positioning in the mental imagery became simpler to study though corresponding physical movements and gestures.

4.2.5 Results and Analysis

4.2.5.1 Scenario-1: Guiding Task

Protocol Analysis

As mentioned earlier, based on the analysis method the protocols were classified into two main information categories - 'Verbal Expressions' and 'Physical Expressions'. Both were transcribed from the videos so as to analyse them with their simultaneity in time. Verbal Expressions were divided into the sub categories - Body and External Space. Physical Expressions were divided into the sub categories - Orientation and Gestures. The sub categories were further broken down into different codes (denoting various elements of mental imagery), which would help us point towards the sense of spatial presence. The information categories, sub categories, codes and the examples found in the protocols that led to different elements of mental imagery can be seen on **Table 4**.

Information Categories (Scenario-1)			
Analysis Method	Sub Category	Codes (Elements of Mental Imagery)	Examples of phrases in protocols as evidence
Verbal Expressions	Body	Position	"You are at the", "you are facing", "you come to"
		Action	"cross the", "keep following", "cut through"

		Direction	"straight up ahead" "ahead of you"
		Orientation	"just turn left", "take a right",
	External Space	Distance	"a little descend", "flight of four steps"
		Specific Location / Space / Building	"P.C. Saxena auditorium", "Victor Menezes centre"
		Elements / Things	"building", "an arch", "walkway", "trees"
		Relative position of elements with respect to other elements	"below the pavement", "adjacent to", "beside you", "above it", "on your right hand side"
		Properties	"narrow path", "kacha path", "parallel roads", "array of trees"
		Visual Sense	"you'll see", "you find", "can you see me?"
Physical Expressions	Orientation	Rotation / Orientation with respect to cognitive map	Left hand points to the left direction | Both hands point right showing the turn| Head turns slightly to the left | Moves left hand to indicate left turn
	Gestures	Self-Position	Right hands points to front twice when saying "further" | Both hands point front down, when suggesting "at the entrance" | Although hands crossed, right hand moves to point down twice when saying "on the entrance"
		Relative position of elements with respect to self-position	Left hand points to the left when saying "auditorium" | Both hands show the shape of an arch above the head | Thumbs point to right and left
		Shapes and forms of elements	Both hands show the shape of a circle when saying "tree" | Right hand has a sloping down gesture | Both hands make the shape similar to a sloping roof.
		Direction	Both hands stretch pointing front but are close together when saying 'between" | Both hands point front twice when saying "further" | Hands move in a curved manner.

Table 4: Information categories, sub categories and examples in protocols for Scenario-1 **[source: author]**

In the case of Scenario-1, verbal data was comparatively difficult to be analysed, as the sense of presence was to be detected indirectly. Although certain aspects of verbal data provided direct references to the locations and movements in the imagery, it was initially unclear how they perceived it in the mind's eye. But as we started studying gestures simultaneously with verbal data, the way they positioned themselves in the mental imagery became clearer to us. Mainly two strategies were observed in guiding techniques:

- The participant guided the friend in real time, through every point between starting and the ending locations;
- The participant guided the friend such that after his guidance, the friend would take that route.

Indication of Presence

The Scenario-1 was indeed more thought provoking, as even a simple task like guiding a person led to indication of presence in mental imagery space. As the task was to help another person, the pronouns used throughout were in second person singular - 'you'. However by carefully analyzing the gestures and upper body movements with respect to verbal data, we found that the (guiding) participants naturally put themselves in the (guided) friend's perspective. For instance we can see in **Table 5** that the participant says "So after you turn left you... have to turn right, you have...". Although he uses the term 'you' as addressing to another person, the corresponding gestures clearly indicate his mental position and orientation. This was detected prominently when turns were to be decided, as orientation became simpler by doing so. This experience was also confirmed from the post experiment discussions with the participants.

Initial orientation was their first concern, so that they established a reference point for the friend to begin. When they asked the friend to orient, gesture analysis showed that they mentally oriented themselves from the friend's perspective at the starting point (even though the task given had placed the participant at the end point).

Since the task was to guide, there were constant references to landmarks in the verbal data with comparatively less number of detailed references to objects that would have appeared on the route. Although they did not physically move, it was noticed that whenever they reached a point where a turn was required, their hand gestures or head movements indicated the direction. And after they took the turn their point of view intuitively took that direction in such a way that the same direction which was few seconds ago to their left or right, became straight ahead. It shows that the spatial imagery was constantly updating in order to give the illusion of movement. While they did not take steps to physically move, the imagery was moving (towards them) and rotating accordingly (similar to a first-person video game view, or a virtual reality CAVE system with joystick for movement controls).

Another interesting aspect was the involuntary shifting of perspective. Some participants remembered that in the task they are standing at the end point, while some forgot about it in the process. Those participants who remembered that, mentioned about it when their friend reached the end location. For instance, one of the participants who guided his friend in real-time, instantaneously shifted his point of view from the friends position to his supposed position, the moment his friend reached the end point. As we can see in **Table 5**, it is clear that till 00:03:42 all his hand gestures corresponded to the friend's point of view and the next moment they switched indicating a point of view exactly opposite to the previous one. It illustrates how one's spatial presence in mental imagery could shift swiftly the point of view, corresponding to task at hand.

Timestamp	Transcripts (Verbal Data)	Gestures and Movements (Physical Data)
00:03:34	So after you turn left you...	Left hand points to the left.
00:03:35		
00:03:36	have to turn right, you have… ten steps ahead of you… you just turn right…	Right hand points to the right, then front, and then right again.
00:03:37		
00:03:38		
00:03:39		

00:03:40		
00:03:41	and you will see this Nescafe…	Both hands make the shape similar to a sloping roof.
00:03:42		
00:03:43	probably I'll be there waving my hand, can you see me?	Waves right hand. Chin lifts up a little.
00:03:44		
00:03:45		
00:03:46	OK	Hands make a 'calling towards' action.
00:03:47	great, great come.	

Table 5: Section of protocols of Participant-1 in Scenario-1, showing the shift in point of view [source: author]

Time and Distance

In addition to studying the protocols, we looked into the time taken by the participants for different segments of the mental task. We compared the time taken by them, to the average time that one would take to walk (at constant speed) from the starting location to the final location in the real world scenario. To analyse the time intervals, two main intermediate landmark points were identified (from the protocols) depending on the locations that every participant had mentioned.

It was interesting to find (as we can see in **Figure 54**) that the time taken by them to mentally go through each part of the route correlated with the average real world time. To confirm this, we compared their speed of mental movement at the relevant intervals. The graph in **Figure 55** shows their speed, with the value of speed in the real world as 1. From the protocols, it was clear that the guiding technique affected the time correspondingly. For instance, wherever the mental speed seems to have slowed down (or the time intervals seemed longer), the transcripts showed that the verbal externalization was more at those points. However, this helped us conclude that there was in fact a positive correlation between the time and the distance taken mentally to reach from one point to another. Although all the participants moved faster than the average real world speed, depending on the amount of verbal data, the time intervals seem consistent with the intervals in average real world time (Pearson correlation coefficient between average time taken to reach the landmarks during Physical Walk and Guiding Task $r = 0.999$, $p = 0.010$).

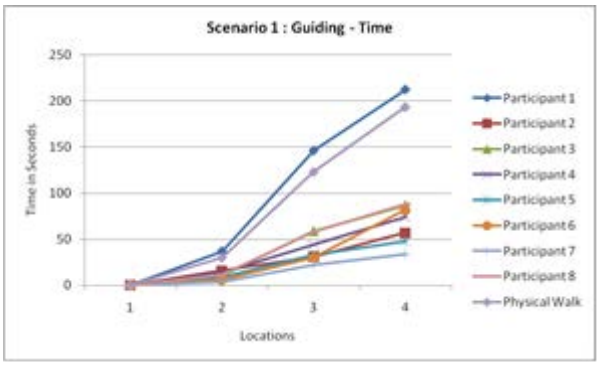


Figure 54: Graph showing the time taken to reach the locations mentally (Scenario-1) compared to the average time of walk in the real world scenario [source: author]

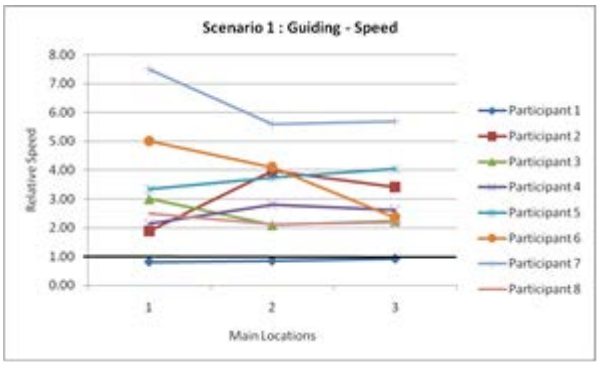


Figure 55: Graph showing the relative speed at 3 locations in mental imagery (Scenario-1) compared to average speed of walk in the real world scenario (taken as 1) [source: author]

Orientation Strategies

When the verbal expressions and the physical movements were correlated, two strategies seemed to emerge. The participants performed:

- Mental movement with physical orientation;
- Mental movement without physical orientation.

At times the participants naturally oriented themselves while imagining turns or pointing to landmarks on their sides, while other times they did not move at all. They constantly shifted between the two strategies. In both cases the gestures were very helpful in unravelling where they were at a particular point of time. In some participants, there was hesitation in the use of gestures at the beginning of the experiment. But as they became involved in the mental process, gestures came out naturally. It was interesting to note that the participants who did not move, or resisted in performing any hand gestures, unknowingly moved their upper body, or just their head in different ways. These subtle movements also helped us detect where they were present in the mental space during that time. This supports the views of Kosslyn (1994) and Reisberg and Logie (1993) that the mental transformations may be preceded or guided by the motor system.

4.2.5.2 Scenario-2: Mental Walk

Protocol Analysis

In this case, the main analysis methods remained same, while some subcategories differed. Verbal Expressions were categorised into - Body (Self) and External Space. Physical Expressions were categorised into - Movement, Orientation and Gestures. The sub categories were again broken down into different codes representing the elements of mental imagery. The information categories, sub categories, codes and the examples from the protocols can be seen on **Table 6**.

Information Categories (Scenario-2)			
Analysis Method	Sub Category	Codes (Elements of Mental Imagery)	Examples of phrases in protocols as evidence
Verbal Expressions	Body (Self)	Position	"I am", "up ahead", "to my left", "I reach", "onto my right"
		Action	"getting down", "moving", "cut across", "walking", "I take the", "I use the"
		Direction	"towards the", "through the", "along the"
		Orientation	"facing the", "I take the left", "taking my right turn"
	External Space	Distance	"Near", "twenty meters", "a foot of steps", "about some, one metre"
		Specific Location / Space / Building	"Echo Point", "Saxena Hall", "junction", "building"
		Elements / Things	"pine trees", "ramp", "pavement", "bull", "cow dung", "chains"
		Relative position of elements with respect to other elements	"inside the", "corridor in front of the seminar hall", "trees on either side"

		Properties	"a huge tree", "Concrete road", "beautiful road", "greenery"
		Visual Sense	"I see", "admiring the clouds"
		Other Senses	"loud music", "echo comes"
Physical Expressions	Movement	Location	Takes two to three steps further | Moves a little to the left
		Direction of movement	Takes few steps ahead | Walks few steps, straight | Walks few steps, in a curved path
	Orientation	Rotation / Orientation with respect to cognitive map	Takes a left turn | Turns right Slowly turns right without mentioning about it
	Gestures	Self-Position	hands point down | Both palms open pointing what's in front.
		Relative position of elements with respect to self-position	Left hand points to the left when saying "from P.C. Saxena" Left hand points to the left when saying "auditorium"
		Shapes and forms of elements	Both hands stretched out, above the head, indicate the shape of an arch.
		Direction	Left hand indicates a left turn | Both hands point forward Slight rotation of head in the roll axis towards the right. Rotation of head in the roll axis towards the left indicating the "left" edge.

Table 6: Information categories, sub categories and examples in protocols for Scenario-2 [source: author]

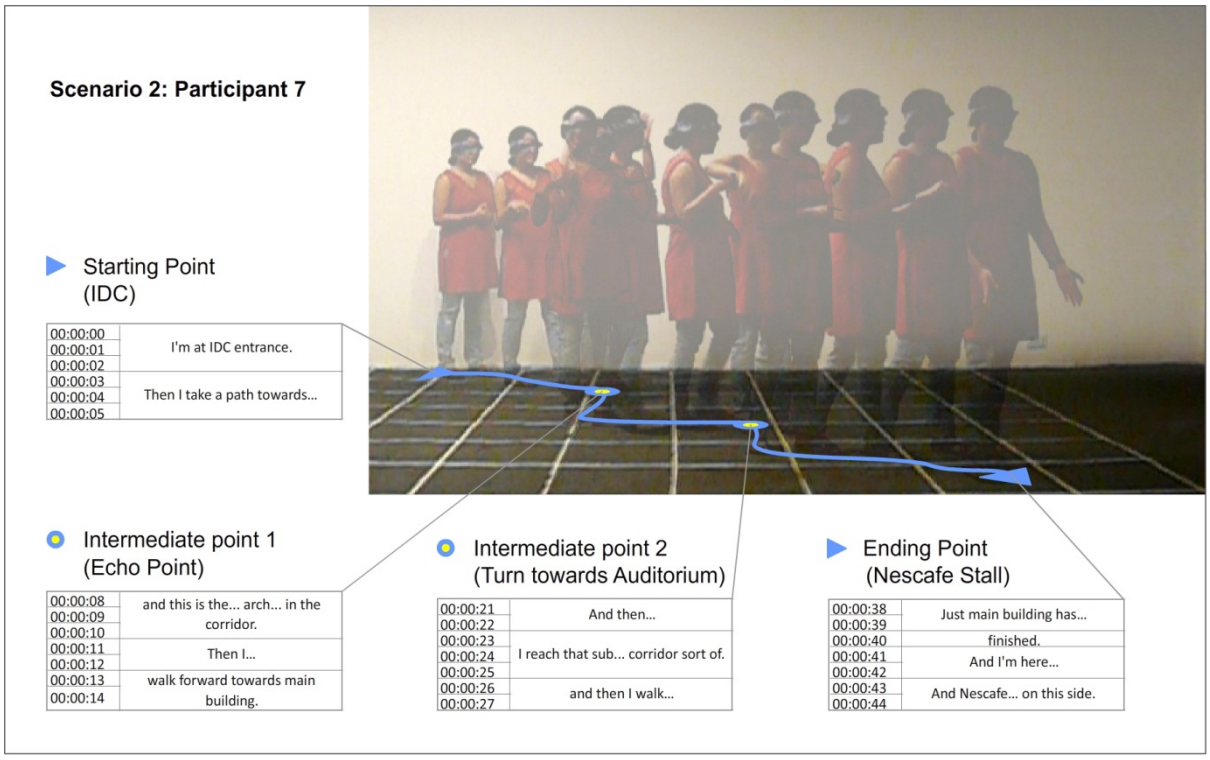


Figure 56: Example showing how the physical movements of Participant-7 (in Scenario-2) were mapped with the help of transcripts and the floor grid [source: author]

It was easier to analyse presence in this case, as the participants naturally evoked the mental space to be experienced from their own perspective. The idea was to explore further the sense of presence, and thus this scenario seemed relevant. We found that while the participants moved in the mental space, their corresponding physical movements occurred naturally. We believe that physical movements may have in fact helped them to navigate in the mental space better and with ease of orientation. An example of how these physical movements corresponding to the mental walk were mapped with the help of transcripts can be seen in **Figure 56** below. Here we can also see how the four major points (starting, intermediate1, intermediate2 and ending points) were identified and marked on the route map.

Indication of Presence

In this scenario, it was rather simpler to study presence as the mental task given was quite direct. As the task was to think aloud one's own experience, it was natural that the verbal expressions were in first person singular - 'I am', 'my left', 'ahead of me' etc (and very occasionally generalizing it in first person plural - 'we' or second person singular - 'you'). Before the experiment started almost all the participants wanted to orient themselves in certain directions. They knew that they will be blindfolded and will have no idea of their physical distances once the experiment starts. So, before beginning some of them chose to stand at the end corners of the grid floor mentally calculating a quick vague path. Their movement strategies in this scenario will be discussed later.

As they thought aloud their experience, many additional interesting elements were noticed which did not turn up in the first scenario. For instance two out of the eight participants imagined sounds in addition to visual imagery. On evaluation we could see that auditory imagery was a result of certain events that participants had previously experienced in their everyday life, which were well embedded in the memory. Thus the auditory elements too contributed to their sense of presence in mental imagery, although very specific to the individual participants. At times the mental walk and the physical walk were so linked that certain imagery details were involuntarily omitted in the verbal data, but were noticeable in the physical movements. So gestures and movements played a great role in catching those missing details. A simple example can be seen in **Table 7**.

Timestamp	Transcripts (Verbal Data)	Gestures and Movements (Physical Data)
00:01:44	Keep walking and then suddenly you see…	Slowly turns right without mentioning about it.
00:01:45		
00:01:46	this whole loud music… coming from the P.C. Saxena [auditorium]…	Left hand points to the left, when saying "from the P.C. Saxena"
00:01:47		
00:01:48		

Table 7: Section of protocols of Participant-3 in Scenario-2, showing how gestures and movements complimented the missing verbal data [source: author]
(Here the verbal data lacked information on the turn, the direction of the turn and the location of a building, but were deciphered by analysing gestures and movements).

Time and Distance

On exploring the time aspects, this case also showed considerable correlations with time that one would take in a real situation. As we can see in **Figure 57**, all the participants performed the task faster than the average time to walk in the real world scenario. Although the time taken was shorter than actual walk, it shows considerable correlations (Pearson correlation coefficient between average time taken to reach the landmarks during Physical Walk and Mental Walk $r = 0.997$, $p = 0.045$), which can as well be observed from their relative speed at different landmark points (**Figure 58**). Similar to the previous experiment scenario (guiding task), it was noticed that the time intervals were longer when more verbal details were reported. Although it might also show that the time intervals were affected by the ability of the participants to put those details into right words while thinking aloud. This factor was quite consistently reflected in the time taken to think aloud by each participant, in both cases - Guiding Task and Mental Walk ($r = 0.541$, $p = 0.166$). It was clear that their spatial attention was very much selective and task related and irrelevant details were often not evoked at all. Moreover, we already found that in order to maintain the speed of the mental movement and the corresponding physical movements, they at times omitted verbal details (even a simple right or a left turn). Thus there were certainly details that were in fact experienced in the mental imagery space, but weren't verbally externalized due to their respective speeds. However, in this scenario, several of those details were often noticeably reflected in the associated physical movements.

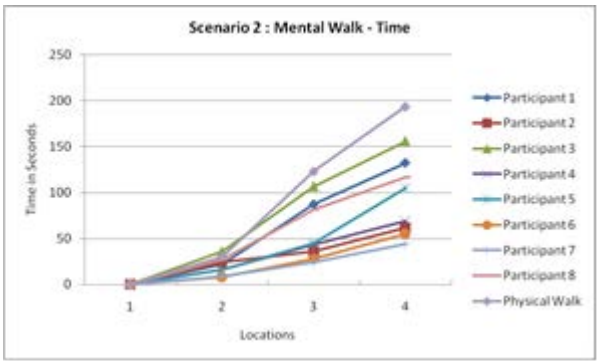


Figure 57: Graph showing the time taken to reach the locations mentally (Scenario-2) compared to the average time of walk in the real world scenario [source: author]

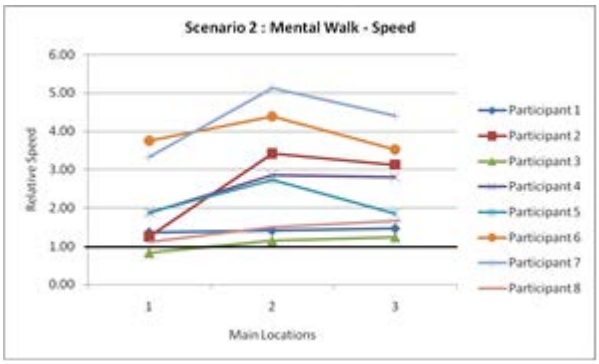


Figure 58: Graph showing the relative speed at 3 locations in mental imagery (Scenario-2) compared to average speed of walk in the real world scenario (taken as 1) [source: author]

Movement and Orientation Strategies

Even though it was a closed hall and was devoid of any clues of the location in the experiment task, most of them tried to physically orient themselves with what they thought would be the actual orientation. Participants who wished to move around chose to stand at one end of the grid floor, so that they have enough space to do so. During the task, almost all the participants moved physically, corresponding to their mental walk. Although a few did not intend to, they ended up taking few steps at times as there was enough space to move around. There was also one participant who did not move at all, but his upper body and head movements often indicated directions and few properties of his mental space. **Figure 59** shows the physical movements of all the participants mapped on the floor grid of the experiment hall.

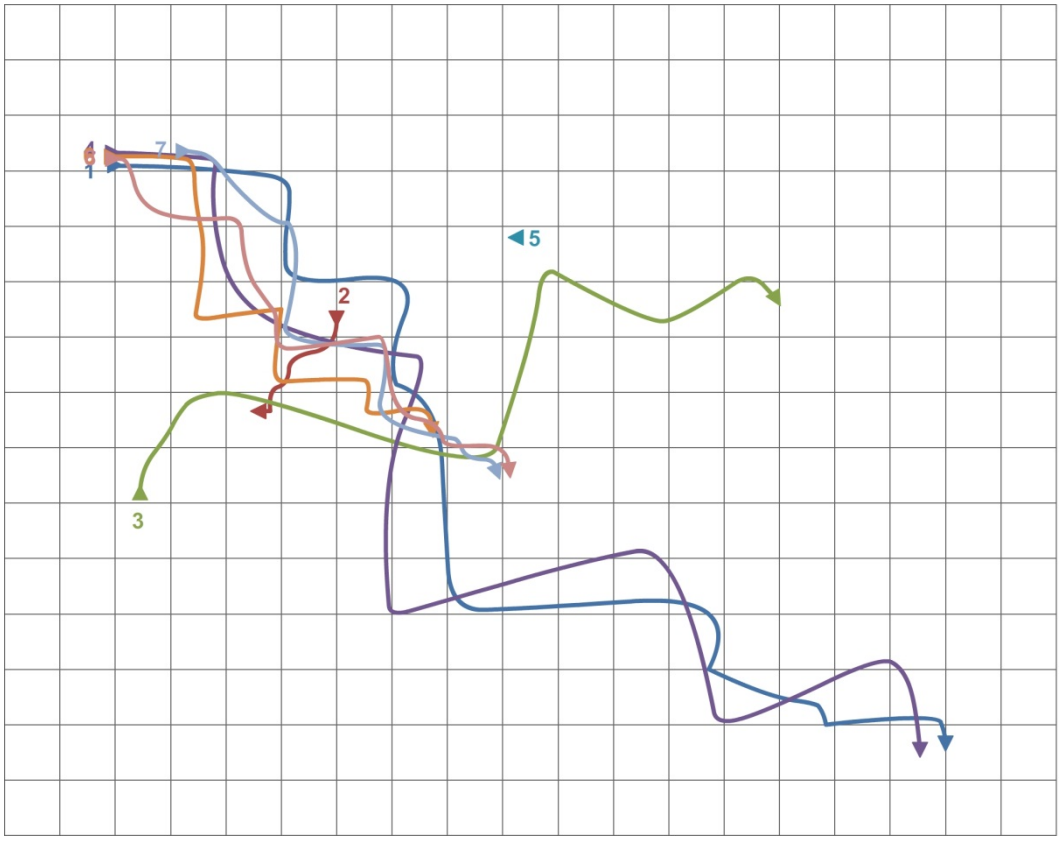


Figure 59: Physical movements of the participants in relation to their mental walk [source: author]

So, in this case of mental walk scenario, three strategies seemed to evolve:

- Mental movement with corresponding physical movement and orientation;
- Mental movement with partial physical movement or orientation;
- Mental movement without any physical movement or orientation (although with faint upper body responses)

One participant (Participant-5) adopted the third strategy and was consistent about it. The rest of the participants seemed to adopt the first strategy quite consistently from the beginning to the end. But on close observation we noticed that they shifted at times between first and second strategies. Out of the rest seven participants, three of them (Participant-1, 7 and 8) were fairly consistent in both movement and detailed orientation (thus consistent to the first strategy but rarely shifting to second strategy). The rest four of them although seemed to use first strategy, only the major movements and orientations were performed (thus consistently shifting between first and second strategy).

To study the physical movements corresponding to the mental task, we plotted them on a graph. **Figure 60** shows the actual path that one would take from point A (IDC) to point B (Nescafe). In **Figure 61** we can see the physical movements of each participant with respect to their mental walk (please note that the physical movements plotted on the grid floor were in fact extremely disordered with different initial orientations, however in the figure they are arranged according to their initial orientations facing the same direction to make it comprehensible for studying).

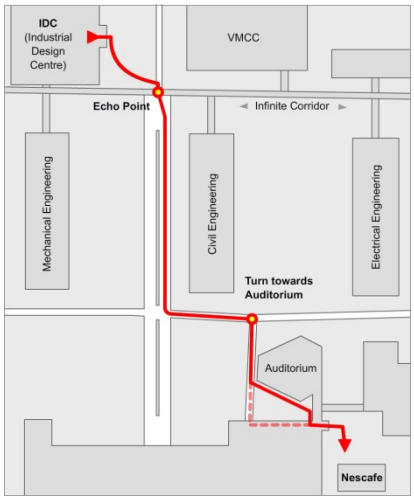


Figure 60: Map showing the path that one would take from point A (IDC) to reach point B (Nescafe stall) and the two main landmark points [source: author]

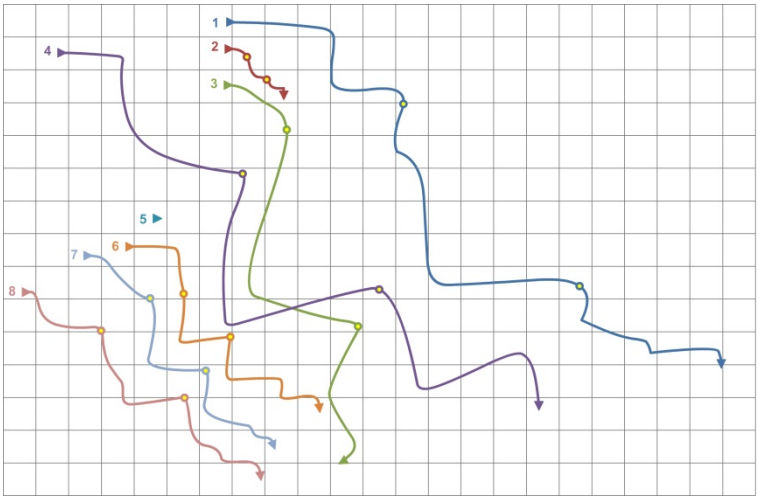


Figure 61: Physical movements of the participants in relation to their mental walk (arranged according to the initial orientation) and their respective positions of the two intermediate landmark points [source: author]

The intermediate points were also plotted with reference to the protocols. We can clearly see correlations in the movements of participants. Although the scales of their movements differ notably, we can't deny their remarkable similarity with the actual path. As the experiment was related to way finding, this plotting of movements turned out to be an excellent approach to efficiently mapping and thus confirming to an extent the mental path they took during the task.

4.2.6 Inferences

4.2.6.1 Summary of Results

Analysing Protocols

Transcripts of verbal data provided rich information to be decoded, for the mental imagery to be analysed. When analysis combined the information of gestures and movements, the protocols made more sense and the properties of mental imagery (as seen above) became remarkably clearer. Especially in the first indirect scenario, even though the participants used second person singular expressions, we could observe how they experienced the imagery from their perspectives and mentally where they were positioned or how they oriented themselves.

Analysing Time

When time intervals were analysed, it showed positive correlations between the mental events and real events. For the comparison of time, average time to walk from point A to B was calculated. The time intervals depended on the distance they travelled mentally and were proportional to time intervals in a real situation. As discussed earlier, the time taken was surely influenced by the details that were evoked during the mental events. It was evident from the fact that when the verbal data contained more details their speed of movement was reduced. But this difference on speed of mental movement might also have been affected by the ability of the person to put them into words during the think aloud process. It was found that so as to maintain the task related speed certain details of the imagery space were occasionally omitted as well.

Mapping Movements

Although to experience mental imagery one need not make any physical movements, we provided the participants with the opportunity to move if they preferred to. It turned out that the physical movements came intuitively with respect to mental imagery without affecting the imagery experience. It was noticed that when one moved in mental space without moving physically, it still triggered certain subtle movements in the upper body and head. In most cases the physical movements helped in the efficient orientation in the mental space. Plotting these movements corresponding to the mental walk confirmed the genuineness of the path mentally taken by them. It also provided insight into different orientation and movement strategies.

Along with visual imagery, hints of audio in imagery were also detected in certain participants at very specific points during their mental walk (Scenario-2). Even the directions from which the sounds originated were observed. In the previous experiments on blindfold architects (Athavankar et al., 2008), we noticed that although their mental imagery space was constantly being designed and modified, they remained immersed and thus experienced a sense of presence there. As in our experiments we concentrated on presence in particular (in voluntarily evoked imagery), we could confirm that this sense of presence in mental imagery is in fact an involuntary experience.

4.2.6.2 Signs of Presence in Mental Imagery

If we find similarities in an experience of evoked reality (in virtual reality or mental imagery) with the real world experiences, we are certainly experiencing a sense of presence. The concept of self, being in a place, is the first step towards the signs of evidence of presence (the subsequent steps being the vividness of experience, levels of presence, spatial attention characteristics, multisensory experiences, etc). The illusion of perceiving a spatio-temporal reality (as space and time) validates presence. From our experiments in this study we can definitely observe various signs of this experience, of sense of presence in mental imagery.

Every participant expressed a sense of moving in a mentally evoked space for a certain amount of time. Similar to the phenomenon of visual selective attention in a real world scenario (Duncan, 1984; Koch and Ullman, 1985; Freiwald and Kanwisher, 2004), the elements of mental imagery spaces were selective as well and this played a major role in their subjective experiences. Kosslyn's (1980) works show that maintaining images and their details is an active process and imposes mental load. That explains why imagery is selective when it comes to evoking space around oneself. The mental load was balanced by evoking only the relevant details required for the task. For instance, there is a very noticeable yellow coloured pencil like sculpture that one normally finds on the route. On post-facto inquiry, almost all of them admitted that they never even saw it during the mental task. But they sometimes evoked extremely non task-related elements as well, as they were well set in their memory. Some of these unspoken details were also identified during the retrospective sessions, when the participants admitted to seeing certain specific elements in the mental imagery space.

Similarities with Presence in Virtual Reality (or Media-Evoked Reality)

The evoked sense of presence in mental imagery clearly showed much resemblance with the experience of presence in virtual reality and associated media. Here we provide a comprehensible account of the comparisons between presence in mental imagery and media

experiences. To begin with, there was a sense of 'diegetic effect' in the mental imagery experience, similar to the scenario whereby spectators experience (in film or narrative literature) the 'diegetic' world through recounting of events in the words of a narrator (Burch, 1979; Schubert and Crusius, 2002). In this study, this was brought about especially due to the think aloud method of the experiments.

After the experiments it was intriguing to note that the participants referred to the mental imagery space as a place they just visited and the mental events as something that happened a few minutes before ("when I was at that road..., I saw on the left..."), which also strongly implied their experience of presence. It is similar to the case of post-virtual reality (or post-media) experience of the sense of 'being there' in a place depicted by the medium (Reeves, 1991; Slater et al., 1994; Barfield et al., 1995; Slater and Steed, 2000).

There was also the element of 'suspension of disbelief', that normally occurs among the users of virtual reality systems, by which they believe that they are in a world other than where their real bodies are located (Slater and Usoh, 1993; Lombard and Ditton, 1997). This helped the participants move and interact well with the mental imagery environment, although they knew on a sub-conscious plane that they were actually in the experiment hall.

Our ability to project our point of view into another person at another location was observed especially in the first experiment scenario. Buckner and Carroll (2007) identified four related forms of self-projection (with respect to episodic memory, navigation, theory of mind and prospection) and suggested that they may share a common functional anatomy. They illustrated how the phenomenon of self-projection relies on a personal mental simulation of another time, place or perspective. This attribute is comparable to one of the primary characteristics of a virtual reality illusion that gives us the feeling of 'telepresence' (Sheridan, 1992; Schloerb, 1995; McLellan, 1996; Draper et al., 1998) or a sense of 'transportation' to a virtual world (Gerrig, 1993) or what Rheingold (1991) called 'a form of out-of-body experience'.

And most of all, mental imagery elements are evoked internally without the requirement of any external perception. Although this illusion of reality evoked in the mind is entirely endogenous, due to the presence thus evoked, we interact with the mental imagery environment as if it may have been real. This phenomenon is comparable to the sense of presence due to external mediation, which is often referred to as 'Perceptual Illusion of non-mediation' (Lombard and Ditton, 1997) or 'mediated presence' (Biocca et al., 2001).

Although we found evidence of presence, its properties have to be further explored. The experience of presence is often referred to as a psychological state or a subjective perception (Research, 2000). So, various aspects of mental imagery like the imagery itself (for instance, its vividness compared to physical reality) may be still indefinable. We expect that further research on mental imagery would help us probe into our experience of sense of presence and consequently contributing to our knowledge on internal perception and cognition.

4.2.7 Acknowledgements

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RÉSUMÉ DU CHAPITRE 4.2 : EXPÉRIENCE 2

LA PRÉSENCE EN RÉALITÉ AUTO-ÉVOQUÉE

La présence dans la Self-ER a été rarement bien étudiée. Pour étudier objectivement et démontrer que la présence peut être également expérimentée dans la Self-ER, une expérience sur l'imagerie mentale a été réalisée (sans l'intervention d'aucune médiation). Les études sur l'imagerie mentale (l'imaginaire) confirment que nous pouvons évoquer des objets et des espaces dans nos esprits intuitivement sans l'aide d'aucune médiation extérieure immédiate et même interagir avec eux temporellement. Dans cette expérience, les expressions verbales, les mouvements et les gestes physiques ont été étudiés lors d'expériences d'imagerie mentale sur des sujets différents, dans deux scénarios : une épreuve de guidage et un exercice de «mental walk» (« promenade mentale »). Un Protocole d'analyse a été mis en place et utilisé, suivi par l'analyse du temps imparti et la schématisation des mouvements physiques pendant l'expérience de l'imagerie mentale. Les résultats des expériences tendent de toute évidence vers ce phénomène spatio-temporel de l'expérience de la présence. Ils nous ont également amenés à comprendre comment le sentiment de présence dans l'imagerie mentale est fortement comparable à la forte sensation de présence évoquée dans la réalité virtuelle. Cette étude a été rendue possible grâce à une collaboration entre le laboratoire des Arts et Métiers ParisTech de Laval et l'Indian Institute of Technology, Bombay.

Contexte

Il est évident que la meilleure façon d'étudier l'imagerie mentale se fait par «introspection». Mais la recherche sur l'imagerie mentale requiert des méthodes objectives d'analyse pour être crédible et reconnue. Il a en effet fallu de nombreuses années pour que les chercheurs trouvent une méthode Kosslyn (1980) qu'ils ont appelée «la quantification de l'introspection». Cette méthode a tenté d'externaliser les événements mentaux et a essayé de détecter et de mesurer les conséquences comportementales, souvent en termes de performances temporelles de traitement interne. Un des meilleurs exemples illustrant ce dernier point a été l'expérience de Shepard et Metzler (1971) sur la rotation mentale de formes géométriques. Actuellement, l'imagerie mentale est étudiée de manière approfondie, à travers diverses méthodes d'externalisation des activités mentales. Une telle méthode comprend le « Protocole d'analyse » et le procédé qui consiste à penser tout haut où l'externalisation est faite en temps réel à travers les expressions verbales et les gestes et mouvements physiques qui lui sont associés.

Cette tentative consistait à étudier le sens de la présence dans l'imagerie mentale. Pour commencer, Athavankar et al. (2008) avaient déjà trouvé la preuve d'un sens de la présence dans l'imagerie mentale dans les expériences menées avec des architectes à qui l'on avait bandé les yeux. Bien que les objectifs de ces expériences fussent d'explorer les possibilités de conception, l'évidence de la présence dans l'espace auto-évoqué a été manifeste (Athavankar et al., 2000; Athavankar and Mukherjee, 2003; Athavankar et al., 2008). Il a été observé que, même

si les architectes ont utilisé des stratégies différentes dans le cadre de leurs processus de conception, ils sont restés plongés dans les espaces mentalement évoqués (qu'ils concevaient en même temps). Ils ont agi dans l'espace mental de la même manière que s'ils avaient été dans le monde physique. Ces expériences sur les architectes aux yeux bandés ont amené les chercheurs à étudier comment les gens éprouvent l'imagerie mentale (dans une situation de non-conception), avec leur sens de la présence comme première source d'attention. Dans cette expérimentation, la lumière est notamment faite sur l'expérience de la présence dans l'imagerie mentale volontairement évoquée..

Des études montrent que, bien que les transformations mentales impliquent le système visuel, les opérations sont en fait guidées par les entrées du système moteur, et donc il ne peut pas être difficile de les convertir en mouvements physiques correspondants (Kosslyn, 1994; Annett, 1995; Wohlschläger, 1998). Les résultats des expériences neuro-physiologiques qui étaient chargées de surveiller l'activité neuronale dans le cortex pariétal montrent également que les transformations mentales peuvent être précédées par des intentions motrices anticipées sur les transformations réelles (Reisberg et Logie, 1993). Selon Athavankar (1999), les gestes donnent l'impression de compléter naturellement l'élaboration et la manifestation mentale des idées spatiales de l'architecte ; la production de ces gestes ne nécessite aucune attention observable directement.
L'étude des gestes et des mouvements ainsi que des transcriptions verbales ont été envisagées de manière plus poussée par la méthode d'analyse des protocoles et ont permis de schématiser les différents éléments des espaces mentaux évoqués (Athavankar et al., 2008).

Questions de Recherche

Les deux principales questions soulevées lors de cette expérience sont les suivantes :
1. Est-ce qu'on expérimente un «sentiment de présence» dans l'imagerie mentale ?
2. Est-ce que ce sentiment de présence est objectivement identifié par l'analyse des expressions verbales, les gestes et les mouvements ?

L'expérience s'intéressait particulièrement aux espaces d'imagerie évoqués par la mémoire, c'est à dire sans aucune intervention de la conception (car le sens de la présence dans l'imagerie qui est continuellement modifiée est assez manifeste dans les expériences précédentes qui mobilisaient des architectes aux yeux bandés). En répondant à ces questions à travers l'analyse du protocole, quelques méthodes objectives supplémentaires pour étudier la présence sont également proposées. Les corrélations de temps et de distance et la schématisation des mouvements physiques ont été utilisées pour étudier les aspects externalisés de l'imagerie mentale afin de confirmer les activités mentales et le sentiment de présence qui leur est associé.

Procédure Expérimentale

Au début, il semblait simple de pouvoir induire le sentiment de présence dans l'esprit des participants en leur faisant imaginer (mentalement) des espaces. Mais comme il s'agit d'un procédé d'introspection, pour étudier objectivement ses propriétés, l'expérience a dû être conçue de manière appropriée. Nous avons choisi d'avoir deux scénarios pour les expériences : les épreuves directes et indirectes. L'épreuve indirecte a été conçue de telle sorte qu'elle tente d'observer comment l'on pourrait se situer involontairement dans l'espace d'imagerie mentale

et interagir avec elle afin d'effectuer une tâche mentale. Bien que l'épreuve directe ait permis aux participants d'expérimenter automatiquement des espaces d'imagerie mentale à partir d'une perspective qui leur est propre, elle a été conçue dans le but d'étudier de manière plus approfondie les caractéristiques de leur sentiment de présence.

Comme c'était la présence qui nous intéressait particulièrement, nous avons choisi des épreuves qui ne feraient pas intervenir nécessairement la créativité ou la pensée de conception. Nous avons donc décidé d'utiliser le « way finding » (« l'idée de trouver son chemin ») comme le moyen d'étudier la présence de manière indirecte. Il n'a pas été imposé de charge mentale supplémentaire sur les participants et ces derniers pouvaient s'appuyer principalement sur leur mémoire à long terme. Les épreuves ont été définies comme suit :

Expérience Scénario-1 - Guiding Task : Epreuve directrice : "Votre ami est à l'entrée d'IDC et vous êtes au stand Nescafé. Guidez-le par téléphone pour qu'il vous y rejoigne (au Stand Nescafé). »
Les participants ont été invités à guider verbalement un ami par téléphone portable d'un point A à un point B alors qu'ils étaient eux-mêmes au point B. Les emplacements, IDC (abréviation couramment utilisée pour désigner le centre de design industriel de l'IIT Bombay) et le Nescafé stall étaient bien connus des participants, qui étaient respectivement aux points A et B.

Expérience Scénario-2 - Mental Walk (Promenade Mentale) : "Imaginez que vous soyez à l'entrée d'IDC, et que vous deviez rejoindre le stand Nescafé. Vous devez décrire votre "expérience de promenade" à haute voix pendant que vous la vivez.
Chaque participant a été invité à penser tout haut lors de ce deuxième scénario.

Dans les deux cas, les participants avaient les yeux bandés afin de dépendre entièrement de leur imagerie mentale et d'avoir un minimum d'interférences concernant la perception externe au cours des épreuves mentales. Dans les deux cas, ils étaient physiquement dans la salle d'expérimentation et avaient assez d'espace pour se déplacer. De manière à être plus objectif, la consigne des deux épreuves a été changée pour chaque nouveau participant

Pour les deux scénarios, il y avait principalement 3 étapes dans le protocole d'expérimentation:
Etape 1 : L'épreuve a été confiée au participant par écrit. Il devait se rappeler l'épreuve une seule fois, juste avant que l'expérience ne commence.
Etape 2 : Dans la salle, on leur a donné la liberté de choisir où se placer et de s'orienter à leur guise avant de commencer l'expérience. A partir du moment où cela était fait, on leur bandait les yeux.
Étape 3 : Un signal leur a permis de savoir à quel moment ils pouvaient commencer l'épreuve. Du début à la fin de l'épreuve, la session de l'étape 3 a été filmée pour la transcription des expressions verbales et l'étude des gestes et des mouvements.

Outre le fait qu'on leur ait bandé les yeux, coupé la perception visuelle externe, la salle choisie pour l'expérience était insonorisée pour leur permettre de mieux se concentrer sur leurs activités mentales. Athavankar et al. (2000) ont montré qu'autoriser un mouvement physique fournissait des données complètes pour l'analyse comparative et aidait à mieux comprendre les processus mentaux des sujets aux yeux bandés. Avant l'épreuve, on a donné le choix aux sujets de s'orienter à leur guise et de trouver un endroit où se placer. Dans le cas où ils ont préféré se

déplacer pendant l'expérience (Scénario-2), le sol a été marqué par des grilles de 50cm par 50cm, pour la schématisation de leurs mouvements physiques (Figure 52). Après l'étape 3, des discussions informelles post-expérience ont également eu lieu, ce qui en fait nous a permis de clarifier certains aspects de leurs expériences d'imagerie mentale. Bien que de tels éclaircissements soient introspectifs et subjectifs, ils n'ont été utilisés que pour comparer les observations objectives des transcriptions et des vidéos.

Les Participants :
Pour chaque épreuve, il y avait huit sujets (cinq hommes et trois femmes) à participer à l'expérience. Tous les participants avaient une bonne connaissance des lieux mentionnés dans les épreuves et ont souvent utilisé l'itinéraire proposé. Donc l'itinéraire qu'ils ont emprunté, existait déjà dans leur mémoire de telle sorte qu'il pouvait être spontanément évoqué par l'esprit. Ils n'avaient aucune connaissance des véritables objectifs de notre étude et savaient seulement que l'expérience concernait l'imagerie mentale.

Protocole d'analyse :
Le protocole d'analyse est considéré comme une méthode efficace d'analyse de la transcription des données verbales. Comme son efficacité a fait ses preuves dans diverses expériences relatives à l'imagerie mentale et dans les expériences avec des architectes aux yeux bandés, nous l'avons retenue comme méthode principale d'analyse. Comme nous avions un scénario indirect pour l'évaluation de la présence, nous avons cru que le contenu des protocoles (à partir des données externalisées « penser tout haut ») nous aiderait à décoder les différents éléments qu'ils ont rencontrés au cours de l'expérience d'imagerie. A partir des vidéos enregistrées (sessions étape 3), les données ont été ensuite transcrites et entrées dans des feuilles Excel pour l'analyse. L'information a été organisée dans un tableau sous les catégories : horodatage, Transcriptions (données verbales), gestes et mouvements (données physiques). La partie échantillons peut être observée dans les tableaux 2 et 4 de la Section 4. Dans le cas des scénarios 1 et 2, les transcriptions nous ont conduits à deux catégories principales d'informations : «expressions verbales» et «expressions physiques». Ces deux catégories nous ont ainsi permis de schématiser les éléments de l'espace mental.

Schématisation de l'Espace Mental :
Bien que les données verbales aient fourni des informations directes sur divers aspects tels que l'auto-positionnement et l'espace évoqué dans l'imagerie mentale des participants, les mouvements physiques et les gestes nous ont permis de les comparer et de les analyser. Le rôle des mouvements et des gestes dans la compréhension des processus de réflexion est clairement démontré dans Athavankar (1999). Dans le cas du scénario-2, les grilles sur le sol nous ont aidés à tracer les contours des mouvements physiques effectués sous l'effet des mouvements mentaux par les participants. Dans le cas du scénario-1, comme il n'y avait pas de changements physiques dans les positions (qui soient significatifs), nous nous sommes appuyés sur des données verbales et des gestes (avec orientation) pour l'analyse. La verbalisation était d'autant plus utilisée que les épreuves étaient basées sur le mouvement et limitées dans le temps. Les mouvements ainsi que les gestes ont confirmé ce qui a été décrit mais qui n'était pas évident dans les données verbales. En particulier des aspects tels que l'orientation, le point de vue et l'auto-positionnement dans l'imagerie mentale sont devenus plus simples à étudier avec l'aide des mouvements physiques et des gestes correspondants.

Analyse et Synthèse des Résultats

Analyse des Protocoles :
Les transcriptions des données verbales ont fourni des informations riches à décoder et à analyser pour l'imagerie mentale. Lorsque l'analyse combinait de l'information de gestes et de mouvements, les protocoles semblaient plus pertinents et les caractéristiques de l'imagerie mentale apparaissaient bien plus claires. Notamment dans le premier scénario indirect, où, même si les participants ont utilisé les expressions à la deuxième personne du singulier, nous avons pu observer comment ils ont expérimenté l'imagerie de leur propre point de vue et où ils se plaçaient et s'orientaient mentalement.

Analyse du Temps :
Lorsque les intervalles de temps ont été analysés, on a constaté des corrélations positives entre les événements mentaux et les événements réels. Pour la comparaison du temps, le temps moyen pour aller en marchant d'un point A à un point B a été calculé. Les intervalles de temps dépendaient de la distance qu'ils parcouraient mentalement et étaient proportionnels aux intervalles de temps identifiés dans une situation réelle. Comme indiqué précédemment, le temps a été certainement influencé par les détails qui ont été évoqués lors des événements mentaux. Il était évident que lorsque les données verbales contenaient plus de détails, leur vitesse de déplacement était réduite. Mais cette différence sur la vitesse du mouvement mental pouvait aussi être affectée par la capacité de la personne à « mettre en mots » ses informations et à les énoncer tout haut. Il a été constaté que, de façon à maintenir la vitesse liée à l'épreuve, certains détails de l'espace d'imagerie ont parfois été omis.

Schématisation des Mouvements :
Bien que pour faire l'expérience de l'imagerie mentale, on n'ait pas besoin de faire des mouvements physiques, nous avons donné aux participants l'occasion de se déplacer si tel était leur souhait. Il s'est avéré que les mouvements physiques venaient intuitivement à l'imagerie mentale sans affecter l'expérience d'imagerie. On a remarqué que quand on bougeait dans l'espace mental sans se déplacer physiquement, on déclenchait quand même certains mouvements subtils dans le haut du corps et de la tête. Dans la plupart des cas, les mouvements physiques ont contribué à ce que l'orientation se fasse de manière efficace dans l'espace mental. Tracer ces mouvements correspondant à la marche mentale a permis de vérifier l'authenticité de la voie qu'ils prenaient mentalement. Cela a également donné un aperçu des différentes stratégies d'orientation et de mouvement.

En plus de l'imagerie visuelle, des éléments auditifs dans l'imagerie ont été détectés chez certains participants à des points très spécifiques au cours de leur promenade mentale (Scénario-2). Même les directions d'où provenaient les sons ont été observées. Dans les expériences précédentes sur les architectes aux yeux bandés, nous avons remarqué que, bien que leur espace d'imagerie mentale se conçoive et se modifie constamment, ils restent immergés et donc éprouvent un sentiment de présence. Comme dans nos expériences nous avons privilégié l'étude de la présence dans l'imagerie volontairement évoquée, nous avons pu confirmer que ce sentiment de présence dans l'imagerie mentale est en fait une expérience involontaire.

Indications de la Présence dans l'Imagerie Mentale

Si l'on trouve des similitudes dans l'expérience de la Réalité Évoquée (en réalité virtuelle ou en imagerie mentale) avec les expériences du monde réel, nous éprouvons assurément un sentiment de présence. Le concept de soi situé dans un endroit est la première étape vers les signes de l'évidence de la présence (les étapes subséquentes étant la vivacité de l'expérience, les niveaux de présence, les caractéristiques de l'attention spatiale, les expériences multi-sensorielles, etc.) L'illusion de percevoir une réalité spatio-temporelle (comme l'espace et le temps) valide la présence. D'après nos expérimentations, nous sommes en mesure de montrer divers signes de cette expérience de sens de la présence dans l'imagerie mentale.

Chaque participant a exprimé un sentiment de mouvement dans un espace mental évoqué pendant un certain laps de temps. Comparable au phénomène de l'attention sélective visuelle dans un contexte réel (Duncan, 1984; Koch et Ullman, 1985; Freiwald et Kanwisher, 2004), les éléments des espaces d'imagerie mentale étaient sélectifs, ce qui a joué un rôle majeur dans leurs expériences subjectives. Les travaux de Kosslyn (1980) montrent que conserver des images et leurs détails est un processus actif et impose une charge mentale. Cela explique pourquoi l'imagerie est sélective quand il s'agit d'évoquer l'espace autour de soi. La charge mentale a été équilibrée en évoquant uniquement les informations pertinentes nécessaires pour l'épreuve. Par exemple, il y a un crayon jaune très visible qui ressemble à une sculpture que l'on trouve normalement sur l'itinéraire. Sur l'enquête post-facto, presque tous les participants ont admis qu'ils ne l'ont jamais vu au cours de l'épreuve mentale. Mais ils ont parfois évoqué des éléments qui n'avaient strictement rien à voir avec l'épreuve mais qui existaient bel et bien dans leur mémoire. Certaines de ces informations tacites ont également été identifiées pendant les sessions rétrospectives, lorsque les participants ont admis avoir vu certains éléments spécifiques dans l'espace d'imagerie mentale.

Similitudes avec la Présence en Réalité Virtuelle (ou Réalité Média-Évoquée)

Le sens évoqué de la présence dans l'imagerie mentale comporte beaucoup d'analogies avec l'expérience de la présence dans la réalité virtuelle et les médias qui lui sont associés. Nous fournissons ici un compte rendu compréhensible des comparaisons entre la présence dans l'imagerie mentale et les expériences via des médias. Pour commencer, il y avait un sentiment de «l'effet diégétique» dans l'expérience de l'imagerie mentale, semblable à l'effet que les gens peuvent éprouver en se confrontant à un scénario de conte (au cinéma ou dans la littérature narrative) dans le monde diégétique (Burch, 1979; Schubert et Crusius, 2002). Dans cette étude, cela a été mis en évidence grâce à la méthode expérimentale qui consiste à penser à voix haute.

Après les expériences, il était intéressant de constater que les participants s'étaient référés à l'espace d'imagerie mentale comme à un endroit qu'ils venaient de visiter et aux événements mentaux comme quelque chose qui avait eu lieu quelques minutes auparavant ("quand j'étais sur cette route..., j'ai vu sur la gauche..."), qui a également fortement impliqué leur expérience de la présence. Il est comparable au cas de l'expérience de la post-réalité virtuelle (ou post-médiatique) dans le sens de « Being There » (« Etre là ») dans un lieu représenté par le média (Reeves, 1991; Slater et al., 1994; Barfield et al., 1995; Slater et Steed, 2000).

Il y avait aussi l'élément de « suspension de l'incrédulité », qui se produit normalement parmi les utilisateurs de systèmes de réalité virtuelle qui les plonge dans un monde autre que celui où leurs corps réels sont situés (Slater et usoh, 1993; Lombard et Ditton, 1997). Cela a permis aux participants de se déplacer et d'interagir en accord avec l'environnement de l'imagerie mentale, même s'ils savaient à un niveau subconscient qu'ils étaient en fait dans une salle d'expérimentation.

Notre capacité à projeter notre point de vue vers une autre personne, vers un autre endroit a été notamment observée dans le scénario de la première expérience. Buckner et Carroll (2007) ont identifié quatre formes d'auto-projection (en ce qui concerne la mémoire épisodique, la navigation, la théorie de l'esprit et de prospection) capables de partager une anatomie fonctionnelle commune. Ils ont montré comment le phénomène d'auto-projection dépend d'une simulation mentale personnelle d'un autre temps, d'un autre lieu ou d'une autre perspective. Cet aspect est comparable à l'une des caractéristiques principales d'une illusion de réalité virtuelle qui nous donne le sentiment de « téléprésence » (Sheridan, 1992; Schloerb, 1995; McLellan, 1996; Draper et al., 1998) ou un sentiment de « transportation » vers un monde virtuel (Gerrig, 1993) ou ce que Rheingold (1991) a appelé une forme d' « expérience extra-corporelle ».
Et par dessus tout, les éléments d'imagerie mentale sont évoqués en interne sans avoir besoin d'une perception extérieure. Bien que cette illusion de la Réalité Évoquée dans l'esprit soit entièrement endogène, en raison de la présence ainsi évoquée, nous interagissons avec l'environnement de l'imagerie mentale comme s'il était réel. Ce phénomène est comparable à la sensation de présence induite par la médiation externe, ce qui est souvent désigné comme « une Illusion Perceptive de non-médiation » (Lombard et Ditton, 1997) ou « présence médiatisée » (Biocca et al., 2001).

Bien que nous ayons établi la preuve de la présence, ses caractéristiques doivent être étudiées de manière plus approfondie. L'expérience de la présence est souvent désignée comme un état psychologique ou une perception subjective (Research, 2000). Ainsi, différents aspects de l'imagerie mentale comme l'imagerie elle-même (par exemple, sa vivacité par rapport à la réalité physique) peuvent être encore indéfinissable. Nous espérons que d'autres recherches sur l'imagerie mentale nous aideront à étudier notre expérience du sens de la présence et par conséquent apporteront des connaissances supplémentaires sur la perception interne et la cognition.

Conclusion : Expérience 2

Nous avons abordé deux questions de recherche principales, et nous avons répondu aux deux questions de façon cohérente et positive.

1. Oui, on éprouve sans aucun doute un sentiment de présence dans l'imagerie mentale, semblable à celui qu'on pourrait éprouver dans un environnement de réalité virtuelle (voir ci-dessus). Dans le cas de la réalité virtuelle, la présence est évoquée car notre perception extérieure est médiatisée, conduisant à une illusion de réalité semblable à notre monde physique. Dans l'imagerie mentale, des espaces sont évoqués de façon endogène par notre esprit sans que n'intervienne une perception extérieure, entraînant une sensation de présence. Parce que, dans le cas d'une Media-ER (comme la réalité virtuelle), l'illusion d'une réalité

différente est créée en forçant nos organes sensoriels externes à percevoir le monde généré par ordinateur d'une manière intuitive, alors notre perception ressemble de très près à ce que nous pourrions vivre dans telle ou telle situation du monde réel. Dans le cas de la Self-ER comme l'imagerie mentale, même si les éléments perceptifs sont évoqués en interne par notre esprit, il y a des similitudes avec les scénarios du monde réel. Des études menées par des neuroscientifiques montrent également que les stimuli imaginaires et les stimuli réellement perçus présentent des similitudes notables en termes de schématisation neuronale (Kosslyn, 1994, 2005).

2. Oui, ce sentiment de présence peut être détecté en analysant les expressions verbales, les gestes et les mouvements. En fait, les expressions verbales et physiques se complètent mutuellement en comblant les manques et nous permettent de conjuguer les externalisations de l'expérience mentale. Il était clair que les participants avaient traité les images de leur propre point de vue, en évoquant l'espace mental environnant associé aux tâches proposées. Mais est-ce que ces méthodes expérimentales peuvent être utilisées dans l'étude de la présence dans d'autres scénarios mettant en jeu la Réalité Évoquée comme dans les environnements virtuels générés artificiellement ? La question de savoir comment ces méthodes pourraient être efficacement étendues à la recherche en réalité virtuelle, devrait être étudiée à l'avenir.

Significations et Perspectives

Les expériences ont été plutôt réussies en fournissant des preuves de la présence dans l'imagerie mentale. Elles nous ont permis de démontrer que le sentiment de présence était expérimenté non seulement dans la réalité virtuelle mais aussi dans les espaces d'imagerie mentale (ou la Self-ER) qui sont complètement évoqués par nos esprits. Ainsi, nous croyons fermement que l'étude sur la présence devrait être plus poussée et ne devrait pas se limiter à la réalité virtuelle ou à la médiation des environnements virtuels.

Pendant l'expérience, puisque les participants se déplaçaient dans l'espace physique plus rapidement ou à la même vitesse que d'habitude, les détails qu'ils ont expérimentés ont pu ne pas être entièrement relatés dans les expressions verbales (même si elles étaient suffisamment riches pour l'analyse). Bien que les gestes et les mouvements aient également contribué à la compréhension de la nature de leur imagerie, certaines expériences ont cependant été occultées. Dans une certaine mesure, les participants ont pu être tentés de passer par l'introspection au cours des discussions qui ont suivi l'expérience. Cela nous met face à un autre défi, qui certainement nécessite des travaux futurs : comment faire la différence entre « rapports sélectifs », « omission de déclare r» et « non-expérimentation ». Nous croyons que cette étude n'est que la première étape vers de nombreuses expériences qui contribueront à l'exploration du sens de la présence dans l'imagerie mentale.

CHAPTER 5: DISCUSSION

5.1 EVOKING AND ALTERING REALITY

The attempt of this study is a novel idea to bring together different concepts regarding presence into a single coherent graphical representation. Although this concept of ER and EP along with the proposed map provides us a simplified way of looking at reality and presence, it raises plenty of scientific and philosophical questions.

Can the experience of an altered state of consciousness (ASC) like hallucination, delusion or psychosis due to mental disorders be a kind of Self-ER? Revonsuo et al. (2009) redefined ASC, as the state in which consciousness relates itself differently to the world, in a way that involves widespread misrepresentations of the world and/or the self. They suggest that to be in an altered state of consciousness is to deviate from the natural (world-consciousness) relation in such a way that the world and/or self tend to be misrepresented (as evident in reversible states like dreaming, psychotic episodes, psychedelic drug experiences, epileptic seizures, and hypnosis). According to Ramachandran and Hirstein (1997) we have internal mental simulations in the mind using less vivid perceptual attributes, in the absence of the regular external sensory inputs. If they possessed full-strength perceptual quality, that would become dangerous leading to hallucinations. They argue that in cases like temporal lobe seizures, this illusion (Self-ER) may become indistinguishable to real sensory input losing its revocability and generating incorrect sense of reality (creating a permanent Evoked Reality situation that makes it difficult to return to Primary Reality). So can hallucinations due to Self-ER be compared to Augmented Reality due to Media-ER?

In contrast to Presence, is there an 'Absence' and do we experience that? If so, how? Can it be compared to a dreamless sleep? Can Presence Threshold itself be subjective and differ from person to person? With reference to the Reality-Presence Map, is there a possibility of an experience analogous to uncanny valley when ER is nearest to the two extreme poles? Is this the reason why many experience anomalies during exceptionally vivid nightmares or lucid dreams? Similarly on the Media-ER side, can simulator sickness due to inconsistencies during virtual reality simulations be compared to this phenomenon?

In future we will definitely be able to measure or rate presence experiences more efficiently, and the Reality-Presence Map will help us visually categorize and study them. Although many questions still remain unanswered, we may be able to predict future aspects of virtual reality and media. Observing the present-day advancements in media technologies, art and entertainment, we can foresee their directions and speculate where they are heading towards. We would like to put forward (below) a possible near future experience scenario: an intersection point of different fields of art and science.

5.1.1 Aesthetiography: The Next Milestone in the Confluence of Media

Art and technology always evolved simultaneously, often inspiring and complimenting each other. This can be observed at every point in the history of media; for instance, the evolution of 'Cinema'. When the 'motion picture' was born, it was a sensation as it gave the prevalent media of photography a new dimension - time. The exhilaration was of recording images in a sequence that made us able to present a part of an event in time, unlike still photography or paintings. Although initial black and white movies were silent, they were usually accompanied with live

musical performances that gave an additional sense of ambience. The cinema then became the 'talkies', with the development of electronic sound recording technologies that further simplified the addition of a new perceptual dimension - sound, making silent movies obsolete. Gradually colour movies took over and cinema has been evolving since, both in terms of artistic styles and technological improvements. Introduction to stereo recording and projection technologies helped give cinema (popularly known as 3D movies) the spatial dimension of depth perception. In the recent past, the visual resolution took a leap, with the development of recording formats like IMAX and exceptionally high definition cameras. Digital recording and projection systems have revolutionized cinema experience in the last few decades. As cinema evolved, so did related interactive audio-visual media like video games, flight simulators and virtual reality systems, introducing non-linear narratives and real-time computer generated worlds. Notably, the Sensorama Simulator (Heilig, 1962) is one among the first virtual reality systems that attempted to induce multisensory simulated experiences. Today's significant progress in the field of virtual reality helps immerse ourselves considerably into the artificial worlds. Thus, in light of this endless quest for an ultimate experience, one cannot help but wonder where these representational media will take us.

> *"The ultimate representational system would allow the observer to interact 'naturally' with objects and other individuals within a simulated environment or 'world,' an experience indistinguishable from 'normal reality.' Although such a representational system might conceivably use direct brain stimulation in the future, it will more likely use digitally controlled displays that stimulate the human sensory organs, the natural conduits to the brain."*
> - (Loomis et al., 1999)

Figure 62: Sensorama 3D Motion Picture Camera
[source: telepresence.org, 2006]

Figure 63: Sensorama Motion Picture Projector
[source: telepresence.org, 2006]

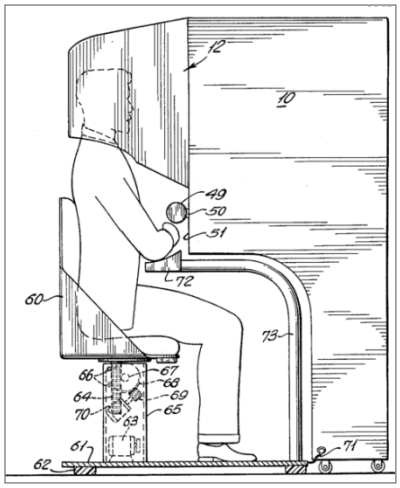

Figure 64: The Sensorama, from U.S. Patent #3050870
[source: Heilig, 1962]

If we examine the history of media, we can notice that the advancements in virtual reality and interactive gaming technologies also occurred in parallel to that of cinema, and they often crossed paths at different points. Experimental systems like multi-projector Cinerama (that helped in widescreen projections), Morton Heilig's Sensorama (one of the earliest attempts at

immersive multi-sensory technology and an excellent example of the merging of movie experience with virtual reality) (**Figure 62**, **Figure 63** and **Figure 64**), stereo and holographic projection technologies and head mounted displays (that track the user's head movements in order to update the viewing perspective in real-time) are few such examples. While experimental non-linear and interactive movies and videos are being inspired by video games, additional sensory immersion in virtual reality is being attempted with the help of multisensory technologies, striving for an ultimate medium of representation and experience.

Cinema, virtual reality, video games and associated media technologies that help us share experiences have been taking different but often intersecting evolutionary paths. It is clear to us that presently they are heading towards another major crossover along their paths, although with distinct concerns of their own. The art oriented fields like cinema constantly adopts the higher dimensions provided by technology, rapidly adapting to the developments, while virtual reality and gaming technologies are always looking for aesthetic and artistic solutions to enhance our experience of presence in the Evoked Reality. Although today this may seem far-fetched, we suggest that the ultimate aim of media is the hypothetical scenario of a 'simulated reality', where one may not distinguish the experience from that of the real world. However at this point of time, a definite objective for these domains is to evoke a convincing illusion of experience of reality, using stronger immersion technologies that could recreate or reproduce the maximum number of perceptual sensations possible. This meeting point of art-forms, cinema, virtual reality and associated technologies in the near future, is what we would like to refer to as "Aesthetiography" - the art and science of capturing (or creating) and reproducing an absolute perceptual experience (Pillai et al., 2013b) (**Figure 65**). We derive the term Aesthetiography from the Greek aisthēsis "sensation" and -graphein "to write or to record".

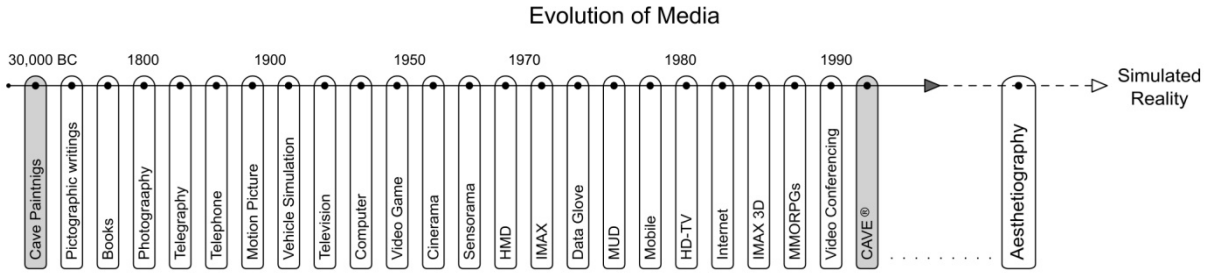

Figure 65: Aesthetiography: The next milestone in the confluence of media [source: Pillai et al., 2013b]

Aesthetiography is the media technology that would help us capture the entire essence of a perceptual experience from the real world, modify it, or even artificially synthesize it to be reproduced and experienced subsequently or in real-time. The method of experience, especially evoking powerful Perceptual Illusions will be perfected by virtual reality related technologies while the approach towards evoking intense Psychological Illusions will be improved by cinema and connected artistic media. We propose that Aesthetiography will soon convey its impact on the evolution of media and will therefore be the next milestone in the confluence of new-media technologies. As we progress towards such a scenario in the passionate pursuit of an ultimate medium of experience, like many other technological innovations, Aesthetiography also may lead to serious ethical and cognitive concerns in the future, with regard to experience sharing.

5.1.2 Inclusive vs. Exclusive Reality

Other than the obvious difference between Media-ER and Self-ER discussed before, they have another main differentiation. In most cases of Media-ER, multiple users could share the experience of a common Evoked Reality at the same time (naturally, with subjective differences, especially due to Psychological Illusion). While in the case of Self-ER, every person's mind experiences unique Evoked Reality. Thus a Dream is typically an individual experience (as far as our present technological advancements and constraints suggest), while Simulated Reality may be shared.

5.2 REALITY WITHIN REALITY

5.2.1 Simulation within a Simulation

Furthermore, the Reality-Presence Map helps us investigate into potential ideas on Reality, for instance the possibility of Simulation within a Simulation (SWAS) (Pillai et al., 2013a). The Map could be extended to and be applicable for any level of reality, in which we believe there's a Primary Reality - the base reality, to which we return to in case of absence of any form of Evoked Reality. Let's imagine that someday we achieve a scenario of perfect Simulated Reality. As per our proposition, one's mind would accept it as the Primary Reality as long as the experience of presence continues (or till a 'Break in Reality (BIR)' occurs). It would imply that at such a point, one can experience presence exactly as in the Primary Reality. In this perfect Simulated Reality condition, if one experiences Media-ER (e.g. virtual reality) or Self-ER (e.g. dream), as soon a BIR occurs they return back to it since it's the immediate Parent Reality. **Figure 66** attempts to illustrate such a scenario of Simulation within a Simulation.

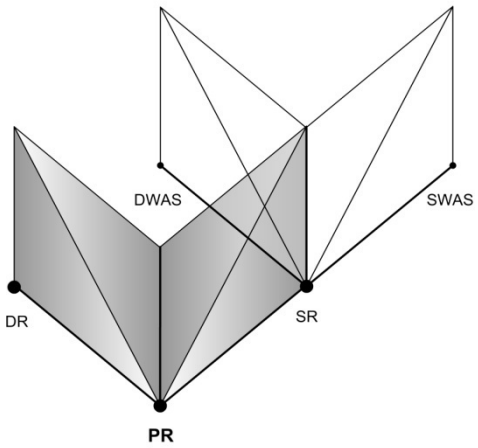

Figure 66: Simulation within a Simulation
[source: Pillai et al., 2013a]

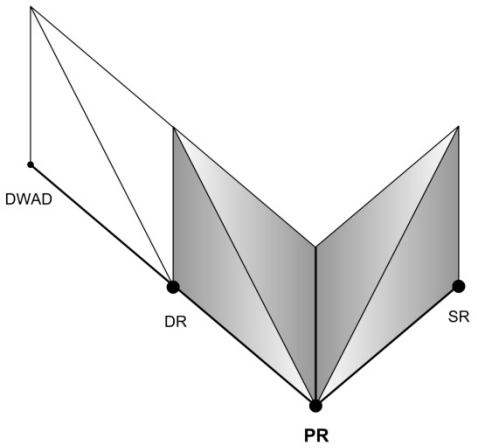

Figure 67: Dream within a Dream
[source: Pillai et al., 2013a]

5.2.2 Dream within a Dream

Similarly in the Self-ER side, one's mind could experience a Dream within a Dream (DWAD) (Pillai et al., 2013a). When one wakes up from such a dream, he could find himself in the parent Dream Reality from which he would have to wake up again into the Primary Reality. Can this be

how people experience such false awakenings [a hallucinatory state distinct from waking experience (Green and McCreery, 1994)]? **Figure 67** attempts to illustrate such a scenario of Dream within a Dream.

5.3 REALITY CONTINUUM

In fact it makes us curious about the even bigger questions. Can there be a reality before our Primary Reality? In a way this map tries to satisfy many philosophies about our reality that we live in. From a materialist perspective, Primary Reality is our Physical Reality. But for a realist, there may be an ultimate reality beyond Primary Reality or even beyond the scope of this map. The Simulation argument claims that we are almost certainly living in a computer simulation (Bostrom, 2003), in which case what we believe to be our Primary Reality might itself be a Simulated Reality [similar to Brains in a vat scenario (Putnam, 1982)]. Metzinger (2009) proposed that our experience of the Primary Reality is deceptive and that we experience only a small fraction of what actually exists out there. He suggests that no such thing as 'self' exists and the subjective experience is due to the way our consciousness organizes the information about outside world, forming a knowledge of self in the first person. He claims that everything we experience is in fact a Simulated Reality and the on-going process of conscious experience is not so much an image of reality as an 'ego tunnel' through reality. So, is our Primary Reality in fact the base reality? Are we always under an Evoked Reality of some kind?

Thus another important question would be if we ever experience an unmediated pure presence in our Primary Reality. **Figure 68** attempts to put together different levels of reality as a Reality Continuum (Pillai et al., 2013a). It would make us wonder if it's probable, to how many levels would one be able to go? Do we already visit them unknowingly through our dreams? Would the levels of reality in the figure be represented as a never ending fractal structure?

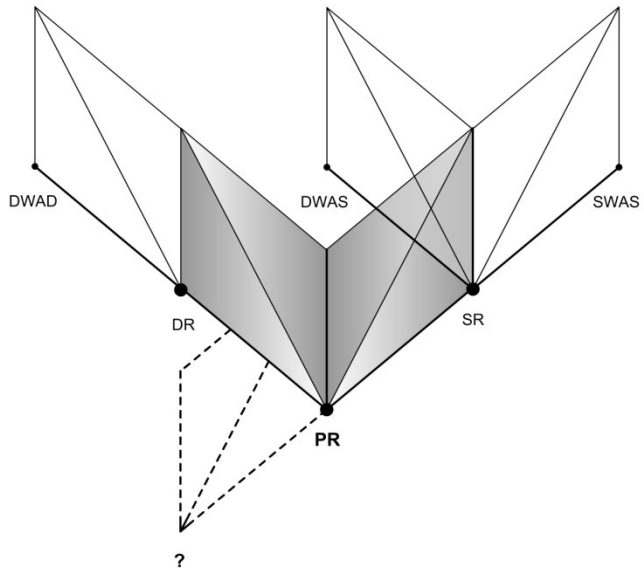

Figure 68: Reality Continuum (illustrating the levels of reality) [source: Pillai et al., 2013a]

In any case, will we be able to understand someday, all these aspects of our experience of reality? Furthermore will the Reality-Presence map help us explore the concepts on consciousness? As Chalmers, (1995b) puts it, "The ambiguity of the term 'consciousness' is often exploited by both philosophers and scientists writing on the subject. It is common to see a paper on consciousness begin with an invocation of the mystery of consciousness, noting the strange intangibility and ineffability of subjectivity, and worrying that so far we have no theory of the phenomenon. Here, the topic is clearly the hard problem - the problem of experience." On the other hand, Dennett (1996) made a parallel claim - "If you don't begin breaking them ['subjective qualities' or *'qualia'* of experience] down into their (functional) components from the outset, and distributing them throughout your model, you create a monster - an imaginary dazzle in the eye of a Cartesian homunculus".

Although it appears that the explanations regarding consciousness and *qualia* still have a long way to go, with advancements in neuroscience and related technologies, perhaps in the future we will be able to trace all the mental activities to their corresponding neural correlates. Perhaps someday we may cross the barrier of expressing our subjective experience of *qualia* by overcoming the human failing to communicate accurately our first-person experiences (only to realize what is said in Dennett (1988, p.409) - "contrary to what seems obvious at first blush, there simply are no *qualia* at all"). Or perhaps we may be able to experience another person's *qualia* through what Ramachandran and Hirstein (1997) call a 'bridge of neurons'. Nevertheless, the brain may certainly evoke mind, but it's undeniable that mind can evoke universes beyond perception.

RÉSUMÉ DU CHAPITRE 5 : DISCUSSION

Évoquer et modifier la Réalité

Cette étude a ceci d'original qu'elle tente de confronter différents concepts concernant la présence en une seule et même représentation graphique qui soit cohérente. Bien que ce concept de « ER » et de « EP » ainsi que le modèle proposé nous offrent un moyen simplifié d'observer la réalité et la présence, il soulève beaucoup de questions.

Est-ce que l'expérience d'un état de conscience altéré (ASC), comme l'hallucination, le délire ou la psychose dus aux troubles mentaux, peut être considérée comme une sorte de Self-ER ? Revonsuo et al. (2009) ont redéfini l'ASC, comme l'état dans lequel la conscience se rapporte au monde d'une manière telle qu'elle implique de fausses représentations du monde ou de soi-même. Ils avancent que, pour être dans un état de conscience altéré, il faut s'écarter de la relation naturelle (de la conscience du monde) de telle sorte que le monde ou le soi aient tendance à être déformés (comme c'est observable dans les états réversibles comme le rêve, les épisodes psychotiques, les expériences de drogues psychédéliques, les crises d'épilepsie, et l'hypnose). Selon Ramachandran et Hirstein (1997), il se produit dans l'esprit des simulations mentales internes par l'utilisation d'attributs perceptifs moins vifs, en l'absence des manifestations sensorielles externes habituelles. Si elles possédaient une qualité perceptive maximale, elles deviendraient dangereuses et pourraient mener à des hallucinations. Ils font valoir que dans des cas comme des crises du lobe temporal, cette illusion (Self-ER) peut devenir

indiscernable de l'entrée sensorielle réelle et générer un sens erroné de la réalité (créer une situation permanente de Réalité Évoquée qui rend difficile le retour à la réalité primaire). Ainsi, les hallucinations dues à la Self-ER peuvent-elles être comparées à la réalité augmentée en raison de la Media-ER ?

A l'avenir, nous serons certainement capable de mesurer ou de calculer les expériences de présence plus efficacement et le Reality-Présence Map (la Carte Réalité-Présence) nous aidera à les étudier et à les catégoriser de manière à les rendre plus visibles. Bien que de nombreuses questions attendent encore une réponse, nous pourrions être capables de prédire les caractéristiques futures des environnements de réalité virtuelle et des médias associés. En observant les avancements actuels des technologies des médias, de l'art et du divertissement, nous pouvons prévoir vers quels types d'horizons ils se dirigent. Nous voudrions proposer un scénario qui pourrait avoir lieu dans un avenir proche, un point d'intersection de différents domaines de l'art et de la science.

Aesthetiographie : Le prochain Jalon dans la Confluence des Médias

Art et technologie ont toujours évolué simultanément, souvent en se complétant l'un l'autre et en s'inspirant l'un de l'autre. Ceci peut être observé à chaque étape de l'histoire des médias ; considérons par exemple l'évolution du Cinéma. La naissance de la «motion picture»(du film) a été un évènement car il a donné aux médias déjà existants comme la photographie une nouvelle dimension, celle du temps. L'euphorie qui l'a accompagnée trouvait son explication dans l'originalité de la manœuvre : enregistrer des images dans une séquence capable de présenter une partie d'un événement à un moment donné, contrairement à la photographie ou aux peintures. Bien que les premiers films en noir et blanc fussent silencieux, ils étaient généralement accompagnés de spectacles musicaux qui ont ajouté une notion d'ambiance. Le cinéma est ensuite devenu les parlant, avec le développement des technologies électroniques de l'enregistrement sonore qui ont facilité plus encore l'adjonction d'une nouvelle dimension perceptive, celle de l'audio, ce qui a rendu obsolètes les films muets. Progressivement, les films en couleur se sont multipliés et le cinéma a évolué depuis, tant en termes de styles artistiques et qu'en améliorations technologiques. L'introduction de l'enregistrement stéréo et des technologies de projection ont contribué à donner au cinéma (communément appelé en 3D) la dimension spatiale de la perception de la profondeur. Ces dernières années, la résolution visuelle a fait un bond en avant avec le développement de formats d'enregistrement comme l'IMAX et les caméras à haute résolution à la pointe des technologies. Les systèmes numériques d'enregistrement et de projection ont révolutionné l'expérience cinématographique dans les dernières décennies. Alors vers quels horizons les médias de représentation se dirigent-ils ?

Le cinéma, la réalité virtuelle, les jeux vidéo et les technologies qui sont associées aux médias et qui nous permettent de vivre des expériences ont pris des chemins d'évolution différents mais se retrouvent parfois sur la même route. Nous pensons qu'ils sont susceptibles de se croiser à un moment ou à un autre, mais toujours avec des intérêts qui leur sont propres. Les domaines axés sur l'art comme le cinéma s'emparent constamment du meilleur de la technologie, en s'adaptant rapidement aux évolutions, tandis que la réalité virtuelle et les technologies relatives aux jeux vidéo sont toujours à la recherche de solutions esthétiques et artistiques pour améliorer notre expérience de la présence dans la Réalité Évoquée. Bien que cela semble un peu farfelu aujourd'hui, nous avançons l'idée que l'objectif ultime des médias est le scénario

hypothétique d'une «Réalité Simulée», où l'on ne peut pas distinguer l'expérience virtuelle de celle du monde réel. Toutefois, à ce stade, un objectif précis concernant ces domaines est d'évoquer une illusion convaincante de l'expérience de la réalité, en utilisant des technologies d'immersion fortes qui affectent un maximum de sens possibles.

Ce point de rencontre du cinéma, de la réalité virtuelle et des technologies associées qui pourrait naître dans un futur proche, c'est ce que nous voudrions désigner par « Aesthetiographie », l'art et la science de la capture (ou de la création) et de la reproduction d'une expérience. Il s'agit des technologies de médias qui nous permettraient de capturer toute l'essence d'une expérience perceptive du monde réel, de la modifier, ou même de la synthétiser artificiellement de façon à ce qu'elle soit reproduite et expérimentée subséquemment ou en temps réel. La méthode de l'expérience, en particulier celle qui consiste à évoquer des Illusions Perceptives puissantes, sera mise au point par les technologies liées à la réalité virtuelle, alors que l'approche impliquant des Illusions Psychologiques intenses sera améliorée par le cinéma et les médias artistiques associés. Comme nous progressons vers un scénario qui impliquerait la poursuite passionnée d'un média ultime, comme beaucoup d'autres innovations technologiques, l'Aesthetiographie peut aussi faire apparaître de sérieux enjeux éthiques concernant le partage d'expériences.

Réalité dans une Réalité

Par ailleurs, la Reality-Presence Map (La Carte Réalité-Présence) nous permet d'examiner des concepts potentiels sur la réalité comme par exemple la possibilité d'une simulation au sein d'une simulation (Simulation within a Simulation - SWAS). La Carte Réalité-Présence pourrait être étendue et applicable à n'importe quel niveau de la réalité où pourrait se trouver une Réalité Primaire, la réalité de base, à laquelle nous revenons en cas d'absence de toute forme de Réalité Évoquée. Imaginons qu'un jour, nous atteignions une réalité parfaite simulée. Selon notre postulat, l'esprit est capable de l'accepter en tant que Réalité Primaire tant que l'expérience de la présence continue (ou jusqu'à ce qu'un « Break in Reality » (BIR) - une cassure dans la Réalité - se produise). Cela impliquerait, à un tel stade, que l'on puisse expérimenter la présence exactement comme dans la Réalité Primaire. Dans cette réalité parfaite simulée, si l'on expérimente la Media-ER (par exemple la réalité virtuelle) ou la Self-ER (par exemple un rêve), dès qu'une BIR se produit, on revient à cette réalité parfaite puisqu'il s'agit de la Réalité Apparente Immédiate. La Figure 64 tente d'illustrer ce cas avec la Réalité Rêvée (DR) et la Réalité Simulée (SR) comme deux pôles orthogonaux/opposés de la réalité.

De la même façon, du côté de la Self-ER, l'esprit peut engendrer un rêve dans un rêve (Dream within a Dream - DWAD). Quand on se réveille et qu'on s'extrait d'un rêve, on pourrait se retrouver dans la Réalité Rêvée Apparente à partir de laquelle il faudrait se réveiller encore pour se retrouver dans la Réalité Primaire. Cela peut-il concerner la façon dont les gens vivent ces réveils fictifs («false awakening», état hallucinatoire distinct de l'expérience de veille) ? La Figure 65 tente d'illustrer ce scénario de rêve dans un rêve.

En fait, cela attise notre curiosité quant au type de questions plus importantes à poser. Peut-il y avoir une Réalité Apparente avant notre Réalité Primaire ? D'une certaine manière, notre modèle tente de satisfaire plusieurs philosophies (ou théories) sur la réalité dans laquelle nous vivons. D'un point de vue matérialiste, la réalité primaire est notre réalité physique. Mais pour

un « Réaliste », il peut y avoir une réalité ultime au-delà de la Réalité Primaire ou même au-delà des possibilités de la Carte Réalité-Présence. D'après l'argument de simulation, il est certain que nous vivons presque dans un contexte de simulation informatique (Bostrom, 2003), dans lequel, ce que nous croyons être notre Réalité Primaire pourrait être une Réalité Simulée ; comparable au scénario qui présente des cerveaux dans une cuve (Putnam, 1982).

Metzinger (2009) a révélé que notre expérience de la Réalité Primaire est trompeuse et que nous éprouvons seulement une petite fraction de ce qui y existe réellement. Il suggère que rien d'autre que le « soi » n'existe et que l'expérience subjective est due à la façon dont notre conscience organise l'information sur le monde extérieur en formant une connaissance de soi à la première personne. Il affirme que tout ce nous expérimentons est en fait une Réalité Simulée et le processus en action de l'expérience consciente n'est pas tant une image de la réalité, mais un « tunnel de l'ego » à travers la réalité. Par conséquent, notre Réalité Primaire est-elle en fait la Réalité de base ? Sommes-nous toujours dans une sorte de Réalité Évoquée ?

Continuum de la Réalité

Ainsi, une autre question importante pourrait porter sur le point suivant : l'expérience d'une présence pure et non médiatisée dans notre réalité primaire. La Figure 66 tente de regrouper les différents niveaux de réalité comme un Continuum de Réalité. Ce qui revient à se demander à combien de niveaux nous sommes capables d'aller. Les avons-nous déjà visités sans le savoir, à travers nos rêves ? Les niveaux de la réalité peuvent-ils être représentés par une structure fractale interminable ? Dans tous les cas, serons-nous en mesure de comprendre tous les aspects de notre expérience de la réalité un jour ? En outre, la Carte Réalité-Présence peut-elle nous aider à étudier les concepts qui touchent à la conscience ?
Avec les avancées technologiques liées aux neurosciences, nous serons peut-être en mesure de retracer, à l'avenir, toutes les activités mentales correspondant à leurs corrélats neuronaux. Peut-être qu'un jour on pourra franchir la barrière de l'expression de notre expérience subjective des *qualia* en surmontant les biais humains pour communiquer avec précision nos expériences à la première personne (seulement pour comprendre ce qui est dit dans Dennett (1988, p.409) : "contrairement à ce qui semble évident à première vue, il n'y a simplement pas de *qualia* du tout"). Nous sommes également en mesure de faire l'expérience des *qualia* d'une autre personne à travers ce que Ramachandran et Hirstein (1997) nomment un « pont de neurones ». Cependant, le cerveau peut certainement évoquer l'esprit, mais il est indéniable que l'esprit peut évoquer des univers au-delà de la perception.

CHAPTER 6: PROSPECTS AND CONCLUSION

6.1 PROSPECTIVE CONTRIBUTIONS

6.1.1 Hypotheses Explored

As mentioned earlier, we began exploring presence from a VR perspective. So, the definitions of presence were found to be confined to VR and closely related media. However its influence spanned over a range of disciplines related to cognition. It is the reason why we attempted to put these diverse ideas on presence into a joint concept, so as to be examined from a global perspective.

The two main hypotheses put forward by this thesis were:

1. It is through an experience of an Evoked Reality (illusion of reality) that our mind experiences an Evoked Presence (sense of presence).
    - An Evoked Reality is either Media-Evoked or Self-Evoked.

2. An Evoked Reality is a subjective spatio-temporal experience.
    - These *qualia* of experience of Evoked Reality are what define Evoked Presence.

In order to confirm our hypotheses, at first we defined our concept of Evoked Reality - the spatio-temporal illusion of reality evoked in our mind, and Evoked Presence - the conscious experience of an ER. We clearly defined two kinds of ER - one that is evoked with the help of external mediation and the one that requires no mediation whatsoever. We subsequently examined the difference between Media-ER and Self-ER. It helped us observe where different cognitive experiences linked to virtual reality, simulated reality or dreams fall, in the large spectrum of our experiences. It led us to introduce the Three Pole Reality Model, which attempts to redefine the traditional concept of Reality-Virtuality Continuum. Eventually we proposed a graphical model that we call Reality-Presence Map, on which we may represent EP and ER relating to any cognitive experience one may have. We then studied the *qualia* of the experience of ER. We questioned the subjectivity of our cognitive experiences and attempted to analyze how and why we experience them, especially with the help of experiments. Two experiments were conducted, each for Media-ER and Self-ER respectively.

6.1.2 Research Questions Answered

In the first experiment, we had three main research questions that we were able to answer:

1. Any media can induce ER experience, including media with lower levels of immersion. We saw that even with the lack of perceptual immersion in media like narratives, it is possible to induce strong internal Perceptual Illusion. It was evident from the ER questionnaire responses that Media-ER evoked not just an illusion of space but an illusion of time as well, which strengthens our concept that Evoked reality is a combined spatio-temporal illusion of reality.

2. Presence questionnaires can be helpful in analysing presence evoked by a system, which can be eventually visually represented on Reality-Presence Map. We can pin-point the location of ER based on the presence score obtained. However, there is a need for better measurement techniques that can incorporate objectively analysing presence experiences in different kinds of media, over different immersive levels.

3. Physiological changes can help us compare presence evoked by different types of Media-ER. We noted that even a lower perceptually immersive media like textual narrative (but with no accompanying audio -visual media) evoked a strong ER, elevating the heart rates at specific points in time. The analyses of ER and Perceptual Illusion evoked during game and story support this idea as well.

In the second experiment we had two main research questions that we were able to respond to:

1. We definitely experience a sense of presence in Self-ER, specifically in mental imagery, similar to being in a virtual reality environment. In the case of virtual reality, presence is evoked since our external perception is mediated, leading to an illusion of reality similar to our physical world. In mental imagery the spaces are evoked endogenously by our mind without the help of any external perception, bringing about an experience of presence.

2. The sense of presence can be detected by objectively analysing verbal expressions, gestures and movements. We found that the verbal and physical expressions complemented each other and enabled the assembly of the externalization of the mental experience.

In the beginning we had raised the question paramount to this thesis research:
What is this common element in the experience of the sense of 'presence' with respect to diverse research disciplines?

Referring to the state-of-the-art, we proposed that the common constituent in any experience of a sense of presence be an 'illusion of reality' (whether created by an external mediation of senses or generated internally) evoked in our mind. Thus the concept of 'Evoked Reality' was born (Pillai et al., 2013a). With the help of further explorations and experiments, now we can see that this concept is in fact a new step towards understanding our experiences of reality (or illusion of reality) and associated presence (or sense of presence).

6.1.3 Objectives and Scope

The objectives of this thesis were:

1. To study how we experience presence and reality from disciplines within and outside virtual reality. (cf. **Chapter 2**)
2. To propose and justify the concept of Evoked Reality that would help in observing and defining the sense of presence from a global perspective. (cf. **Chapter 3A**)
3. To develop a graphical model that combines reality, presence, Evoked Reality and Evoked Presence in a coherent manner. (cf. **Chapter 3A, 3.4**)
4. To study the *qualia* of experience of presence and reality. (cf. **Chapter 3B**)
5. To suggest the future scope of Evoked Reality in the research of presence. (cf. **Chapter 4** and see sections below)

In the last 5 chapters, we achieved these objectives thoroughly. Although a stimulating concept, Evoked Reality still requires further research and analysis. There is a very long way to go, in order to understand our cognitive experiences, when subjected to different media. Only then, we may understand how to evoke stronger illusion of Media-ER. We must also examine in detail our internal Perceptual Illusions like mental imagery experiences and associated Psychological

Illusion in order to fully appreciate the effects and applications of Evoked Reality. Only then we may comprehend our experience of sense of presence, at least to certain extent.

6.1.4 Specific Contributions

With respect to the domain of virtual reality and communication media, our model may help analyse and compare the strength of ER and EP in different systems. The proposed concept suggests that our state of mind continuously shifts or fluctuates with time for which the graphical model could be used to locate one's state at any point in time.

This research work will definitely help in the better understanding of our notion of experience of presence, especially with respect to reality. Our concept may help different researchers to come together and explore presence and reality from a common perspective. The model also attempts to have consistency with various theories on reality and consciousness, so that researchers with different philosophical or psychological backgrounds with different views on reality may still be able to work together on presence. As the concept of Evoked Reality attempts to bring together different disciplines onto a common platform where we could study presence and reality from a macro level, it may help towards better understanding of our consciousness. We suggest that our concept may have significant applications in the future study of presence and reality.

6.1.5 Future Prospects

As we saw in **Chapter 4**, we were able to demonstrate that every media does evoke reality (as some researchers may agree). Thus we may be able to break the common notion among few VR researchers, that presence is only possible in higher forms of media like VR. We also observed how Reality-Presence Map can add to presence analysis and comparison of media through schematic representation of ER and EP. In future, with technological improvements, VR systems will gradually become powerful enough to bring ER closer and closer to Simulated Reality. Consequently, the Reality-Presence Map may help examine our consciousness and possibly regulate or control the experience levels for media, depending on specific guidelines for groups of people with different cognitive concerns.

Many questions still need to be addressed. How do we objectively measure presence in media with lower forms of immersion; like textual or simple audio narratives or pictures or paintings (with no interactivity)? Can we develop a generic presence questionnaire that may help compare presence in lower and higher media? Other measurement techniques like skin conductance or EEG may help define presence measurement over different immersion levels. These concerns require further study, numerous tests, and analysis.

Furthermore, at the moment there are no presence measurement techniques dedicated to Self-ER, although, there is enormous research work on understanding Self-ER in general (mental imagery, dreams, lucid dreams, altered states of consciousness, etc.). However, we were able to successfully provide evidence of presence in mental imagery (cf. **Chapter 4, 4.2.6**). The second experiment helped us reveal that sense of presence is experienced not just in virtual reality (or Media-ER), but also in mental imagery spaces (or Self-ER) that are completely evoked by our

minds. This helped us clarify that presence study should be opened up further and may not be confined to virtual reality or mediated virtual environments.

When it comes to analysing Self-ER, it's in fact even more difficult as the entire experience is internal. We may use either externalization techniques like behavioural or physiological data, or explore psychological activities or neural correlates, in order to go further into understanding Self-ER. In our second experiment we used externalization techniques, especially think aloud process. Although protocol analysis, gestures and movements contributed to the understanding of the nature of mental imagery experiences, some experiences were however hidden. This presented us with another challenge - how to differentiate between 'selective reporting', 'failure to report' and 'not experiencing at all'. Thus we believe that there is a need for further experiments that would contribute to the exploration of sense of presence in Self-ER. This experiment was efficient enough to detect presence in mental imagery experiences, it made us contemplate whether these experimental methods can be used in studying presence in Media-ER scenarios as well. How these methods could be efficiently extended to Media-ER (especially in virtual reality experiences) is also something to be explored in future.

6.2 CONCLUSION

In this study we explored presence and different elements that contribute to it. Presence is not just 'being there' but a combination of multiple feelings (Loomis, 1992; Steuer, 1992; Slater et al., 1994; Barfield et al., 1995; Steuer, 1995; Biocca, 1996; 1997; Kim and Biocca, 1997; Lombard and Ditton, 1997; Witmer and Singer, 1998) and most importantly 'experiencing reality'(Pillai et al., 2013a). The two main factors affecting presence due to mediation are Perceptual Illusion and Psychological Illusion. These factors evoke an illusion of reality in our mind in which we feel presence. We are constantly subjected to such illusions of reality, during which we experience presence differently from that of our apparent real world. This illusion of reality is called Evoked Reality (ER).

ER is not just media-evoked but can also be self-evoked. Media-ER may range from the mild effect of a painting to an extremely plausible immersive Virtual Reality experience while Self-ER may range from a simple thought to an exceptionally believable dream reality (the strength of ER may not necessarily be in the same order, as it depends on one's *qualia* and personal characteristics). This dual nature of ER led us to define three poles of reality: Primary Reality – the unaltered and unmediated Real World, Simulated Reality - the ultimate Media-ER (a perfect Virtual Reality condition) and Dream Reality - the ultimate Self-ER (a perfect dream condition). *Thus Evoked Reality is an illusion of reality formed in our mind, which is different from Primary Reality.* It's a combined illusion of space and events, or at least one of them. It is in this Evoked Reality, one would experience presence. Thus *Evoked Presence is the spatiotemporal experience of an Evoked Reality.*

The proposed Reality-Presence Map attempts to graphically illustrate the concept of ER and EP. This map provides a framework where the various experiences of ER could be mapped. The subjectivity of ER *qualia* and how these subjective factors affect Media-ER and EP were explained. The idea of Presence Threshold was also explored which formed the basis for different levels of EP and temporal Presence Shifts. Different possibilities like Simulation within

a Simulation and Dream within a Dream conditions were discussed with respect to the proposed model. However certain elements still demand clarifications to enhance the theory. The concept presented here may be an inception of a potential future research. We strongly consider that Evoked Reality and the proposed Reality-Presence Map could have significant applications in the study of presence and most importantly in exploring the possibilities of what we call 'reality'.

RÉSUMÉ DU CHAPITRE 6: PERSPECTIVES ET CONCLUSION

Les apports potentiels

Hypothèses envisagées

Comme mentionné précédemment, nous avons commencé à étudier la présence sous le prisme de la RV (Réalité Virtuelle). Ainsi, il se trouve que les définitions de la présence ont été limitées à la RV et étroitement liées aux médias. Cependant, son influence s'étend sur tout un panel de disciplines s'intéressant à la cognition. C'est la raison pour laquelle nous avons tenté de mettre ces différentes idées sur la présence dans un concept commun de façon à l'étudier d'un point de vue global. Les deux hypothèses principales envisagées dans cette thèse sont les suivantes :

1. C'est à travers l'expérience d'une Réalité Évoquée (illusion de la réalité) que notre esprit éprouve une Présence Évoquée (sentiment de présence).
    - Une Réalité Évoquée est soit Média-Évoquée soit Auto-Évoquée.

2. La Réalité Évoquée est une expérience subjective et spatio-temporelle.
    - Ces *qualia* de l'expérience de la Réalité Évoquée sont ce qui définit la Présence Évoquée.

En vue de valider nos hypothèses, nous avons d'abord défini notre concept de Réalité Évoquée (l'illusion spatio-temporelle de la réalité, évoquée dans notre esprit) ainsi que la Présence Évoquée (l'expérience consciente d'une Réalité Évoquée). Nous avons identifié deux types de ER, que nous avons définies clairement : celle qui est évoquée à l'aide de la médiation externe et celle qui ne nécessite de médiation d'aucune sorte. Nous avons ensuite étudié la différence entre la Media-ER et la Self-ER. Cela nous a permis d'observer où se situaient les différentes expériences cognitives liées à la réalité virtuelle, à la réalité simulée ou aux rêves dans le vaste éventail de nos expériences. Cela nous a amenés à introduire le modèle tripolaire de réalité, qui tente de redéfinir le concept traditionnel de continuum de la réalité-virtualité. Finalement, nous avons proposé un modèle schématique que nous avons appelé « La Carte Réalité-Présence », sur lequel on a pu représenter la EP et la ER induites par n'importe quelle expérience cognitive que l'on pourrait vivre. Nous avons ensuite étudié les *qualia* de l'expérience des ER. Nous avons interrogé la subjectivité de nos expériences cognitives et tenté d'analyser comment et pourquoi nous les ressentons, surtout avec l'aide d'expériences. Deux expériences ont été réalisées, l'une mettant en jeu les Media-ER et l'autre la Self-ER.

Questions de Recherche résolues

Dans la première expérience, nous avons posé trois questions de recherche principales auxquelles nous avons été en mesure de répondre :

1. Tous les médias peuvent induire l'expérience de la ER, y compris les médias ayant un faible niveau d'immersion. Nous avons vu que, même en l'absence d'immersion perceptive dans un média comme pour l'exemple des récits, il est possible d'induire une forte Illusion Perceptive intérieurement. Il était évident au vu des réponses du questionnaire sur la ER que la Media-ER évoquait non seulement une illusion d'espace, mais une illusion du temps aussi, ce qui renforce notre idée que la Réalité Évoquée est une illusion spatio-temporelle de la réalité.

2. Les questionnaires de présence peuvent se révéler utiles dans l'analyse de la Présence Évoquée par un système qui peut être représenté visuellement sur la Carte Réalité-Présence. Nous pouvons indiquer l'emplacement exact de la ER en fonction des résultats de présence obtenus. Cependant, il faudrait de meilleures techniques de mesure qui pourraient intégrer l'analyse objective des expériences de présence dans différents types de médias avec différents niveaux d'immersion.

3. Les changements physiologiques peuvent nous aider à comparer la Présence Évoquée induite par différents types de Media-ER. Nous avons constaté que même un média doté d'une immersion perceptive inférieure comme un récit (sans accompagnement d'éléments visuels ni audio) provoquait une forte ER, accompagnée d'une élévation de la fréquence cardiaque à des moments précis. Les analyses de l'Illusion Perceptive et la ER apparue au cours de l'expérience d'un jeu vidéo et de la lecture d'une nouvelle viennent conforter cette idée.

Dans la deuxième expérience, nous posions deux questions de recherche principales auxquelles nous avons été en mesure de répondre :

1. Nous éprouvons vraisemblablement un sentiment de présence dans la Self-ER, en particulier dans l'imagerie mentale, se rapprochant d'un sentiment de présence pouvant être ressenti dans un environnement de réalité virtuelle. Dans le cas de la réalité virtuelle, la présence est évoquée dès lors que notre perception externe est médiatisée, conduisant à une illusion de la réalité comparable à notre monde physique. Dans l'imagerie mentale, des espaces sont évoqués de façon endogène par notre esprit sans l'aide d'aucune perception externe, entraînant une sensation de présence.

2. Le sentiment de présence peut être décelé par l'analyse objective des expressions verbales, des gestes et des mouvements. Nous avons découvert que les expressions verbales et physiques étaient complémentaires et qu'elles permettaient de mettre sur pied les externalisations de l'expérience mentale.

Au début, nous avions posé la question essentielle de cette thèse :
Quel est l'élément commun dans l'expérience du sentiment de « présence » aux différentes disciplines de la recherche ?

Se référant à l'état des connaissances actuelles, nous avons proposé, en guise de réponse, que c'était l' « illusion de la réalité » (qu'elle soit créée par une médiation externe des sens ou générée en interne) évoquée dans notre esprit, qui était l'élément commun de toute expérience d'un sentiment de présence. C'est ainsi que naquit le concept de « Réalité Évoquée » (Pillai et al., 2013a). Grâce à l'étude et aux expériences, nous pouvons maintenant affirmer que ce concept

est en fait une nouvelle étape vers la compréhension de nos expériences de la réalité (ou l'illusion de la réalité) et de la présence associée (ou le sentiment de présence).

Objectifs et Champs

Les objectifs de cette thèse étaient les suivants :

1. Etudier la façon dont nous expérimentons la présence et la réalité au sein et au-delà la réalité virtuelle du point de vue des différentes disciplines (cf. Chapter 2).
2. Proposer et justifier le concept de Réalité Évoquée permettant d'observer et de définir le sens de la présence d'un point de vue global (cf. Chapter 3A).
3. Développer un modèle schématique qui combine réalité, présence, Réalité Évoquée et Présence Évoquée d'une manière cohérente (cf. Chapter 3A, 3.4).
4. Etudier les *qualia* de l'expérience de la présence et de la réalité (cf. Chapter 3B).
5. Proposer des perspectives impliquant la Réalité Évoquée dans la recherche sur la présence (cf. Chapter 4).

Au cours des 5 chapitres précédents, nous avons atteint ces objectifs en profondeur. Tout en étant un concept pertinent, la Réalité Évoquée nécessite encore des recherches et des analyses. Il y a encore beaucoup de chemin à parcourir afin de comprendre nos expériences cognitives, lorsque celles-ci sont soumises à différents médias. Ce n'est qu'à cette condition que l'on pourra comprendre comment évoquer une illusion plus forte de la Media-ER. Nous devons également étudier en détail nos Illusions Perceptives internes comme les expériences concernant l'imagerie mentale et l'Illusion Psychologique associée, afin d'apprécier pleinement les effets et les applications de la Réalité Évoquée. Alors seulement nous pourrons comprendre notre expérience du sens de la présence ne serait-ce qu'en partie.

Apports Spécifiques

En ce qui concerne le domaine de la réalité virtuelle et de la communication, notre modèle peut aider à analyser et à comparer l'intensité des ER et des EP dans différents systèmes. Le concept proposé suggère que notre état d'esprit se déplace continuellement ou fluctue avec le temps, aspect visible sur le modèle schématique qui peut être utilisé pour localiser son état à tout moment.

Ce travail de recherche va certainement aider à une meilleure compréhension de notre concept d'expérience de la présence, en particulier en ce qui concerne la réalité. Notre concept peut inciter les chercheurs à se réunir pour étudier la présence et la réalité à partir d'un point de vue commun. Le modèle tente également de développer une cohérence avec les différentes théories sur la réalité et la conscience, afin que les chercheurs de différents domaines philosophiques ou psychologiques, partageant différents points de vue sur la réalité, puissent être encore capables de travailler ensemble sur la présence. Comme le concept de Réalité Évoquée tente de mettre d'accord les différentes disciplines afin de trouver un cadre commun à partir duquel nous pourrions étudier la présence et la réalité de manière plus vaste, il est susceptible de fournir une meilleure compréhension de notre conscience. Nous pensons que notre concept peut avoir des applications significatives dans les études menées à l'avenir sur la présence et la réalité.

Perspectives Futures

Nous avons réussi à démontrer que tous les médias évoquaient la réalité (comme certains chercheurs en conviennent). Par conséquent, nous avons été en mesure de revenir sur la notion commune à certains chercheurs adeptes de la RV qui pensent que la présence n'est possible que dans des formes supérieures de médias comme la RV immersive. Nous avons également observé comment la Carte Réalité-Présence peut apporter sa contribution dans l'analyse et la comparaison de la présence provoquée par différents médias à travers la représentation schématique de la ER et de la EP. Avec les améliorations technologiques qui se profilent à l'horizon, les systèmes de réalité virtuelle devraient progressivement devenir assez puissants pour faire que la ER se rapproche encore plus de la Réalité Simulée. Par conséquent, la Carte Réalité-Présence peut aider à étudier notre conscience et même à réglementer ou contrôler les niveaux d'expérience pour les médias, en fonction des directives spécifiques pour des groupes de personnes avec différents types de problèmes cognitifs.

De nombreuses questions doivent encore être tranchées. Comment peut-on mesurer objectivement la présence dans les médias avec les formes inférieures de l'immersion comme les récits (lus ou entendus), les images ou les peintures (sans interactivité) ? Peut-on élaborer un questionnaire sur la présence générique susceptible d'aider à comparer la présence dans les médias inférieurs et supérieurs ? D'autres techniques de mesure comme la conductance de la peau ou l'EEG peuvent aider à définir la mesure de la présence à partir de niveaux d'immersion différents. Ces aspects nécessitent une étude plus approfondie, de nombreux tests et analyses.

En outre, actuellement il n'existe pas de techniques de mesure de présence dédiées à la Self-ER, bien qu'il y ait un travail de recherche énorme sur la compréhension de la Self-ER en général (imagerie mentale, rêves, rêves lucides, états altérés de conscience, etc.). Cependant, nous avons réussi à fournir la preuve de la présence dans l'imagerie mentale (cf. Chapitre 4, 4.2.6). La deuxième expérience nous a permis de révéler que le sentiment de présence est éprouvé non seulement dans la réalité virtuelle (ou Media-ER), mais également dans les espaces d'imagerie mentale (ou Self-ER) qui sont entièrement évoqués par nos esprits. Cela nous a permis de préciser que l'étude sur la présence devait être davantage étendue et ne devait pas se limiter à la réalité virtuelle ou à la médiation des environnements virtuels.

L'analyse de la Self-ER, quant à elle, est encore plus complexe car toute l'expérience se fait en interne. Nous pouvons utiliser des techniques comme l'externalisation des données comportementales ou physiologiques, ou explorer les activités psychologiques ou les corrélats neuronaux, afin d'approfondir la compréhension de la Self-ER. Dans notre deuxième expérience, nous avons utilisé des techniques d'externalisation, en particulier les procédés qui consistaient à penser tout haut. Bien que l'analyse des protocoles, des gestes et des mouvements ait contribué à la compréhension de la nature des expériences d'imagerie mentale, certaines expériences ont cependant été occultées. Cela nous a mis face à un autre défi : comment faire la différence entre « rapports sélectifs », « omissions de déclaration » et « absence d'expérience ». Ainsi, nous croyons qu'il serait pertinent que des recherches à venir portent sur le sens de la présence dans la Self-ER. Cette expérience a été suffisamment efficace pour déceler la présence dans les expériences d'imagerie mentale pour nous amener à nous demander si ces méthodes expérimentales pouvaient être utilisées pour étudier la présence dans les scénarios de la Media-ER. Comment ces méthodes pourraient être appliquées efficacement et de manière pertinente

aux Media-ER (en particulier dans les expériences de réalité virtuelle) est aussi quelque chose qu'il faudrait explorer à l'avenir.

Conclusion

Dans cette étude, nous avons étudié la présence et les différents éléments qui s'y rapportent. La Présence n'est pas seulement synonyme de « Being There » (« Etre là »), mais elle est une combinaison de sentiments multiples (Steuer, 1992; Slater et al., 1994; Barfield et al., 1995; Steuer, 1995; Kim and Biocca, 1997; Lombard and Ditton, 1997; Witmer and Singer, 1998) et surtout de « l'expérience de la réalité » (Pillai et al., 2013a). Les deux facteurs principaux qui affectent la présence par le biais de la médiation sont l'Illusion Perceptive et l'Illusion Psychologique. Ces facteurs évoquent une illusion de la réalité dans notre esprit dans lequel nous sentons la présence. Nous sommes constamment soumis à de telles illusions de la réalité, au cours desquelles nous expérimentons la présence d'une manière différente de celle de notre monde réel apparent. Cette illusion de la réalité est appelée Réalité Évoquée (ER).

La ER n'est pas seulement média-évoquée, mais peut également être auto-évoquée. La Media-ER (Réalité Média-Évoquée) peut varier de l'effet léger d'une peinture à une expérience extrêmement convaincante de la réalité virtuelle immersive, tandis qu'une Self-ER (réalité auto-évoquée) peut varier d'une simple pensée à une réalité rêvée extraordinairement palpable (l'intensité de la ER n'est pas nécessairement dans le même ordre, car elle dépend de ses *qualia* et des caractéristiques personnelles de chacun). Cette dualité de la ER nous a conduit à définir trois pôles de la réalité :

- La Réalité Primaire : le monde réel, non-modifié et non-médiatisé;
- La Réalité Simulée : la Media-ER la plus élevée (une réalité virtuelle parfaite) ;
- La Réalité Rêvée : la Self-ER la plus élevée (un état de rêve parfait).

Ainsi, la *Réalité Évoquée est une illusion de la réalité formée dans notre esprit qui est différente de la Réalité Primaire.* C'est une illusion combinée d'espaces et d'événements (ou seulement d'espaces, ou seulement d'évènements). C'est dans cette Réalité Évoquée qu'on peut expérimenter la présence. Ainsi, *la Présence Évoquée est l'expérience spatio-temporelle d'une Réalité Évoquée.*

La Carte Réalité-Présence présentée tente d'illustrer graphiquement les concepts de ER et de EP. Ce schéma fournit un cadre dans lequel les différentes expériences de la ER peuvent être schématisées. La subjectivité des *qualia* dans la ER et les raisons pour lesquelles ces facteurs subjectifs affectent la Media-ER et la EP ont été expliquées. L'idée de seuil de présence, fondant la base pour différents niveaux de la EP et pour des déplacements temporels de présence, a également été étudiée. Différentes possibilités telles que la simulation au sein d'une simulation et un rêve dans un rêve ont été proposées au regard du modèle développé. Cependant, certains éléments attendent encore des éclaircissements susceptibles de compléter la théorie. Le concept présenté ici est le commencement d'une recherche potentielle pouvant être menée à l'avenir. Nous considérons fermement que la Réalité Évoquée et la Carte Réalité-Présence proposées auront des applications significatives dans l'étude de la « présence » et permettront notamment d'explorer les possibilités de ce que nous appelons la « réalité ».

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APPENDICES

Appendix 1: Glossary of Terms

Definitions of Terms

Telepresence	:	The feeling of being present in a different location than one's true physical location, with the help of different systems like teleoperation or telerobotics.
Teleoperation	:	The ability to virtually present oneself and control objects or events in a different location away from one's true physical location.
Being There	:	The feeling of being present in a location presented by a medium, than one's true physical location.
Presence	:	The feeling of being present inside a reality evoked by a virtual environment. All existing definitions can be found in **Chapter 2, Section 2.1.2.**
Suspension of Disbelief	:	The act of willingly accepting and immersing oneself into the illusion of realty depicted by a medium.
Media	:	The different means of communication.
Mediation	:	The process of providing sensory information by the media.
Sensation	:	The first stage in the functioning of senses that detects and represents stimuli from the environment.
Perception	:	Higher brain function that interprets sense data from events and objects in the world, and creates useful information of the surroundings from the detected stimuli.
Qualia	:	One's subjective conscious experience. The way, things seem to us.
Experience	:	A state of undergoing observable events.
Phenomenology	:	Study of the structures of subjective experience and consciousness.
Mental Imagery	:	The mental experience of perceiving objects, spaces or events (significantly resembling external perception), while in fact none of those is actually present to the senses.
Cognition	:	The mental processes involved in acquiring knowledge and comprehension. The mental processes include attention, remembering, learning, reasoning, problem solving and decision making.

Cognitive Science	:	Interdisciplinary study of mind and cognition, spanning over multiple research disciplines, like philosophy, psychology, artificial intelligence, neuroscience, linguistics and anthropology.
Consciousness	:	The state of being aware. The faculty of conscious experience.

Definitions proposed in this thesis research

Perceptual Illusion	:	The experience that our mind undergoes when presented with either deceptive sensation of external stimuli or a sensation of internal stimuli without external perception. The illusion of perceiving objects or spaces that are physically not present. (but evoked either by mediating our external perception with the help of different media or endogenously evoking internal perception in the mind)
Psychological Illusion	:	Cognitive responses associated with the induced Perceptual Illusion.
Evoked Reality	:	A spatio-temporal illusion of reality, evoked in the mind.
Evoked Presence (sense of presence)	:	The conscious experience of being in an Evoked Reality. (Note that this is just a sense of presence evoked in the mind)
Presence (general)	:	The conscious experience of being in a reality.
Media- Evoked Reality (Media-ER)	:	Illusion of reality evoked or maintained with the help of external mediation.
Self- Evoked Reality (Self-ER)	:	Illusion of reality evoked endogenously in the mind, without the help on an external mediation.
Primary Reality	:	The experience of the real world, with respect to our primary perception and associated cognition.
Primary Presence (real presence)	:	Presence experienced in the Primary Reality. (This is what some may call the real presence, as opposed to the sense of presence)
Simulated Reality	:	The theoretical threshold of Media-ER. The point at which Media-ER would evoke presence indistinguishable to the presence in Primary Reality. So, one would consider it as the Primary Reality.
Dream Reality	:	The theoretical threshold of Self-ER. The point at which Self-ER would evoke presence indistinguishable to the presence in Primary Reality. So, one would consider it as the Primary Reality.

Simulation within a Simulation	:	The hypothetical scenario of being in a reality, which one may eventually find out as been a Simulated Reality which was in fact inside another one. This illusory experience may be realized when presence in the Simulated Reality is broken, to find oneself in what may seem like Primary Reality, and then broken once again to find oneself in the Primary Reality.
Dream within a Dream	:	The illusion of being in a reality, which one would eventually find out as been a dream that was indeed part of another dream. This illusory experience is usually realized when someone wakes up from a dream only to find himself waking up once again in the Primary Reality.

Appendix 2: List of Abbreviations

VR	:	Virtual Reality
ER	:	Evoked Reality
DR	:	Dream Reality
SR	:	Simulated Reality
PR	:	Primary Reality
Media-ER	:	Media-Evoked Reality
Self-ER	:	Self-Evoked Reality
VE	:	Virtual Environment
BIP	:	Break in Presence
BIR	:	Break in Reality
DWAD	:	Dream within a Dream
SWAD	:	Simulation within a Simulation
PQ	:	Presence Questionnaire
SUS	:	Slater-Usoh-Steed (Questionnaire)
ITC-SOPI	:	ITC-Sense of Presence Inventory (Questionnaire)
ASC	:	Altered States of Consciousness

Appendix 3: Questionnaires (Experiment 1)

Before Experiment

General Information and Gaming Experience

(For classification of gamers and non-gamers and analysis of average resting heart rate)

1. Informations
   - Nom et Prenom
   - Age
   - Sexe
   - Profession
2. Jouez vous au jeu vidéo?
3. Répondez aux questions suivantes si vous avez répondu positivement à la précédente.
   Combien de temps passer vous à jouer sur chaque support de 0 à 7 ?
   - PC
   - Console de salon
   - Console portable
   - Jeu sur téléphone

   Combien de temps pensez-vous passer sur chaque type de jeu, de 0 à 7 ?
   - FPS (jeu en vue à la première personne : Doomlike, COD, MWF, Battlefield
   - Simulateurs (Avion, FSX, voiture de courses...)
   - Jeux d'aventures (Jeu en vue à la troisième personne : Lara Croft, Assasin's Creed...)
   - Jeux multijoueur massifs (Jeu en vue à la troisième personne : WOW...)
   - Jeux de plateform 2D et 3D (Mario, Sonic, Megaman, Donkey Kong...)
   - Jeux de sport (Football, Hockey, FIFA, PES...)
   - Casual Game (Réflexion, adresse, Tiny Wings, Angry Birds, Doodle Jump ...)

Immersive Tendency Questionnaire (original | English)

(All questions were to be answered as 'yes' or 'no', Question 7. had options for multiple responses, Question 8. had the options 'bad', 'average' and good')

1. Do you easily become deeply involved in movies or TV dramas?
2. Do you ever become so involved in a television program or book that people have problems getting your attention?
3. How mentally alert do you feel at the present time?
4. Do you ever become so involved in a movie that you are not aware of things happening around you?
5. How frequently do you find yourself closely identifying with the characters in a story line?
6. Do you ever become so involved in a video game that it is as if you are inside the game rather than moving a joystick and watching the screen?
7. What kind of books do you read most frequently? (Circle one item only!)

Spy novels	Fantasies	Science fiction
Adventure	Romance novels	Historical novels

Westerns	Mysteries	Other fiction
Biographies	Autobiographies	Other non-fiction

8. How physically fit do you feel today?
9. How good are you at blocking out external distractions when you are involved in something?
10. When watching sports, do you ever become so involved in the game that you react as if you were one of the players?
11. Do you ever become so involved in a daydream that you are not aware of things happening around you?
12. Do you ever have dreams that are so real that you feel disoriented when you awake?
13. When playing sports, do you become so involved in the game that you lose track of time?
14. How well do you concentrate on enjoyable activities?
15. How often do you play arcade or video games? (OFTEN should be taken to mean every day or every two days, on average.)
16. Have you ever gotten excited during a chase or fight scene on TV or in the movies?
17. Have you ever gotten scared by something happening on a TV show or in a movie?
18. Have you ever remained apprehensive or fearful long after watching a scary movie?
19. Do you ever become so involved in doing something that you lose all track of time?

After Experiment

Questionnaire Attention Allocation

1. Avez-vous perçus des mots qui s'affichaient sur un écran en dehors de l'espace du jeu ?
2. Si oui, combien de mots....
3. Pouvez-vous retranscrire ces mots ci-dessous ?

Questionnaire Subjectif Emotionnel

1. De 0 à 7, Comment vous êtes-vous senti angoissé ?
2. De 0 à 7, Comment avez-vous eu peur ?
3. De 0 à 7, Comment avez-vous été surpris ?

Presence Questionnaire (PQ) (original | English)
(All questions were to be answered as a number within a Likert scale of 7)

1. How much were you able to control events?
2. How responsive was the environment to actions that you initiated (or performed)?
3. How natural did your interactions with the environment seem?
4. How much did the visual aspects of the environment involve you?
5. How much did the auditory aspects of the environment involve you?
6. How natural was the mechanism which controlled movement through the environment?
7. How compelling was your sense of objects moving through space?
8. How much did your experiences in the virtual environment seem consistent with your real-world experiences?

9. Were you able to anticipate what would happen next in response to the actions that you performed?
10. How completely were you able to actively survey or search the environment using vision?
11. How well could you identify sounds?
12. How well could you localize sounds?
13. How well could you actively survey or search the virtual environment using touch?
14. How compelling was your sense of moving around inside the virtual environment?
15. How closely were you able to examine objects?
16. How well could you examine objects from multiple viewpoints?
17. How well could you move or manipulate objects in the virtual environment?
18. How involved were you in the virtual environment experience?
19. How much delay did you experience between your actions and expected outcomes?
20. How quickly did you adjust to the virtual environment experience?
21. How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?
22. How much did the visual display quality interfere or distract you from performing assigned tasks or required activities?
23. How much did the control devices interfere with the performance of assigned tasks or with other activities?
24. How well could you concentrate on the assigned tasks or required activities rather than on the mechanisms used to perform those tasks or activities?

Slater-Usoh-Steed Questionnaire (SUS) (original | English)
(All questions were to be answered as a number within a Likert scale of 7)

1. Please rate your *sense of being in the* virtual environment, on a scale of 1 to 7, where 7 represents your *normal experience of being in a place.*
2. To what extent were there times during the experience when the virtual environment was the reality for you?
3. When you think back to the experience, do you think of the virtual environment more as *images that you saw* or more as *somewhere that you visited*?
4. During the time of the experience, which was the strongest on the whole, your sense of being in the virtual environment or of being elsewhere?
5. Consider your memory of being in the virtual environment. How similar in terms of the *structure of the memory* is this to the structure of the memory of other *places* you have been today? By 'structure of the memory' consider things like the extent to which you have a visual memory of the virtual environment, whether that memory is in colour, the extent to which the memory seems vivid or realistic, its size, location in your imagination, the extent to which it is panoramic in your imagination, and other such *structural* elements.
6. During the time of your experience, did you often think to yourself that you were actually in the virtual environment?

Evoked reality Questionnaire - Game & Story (original | English)

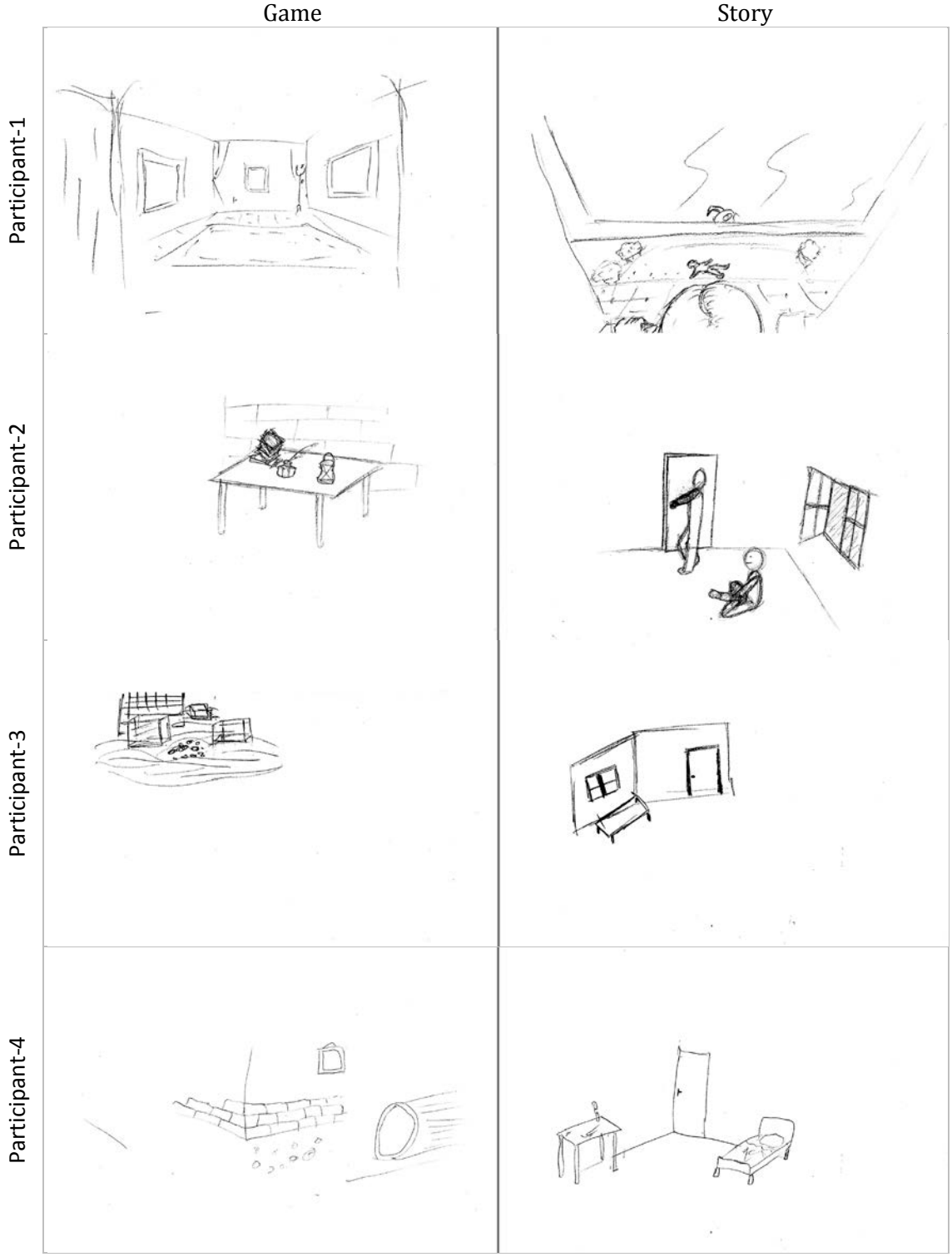
	Game	Story
	Perception of Space	**Perception of Space**
1	Were you able to experience the scenario in your mind along with the game?	Were you able to experience the story in your mind along with the reading?
2		Did you see the events in story from the point of view of the narrator?
3		If no, from whose (or which) point of view did you see the events?
4	Were you able to instantaneously change where you looked using the controls?	Were you able to instantaneously change where you looked according to the narration?
5	When you think of the environment in the game do you remember it as a place you have visited some time before?	When you think of the environment in the story do you remember it as a place you have visited some time before?
6		Did you experience vivid images evoked in your mind?
7	Were the images in the game very realistic (similar to the real world)?	If yes, were they very realistic in your mind (similar to the real world)?
8	Please draw or sketch roughly few things that you remember as images in your mind?	If yes, Please draw or sketch roughly few things that you remember as images in your mind?
9	Did you experience the effects of sounds during the game?	Did you experience the feeling of sounds in your mind, due to the narration of the story environment?
10	If yes, were they very realistic (similar to the real world)?	If yes, were they very realistic in your mind (similar to the real world)?
11	If yes, Please mention them here:	If yes, Please mention them here:
12	Did you experience the feeling of smell in your mind, due to the game environment?	Did you experience the feeling of smell in your mind, due to the narration of the story environment?
13	If yes, were they very realistic (similar to the real world)?	If yes, were they very realistic in your mind (similar to the real world)?
14	If yes, Please mention them here:	If yes, Please mention them here:

	Perception of Time (Please answer from memory, without referring to a watch or a clock)	**Perception of Time** (Please answer from memory, without referring to a watch or a clock)
15	How much time do you think you spent in the Experiment Room?	How much time do you think you spent in the Experiment Room?
16	According to you, for how much time did the events inside the game environment take place.	According to you, for how much time did the events inside the story environment (in the room) take place.
17	At any point of time did you forget that you were in an experiment room?	At any point of time did you forget that you were in an experiment room?
18	If yes, when (at which points)?	If yes, when (at which points)?
19	At any point of time did you forget that you were playing but experiencing the events intuitively?	At any point of time did you forget that you were reading but seeing the events in mind intuitively?
20	If yes, when (at which points)?	If yes, when (at which points)?
21	At any point of time did you disconnect from the experiment due to unrelated thoughts in mind? (E.g. Remembering an appointment, thinking about someone, feeling hungry, feeling to go to the toilet, etc)	At any point of time did you disconnect from the experiment due to other thoughts in mind? (E.g. Remembering an appointment, thinking about someone, sudden need to go to the toilet, etc)
22	If yes, when (at which points)?	If yes, when (at which points)?
23	If yes, Please mention them here - Thought: What triggered the thought (if you know):	If yes, Please mention them here - Thought: What triggered the thought (if you know):
	Comments	**Comments**
24	If you had any other experiences in particular during the experiment, please mention here:	If you had any other experiences in particular during the experiment, please mention here:
25	If you have any other comments, please write here:	If you have any other comments, please write here:

Table 8: Evoked reality Questionnaire - Game & Story [source: author]

Appendix 4: Sketches (Experiment 1)

Sketched Images (Game and Story)



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	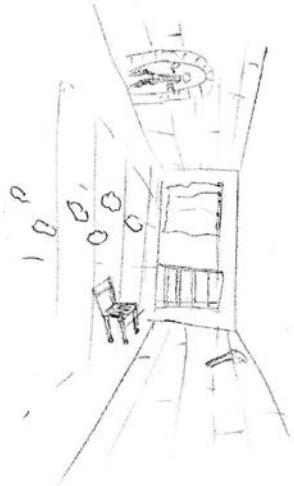	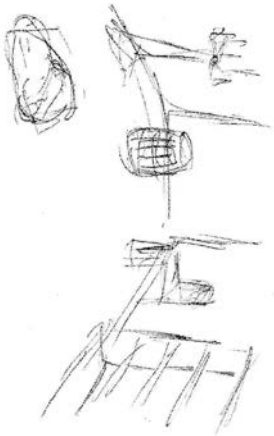	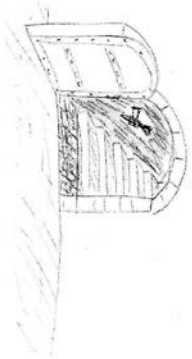	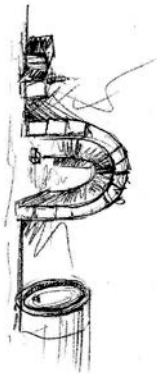
		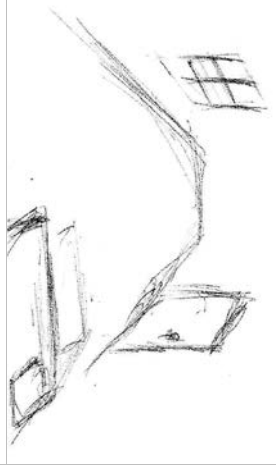	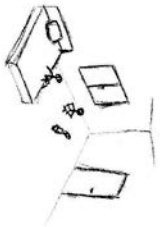	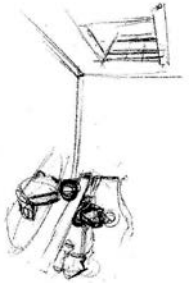

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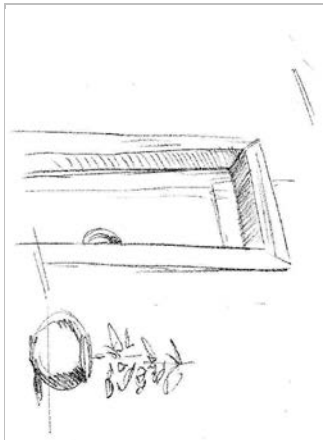	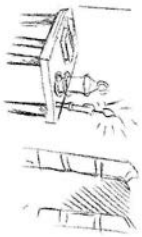	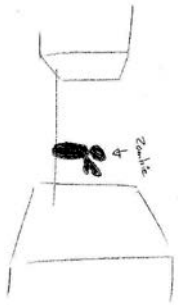	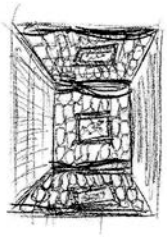	
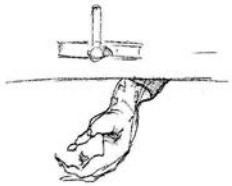	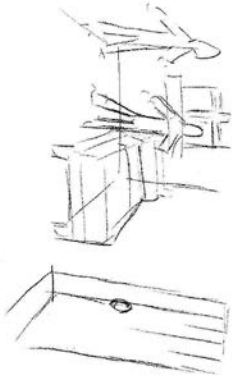		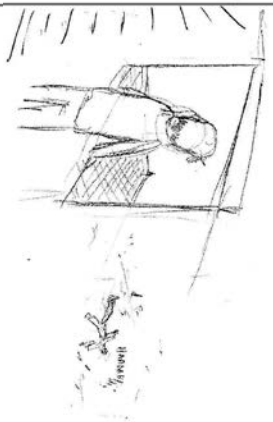	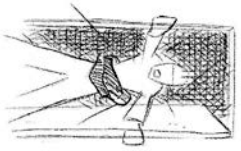

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	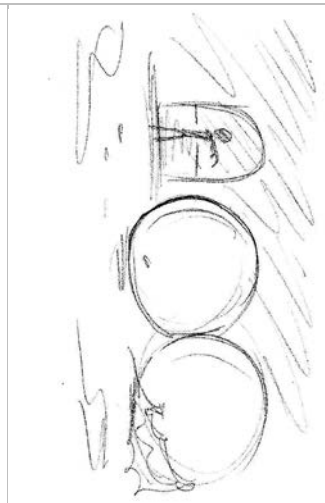	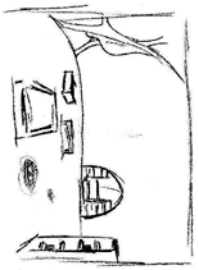	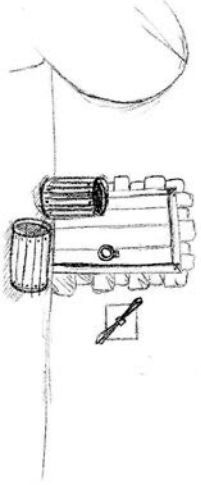	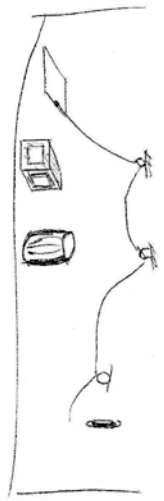
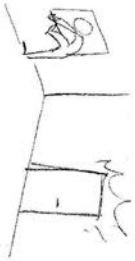	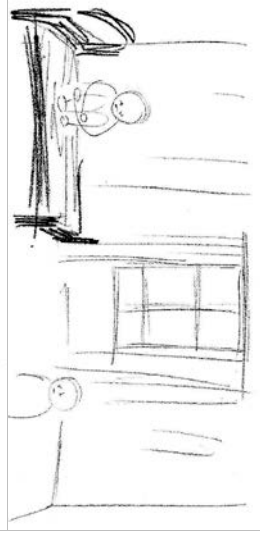	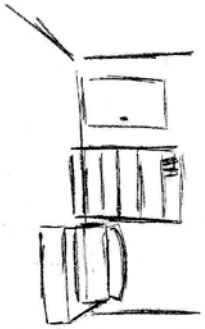	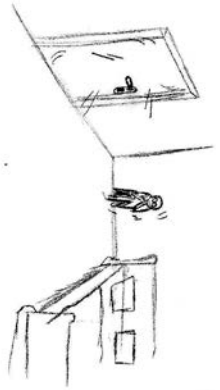	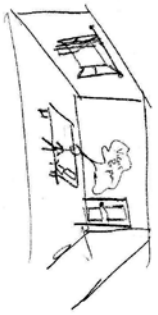

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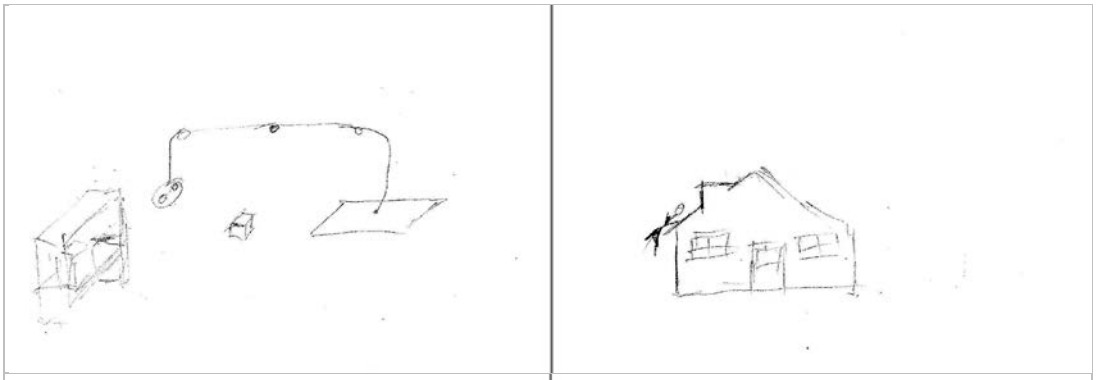

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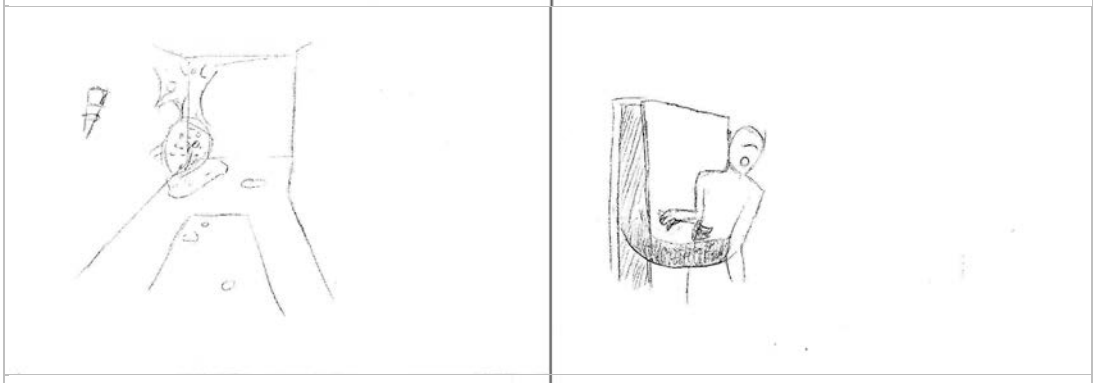

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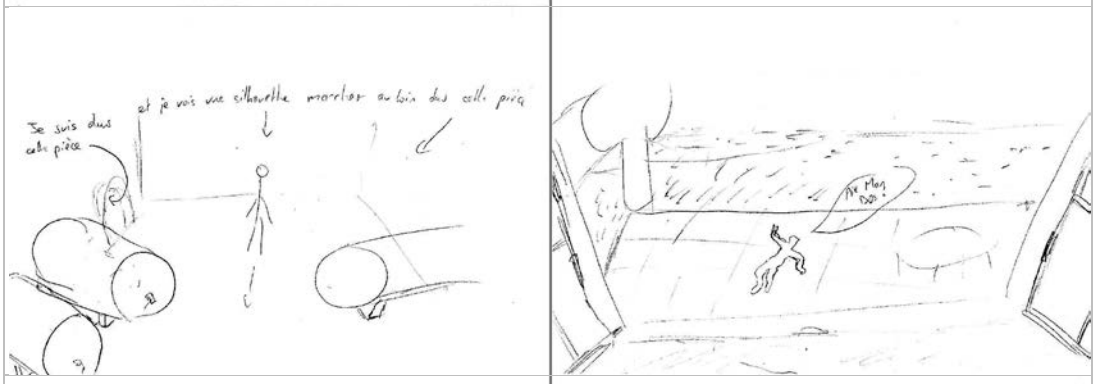

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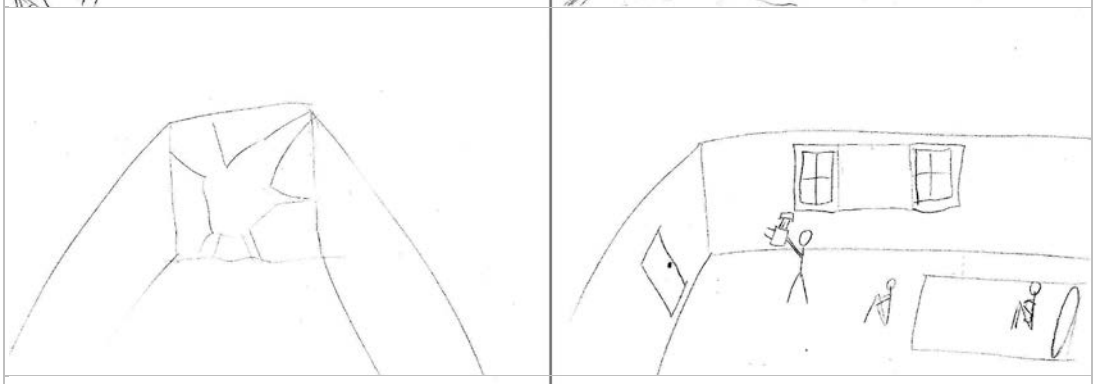

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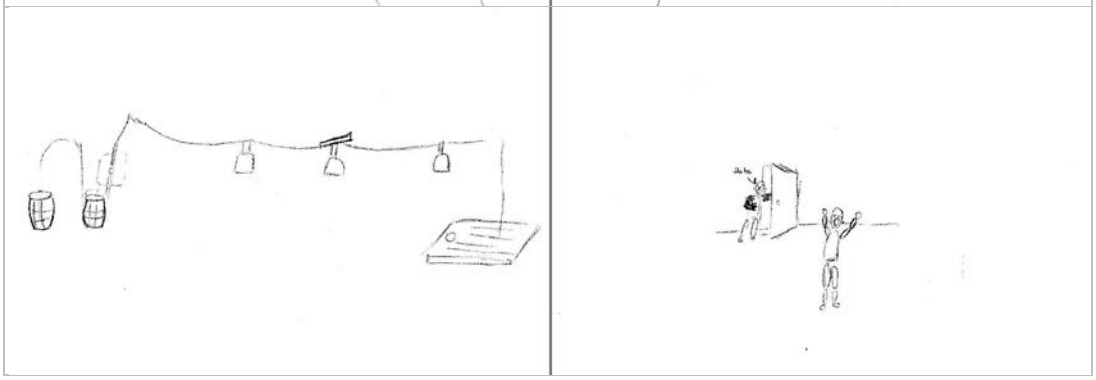

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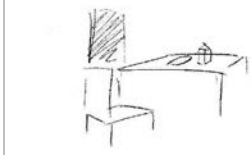

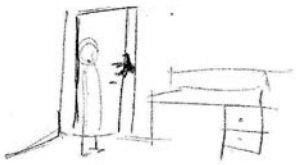

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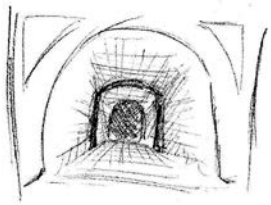

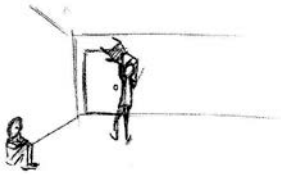

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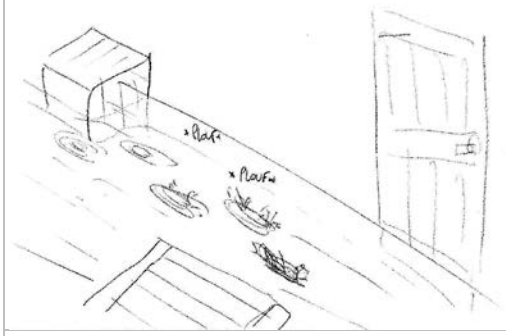

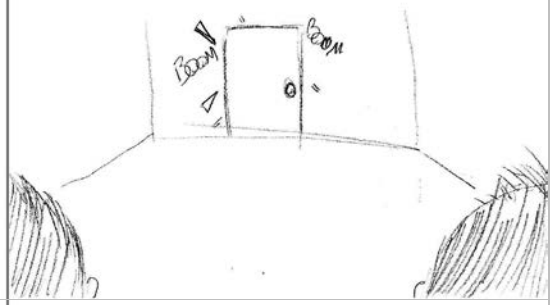

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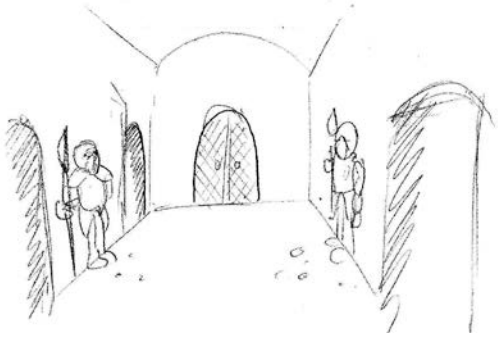

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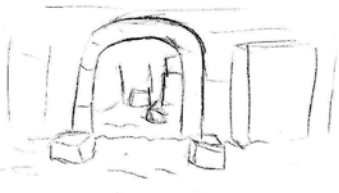


Analysis of sketched elements (Game)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	TOTAL
Space / Objects	Walls	x	x		x			x		x	x	x	x	x			x		x	x		x		x			x		x	x	18
	Wall Texture		x		x	x	x		x		x	x		x			x		x								x				11
	Arch Opening					x	x			x				x				x	x				x				x		x	x	10
	Opening / Door	x					x								x	x	x				x							x	x	x	12
	Boxes / Crates			x		x										x		x		x	x						x		x		8
	Barrel				x	x		x								x	x		x				x								8
	Water			x		x												x		x		x							x		6
	Splashes			x														x		x		x						x			5
	Lantern / Candle		x			x		x						x												x					5
	Steps						x																								1
	Table / Shelf / Artifact		x	x				x	x						x			x										x	x	10
	Web / Slime										x							x	x	x		x		x							6
	Blood Spots				x			x	x										x										x		5
	Corridor																					x					x		x		3
	Paintings on walls	x			x							x																			3
	Torch on wall						x		x													x									3
	Pulley / Handle															x	x				x				x						4
Characters	Monster								x	x			x						x				x								5
	No Characters	x	x	x	x	x	x	x			x	x		x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	24
	Player Himself																						x								1
Point of View	First Person View with Narrator																														0
	First Person View	x				x	x	x	x			x	x	x			x	x	x	x		x					x	x	x	x	17
	Third Person View																						x								1
	Ambiguous View		x	x	x					x	x				x	x					x			x	x	x					11
Game Level	Level 1	x	x				x		x			x		x	x											x			x		9
	Level 2							x	x	x			x			x	x	x	x		x		x				x				11
	Level 3			x		x					x							x		x		x		x				x		x	9
Representation	Dialogue / Label									x			x										x								3
	Perspective view	x		x	x	x	x	x	x			x	x		x		x	x	x	x		x	x			x	x	x	x	21
	Frame / Boundary									x		x				x		x									x				5

Table 9: Distribution of visual elements in the sketches (Game) [source: author]

Analysis of sketched elements (Story)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	TOTAL
Space / Objects	Door		x	x	x		x	x	x	x	x			x	x	x	x	x		x	x	x		x	x			x	x	23
	Window	x	x	x		x	x	x	x			x		x		x			x	x	x		x	x				x		15
	Walls			x	x	x	x		x							x	x	x	x						x		x	x			14
	Bed			x	x	x	x	x	x					x		x	x	x	x					x				x			13
	Carpet							x	x																						2
	Table				x				x																	x					3
	Chair																							x			x		x		3
	Roof Below	x										x									x		x								4
	Shelf								x																						1
	Lawn Outside	x										x											x								3
	Monster Hand									x	x				x										x	x			x		7
Events	Talking		x			x	x		x				x																		5
	Sitting		x			x	x		x								x							x							9
	Standing		x							x		x		x						x				x		x		x			10
	Knocking																x			x							x				3
	Facial Expressions									x	x		x				x		x			x			x			x	x		9
	Falling / Fallen	x										x									x										4
Characters	Arnaud		x			x	x		x	x	x		x	x		x	x		x			x		x	x			x	x		19
	David	x				x	x		x			x								x	x			x							11
	No Characters			x	x			x							x			x													5
	Narrator Himself		x			x	x		x			x		x		x			x					x	x			x			11
Point of View	First Person View with Narrator	x										x																	x		3
	First Person View												x				x			x						x					6
	Third Person View		x			x	x		x					x		x			x					x	x		x		x		11
	Ambiguous View			x	x			x		x	x				x			x			x	x									9
Representation	Dialogue												x				x						x		x						4
	Perspective view	x	x				x		x		x	x		x		x	x	x	x			x	x		x	x	x	x			19
	Frame / Boundary																														0

Table 10: Distribution of visual elements in the sketches (Story) [source: author]

Appendix 5: Summary of Responses (Experiment 2)

Physical Walk (Average)		
Location	Time-stamp	Seconds
IDC Entrance	00:00	0
Echo Point	00:30	30
Turn right after Civil Dept	02:03	123
Nescafe	03:14	194

Guiding (Task 1)																							
	Participant 1			Participant 2			Participant 3			Participant 4			Participant 5			Participant 6			Participant 7			Participant 8		
Location	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio
IDC Entrance	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00
Echo Point	00:37	37	0.81	00:16	16	1.88	00:10	10	3.00	00:14	14	2.14	00:09	9	3.33	00:06	6	5.00	00:04	4	7.50	00:12	12	2.50
Turn right after Civil Dept	02:26	146	0.84	00:31	31	3.97	00:59	59	2.08	00:44	44	2.80	00:33	33	3.73	00:30	30	4.10	00:22	22	5.59	00:58	58	2.12
Nescafe	03:32	212	0.91	00:57	57	3.39	01:27	87	2.22	01:14	74	2.61	00:48	48	4.03	01:22	82	2.36	00:34	34	5.69	01:28	88	2.20

Mental Walk (Task 2)																							
	Participant 1			Participant 2			Participant 3			Participant 4			Participant 5			Participant 6			Participant 7			Participant 8		
Location	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio	Time-stamp	Seconds	Speed Ratio
IDC Entrance	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00	00:00	0	0.00
Echo Point	00:22	22	1.36	00:24	24	1.25	00:36	36	0.83	00:16	16	1.88	00:16	16	1.88	00:08	8	3.75	00:09	9	3.33	00:27	27	1.11
Turn right after Civil Dept	01:27	87	1.41	00:36	36	3.42	01:47	107	1.15	00:43	43	2.86	00:45	45	2.73	00:28	28	4.39	00:24	24	5.13	01:22	82	1.50
Nescafe	02:12	132	1.47	01:02	62	3.12	02:36	156	1.24	01:09	69	2.80	01:45	105	1.84	00:55	55	3.52	00:44	44	4.40	01:57	117	1.65

Table 11: Detail and comparison of time taken during mental imagery experience [source: author]

RÉALITÉ ÉVOQUÉE: DES RÊVES AUX SIMULATIONS
Un cadre conceptuel de la Réalité au regard de Présence

RÉSUMÉ:

Dans cette recherche, nous présentons le concept de «Réalité Évoquée» (« Evoked Reality ») afin d'essayer de relier différentes notions entourant la présence et la réalité au sein d'un cadre commun. Nous introduisons et illustrons le concept en tant que « illusion de la réalité » (Réalité Évoquée) qui évoque un « sentiment de présence » (Présence Évoquée) dans nos esprits. Nous distinguons les concepts de « Réalité Média-Évoquée » et « Réalité Auto-Évoquée » et nous les définissons clairement. Le concept de « Réalité Évoquée » nous permet d'introduire un modèle tripolaire de la réalité, qui remet en cause le modèle classique des deux pôles. Nous présentons également un modèle graphique appelé « Reality-Presence Map » (Carte Réalité-Présence) qui nous permet de localiser et d'analyser toutes les expériences cognitives concernant la présence et la réalité. Nous explorons également les qualia et la subjectivité de nos expériences de Réalité Évoquée. Deux expériences ont été réalisées : l'une dans le domaine de la Réalité Média-Évoquée et l'autre dans celui de l'Auto-Évoquée. Les expériences nous ont permis de valider nos hypothèses et de réaliser que nos recherches empiriques pouvaient encore être poussées plus loin encore. Enfin, nous illustrons les différentes implications et nous examinons les applications et les utilisations possibles de notre concept, en particulier dans le domaine de la recherche sur la présence. En outre, nous proposons d'étendre la recherche sur la présence au-delà du domaine de la réalité virtuelle et des moyens de communication et de l'étudier dans une perspective plus large que celle des sciences cognitives. Nous sommes convaincus que ce concept de Réalité Évoquée et le modèle proposé peuvent avoir des applications significatives dans l'étude de la présence et dans l'exploration des possibilités qui dépassent la réalité virtuelle.

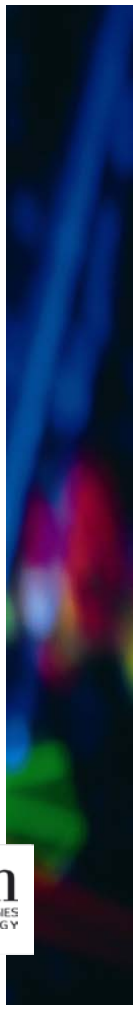
Mots clés : Présence, Réalité Virtuelle, Rêve, Réalité Simulée, Cognition, Réalité Évoquée

EVOKED REALITY: FROM DREAMS TO SIMULATIONS
A conceptual framework of Reality referring to Presence

ABSTRACT:

In this research, we introduce the concept of "Evoked Reality" in an attempt to bring together various ideas on presence and reality onto a common platform. The concept we propose and illustrate is in fact an 'illusion of reality' (Evoked Realty) that simply evokes a 'sense of presence' (Evoked Presence) in our minds. We clearly define and differentiate between a Media-Evoked and a Self-Evoked Reality. That helped us introduce the Three Pole Reality Model that redefines the classical Two Pole Reality Model. We also present a graphical model called Reality-Presence Map, which would help us locate and analyse every possible cognitive experience relating to presence and reality. We also explore the *qualia* and subjectivity of our experiences of Evoked Reality. Two experiments were conducted, one in the area of Media-Evoked Reality and one in Self-Evoked Reality. The experiments in fact lead to fruitful conclusions regarding our hypotheses and help us understand what could be further empirically studied. Ultimately, we illustrate different implications and shed light on prospective applications and uses of our concept, especially in the area of research on presence. In addition, we strongly suggest that we must open up presence research beyond the domain of virtual reality and communication media, and examine it from a broader perspective of cognitive science. We strongly believe that this concept of Evoked Reality and the proposed model may have significant applications in the study of presence, and in exploring the possibilities beyond virtual reality.

Keywords : Presence, Virtual Reality, Dream, Simulated Reality, Cognition, Evoked Reality



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