The Art Of Immersive Spaces
seminar, 11 November, 10:00 – 12:30

Tentative program outline
Agenda

10:00 – 10:15	Introduction by Oliver Grau
10:15 – 10:35	Presentation by Anneke Smelik
10:35 – 10:55	Presentation by Marnix de Nijs
10:55 – 11:15	Presentation by Wijnand Ijsselsteijn
11:15 – 11:35	Presentation by Maurice Benayoun
11:35 – 12:00	General discussion and closing remarks

The intersection of virtual and physical environments is associated with returning philosophical debates dealing, most prominently, with interfacing and disembodiment issues. One could argue that disembodiment is the main motivation and attraction of immersive environments, because it reflects an escapist desire to leave reality behind and immerse in an illusionary world. Other opinions reflect upon the central role of the body as placeholder for perception and physical memory. How do the diverse theories about body, mind, consciousness and reality hold up in the current digital age?
The last few years, an increasing number of researchers, artists and designers studied the effects of (dis)embodiment through interfacing and its influence on the immersion experienced by the user. But although our bodies are utmost important for our perception, a large portion of the bodily capabilities seems to be ignored in most interface designs. Shouldn't we take advantage of our sensory system and become more actively, physically engaged in the virtual reality? What will be the consequences of multimodal interfaces when trying to seamlessly bridge these two realities?

This seminar tries to get a grip on the mediated human experience in immersive environments. It wishes to explore and discuss the issues concerning 'the body and the extended mind' in digital environments, and its applicability in Human Computer Interfaces. Invited experts will present their viewpoints, research and art projects, and will try to reach an understanding of Human Computer Interface design and disembodiment issues in immersive spaces.

With Anneke Smelik (NL), Marnix de Nijs (NL), Maurice Benayoun (F), Wijnand IJsselsteijn (NL). Moderation by Oliver Grau (D).

Oliver Grau

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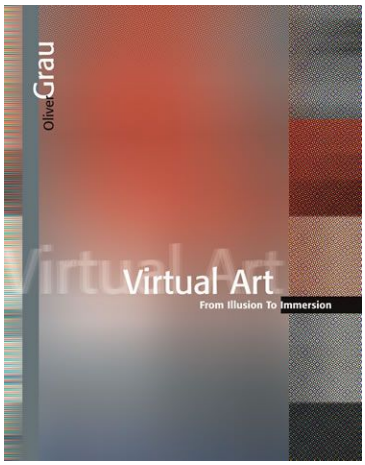
Oliver Grau (D) is a new-media art historian and lectures at the Department of Art History, Humboldt University in Berlin. He is a visiting professor at the Kunstuniversity Linz and is head of the German Science Foundation project on Immersive Art in Berlin, also he is developing the first international data base resource for virtual art. He published widely and lectured in Europe, Japan, Brazil and the US. Oliver Grau is an elected member of the Young Academy of the Berlin-Brandenburg Academy of Sciences (BBAW) and the Leopoldina. His research focuses on the history of illusion and immersion in media and art, the history of the idea and culture of telepresence and telecommunication, genetic art, and artificial intelligence.



Virtual Art
From Illusion to Immersion
Oliver Grau

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Although many people view virtual reality as a totally new phenomenon, it has its foundations in an unrecognized history of immersive images. Indeed, the search for illusionary visual space can be traced back to antiquity. In this book Oliver Grau shows how virtual art fits into the art history of illusion and immersion. He describes the metamorphosis of the concepts of art and the image and relates those concepts to interactive art, interface design, agents, telepresence, and image evolution. Grau retells art history as media history, helping us to understand the phenomenon of virtual reality beyond the hype.

Grau shows how each epoch used the technical means available to produce maximum illusion. He discusses frescoes such as those in the Villa dei Misteri in Pompeii and the gardens of the Villa Livia near Primaporta, Renaissance and Baroque illusion spaces, and panoramas, which were the most developed form of illusion achieved through traditional methods of painting and the mass image medium before film. Through a detailed analysis of perhaps the most important German panorama, Anton von Werner's 1883 The Battle of Sedan, Grau shows how immersion produced emotional responses. He traces immersive cinema through Cinerama, Sensorama, Expanded Cinema, 3-D, Omnimax and IMAX, and the head mounted display with its military origins. He also examines those characteristics of virtual reality that distinguish it from earlier forms of illusionary art. His analysis draws on the work of contemporary artists and groups ART+COM, Maurice Benayoun, Charlotte Davies, Monika Fleischmann, Ken Goldberg, Agnes Hegedues, Eduardo Kac, Knowbotic Research, Laurent Mignonneau, Michael Naimark, Simon Penny, Daniela Plewe, Paul Sermon, Jeffrey Shaw, Karl Sims, Christa Sommerer, and Wolfgang Strauss. Grau offers not just a history of illusionary space but also a theoretical framework for analyzing its phenomenologies, functions, and strategies throughout history and into the future.

Maurice Benayoun

www.moben.net

Maurice Benayoun is a transmedia artist born in 1957. His work explores the potentiality of various media from video, to virtual reality, Web and wireless art, public space large scale art installations and interactive exhibitions. Maurice Benayoun's work has been widely exhibited all over the world and received numerous international awards and prizes.

Co-founder in 1987 of Z-A (Paris) a pioneer Computer Graphics and VR lab, Maurice Benayoun, between 1990 and 1993, wrote with François Schuiten and directed *The Quarxs*, the first HDTV CG series widely awarded and broadcast in more than 15 countries. In 1993, he is prize-winner of the *Villa Medicis Hors Les Murs* grant of the Foreign Ministry for his *Art After Museum* project, a contemporary art collection in virtual reality. After 1993, he creates VR, Web art and interactive art installations. Among them, in 1995, the *Tunnel under the Atlantic,* televirtual project linking the Pompidou center, in Paris, and the Museum of contemporary art, in Montreal. In 1998, he won the Golden Nica, Prix Ars Electronica, Interactive Art category for *World skin, a Photo Safari in the Land of War.* Both works are considered by critics as major works in the field of interactive art. Invited artist at the ZKM, Germany, Ars Electronica Center Austria, ICC Tokyo, Art Center Nabi Seoul, National School of Fine Arts Paris… Professor of media art at the university Paris 1, Pantheon-Sorbonne, he is co-founder and co-director of the CITU research center (*Création Interactive Transdisciplinaire Universitaire*) that he is currently co-directing.

Beside his art works, Maurice Benayoun is involved in many big exhibitions, events and architecture projects for the conception and direction of the interactive scenography. Just to mention some of them: *the Navigation Room* (1997) and *the Membrane* (2001) for the Cité des Sciences de la Villette, the *Panoramic Tables* for the *Planet of Visions Pavilion* for Hanover EXPO2000, the *Multimedia Tour* for the Abbaye de Fontevraud and the *Blue Station*, interactive metro station competition won with the French architect Jean Nouvel. Work now on an artistic and scientific exhibition about the City and the sustainable development.

World Skin, A Photo Safari In The Land Of War, 1997

Crossing Talks, Communication Rafting, 1999

Anneke Smelik

http://www.annekesmelik.nl/

Anneke Smelik (NL) is Professor in Visual Culture at the Radboud University of Nijmegen, the Netherlands. She published *And The Mirror Cracked. Feminist Cinema and Film Theory*, London: Macmillan, 1998 and co-edited *Women's Studies and Culture. A Feminist Introduction*, London: Zed Books, 1995. She is also the main author of a book (in Dutch) about visual and textual representations of femininity and masculinity in the media: *Effectief Beeldvormen* (1999). Her current research focuses on transformations of the body in science fiction films and in cyber art CD-ROMs. She is also developing research on issues of media education.

A Tunnel Vision: Inner, outer and virtual space in visual culture

The past twenty years saw the emergence of cyberpunk sciencefiction films in which virtual reality (VR) is represented in both utopian and dystopian ways. In science fiction films cyberspace or virtual reality is strikingly imaged as a 'tunnel' by computer generated imagery. The tunnel transports the characters at great speed into the vertigo of cyberspace, often called the 'matrix'. The virtual space of the matrix is explored as a potentially hallucinatory and mind-enhancing space, in which the character is liberated from the 'prison of the body' or the 'tyranny of the flesh'.

This article critically assesses the desire of transcending the body and becoming pure mind in cyberfilms, which have sought to represent the new technologies. While this euphoric disembodiment may be read as a suppressed wish to get rid of the body, the cinematic image of the tunnel points to two different representations of cyberspace that are based on analogies with the body. In both cases the 'matrix' is a metaphor for cyberspace.

The first image is cyberspace as a neural / nervous system grid. Here the analogy is between the network of the computer and the brain or the nervous system of the human body. In mathematics the term 'matrix' refers to a "rectangular array of quantities or expressions" or "a grid-like array of elements, especially of data items". The grid-like computer animation of cyberspace, as in *Tron*, *Freejack*, *Hacker*, *Johnny Mnemonic* or *The Matrix* films, points to the mathematical background of the often used metaphor of the matrix for cyberspace. This is a gender neutral image, that is based on a cognitive model of mathematics. Computer games are the visual reference for this representation of the tunnel trip into cyberspace. The privileged part of the body is the eye; in *Freejack* for example the tunnel starts as a trip into an eye.

The second image is cyberspace represented as a uterine or vaginal space. This image foregrounds the original meaning of the matrix as womb. Derived from Latin, and related to 'mater' (mother), 'matrix' originally means the 'womb' or 'breeding female'. The fluid, fleshy and formless tunnel in *Brainstorm*, *Lawnmower Man*, *Virtuosity* and some of *The Matrix* films, is a genderised, feminine, image, which is based on a cognitive model of biology and genetics. Horror films are the visual reference for this representation of the tunnel trip into cyberspace. The privileged part of the body is the mouth; in *Virtuosity* for example the tunnel starts as a trip into a mouth. Here, the VR scenes also point to potential danger and death in cyberspace. The virtual ride is then not only a euphoric flight through the tunnel, away from the physical body, but actually threatens to harm and disintegrate that very body even in its virtuality. The author critically assesses the desire to transcend the body and become pure mind from the point of view of gender. The desire to get rid of the body may be a suppressed wish to get rid of femininity. However, the uterine imagery of the tunnel points to a subversive meaning of the 'matrix'. The matrix is not only the virtual space of cyberculture but also a representation of the maternal-feminine. In spite of the desire to move beyond the flesh, the films show the

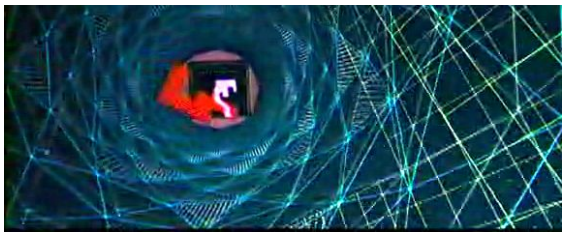
powers of the maternal-feminine body which cannot be ignored: the matrix strikes back.

What happens to the body in these science fiction films is complex and contradictory. There are at least three bodies: the real, the virtual and the metaphorical. While the enfleshed body is literally transcended in virtual reality, left behind like a limp puppet on the stage in real life, the virtual body is propelled through a metaphorical body: through the tunnel represented as nervous or as vaginal 'tube' into a womb-like cyberspace.

This well-known topos in science fiction films will be compared to medical visualisation technologies, such as endoscopy, which represent the inside of the body as tunnels or tubes. E.g. in the BBC documentary *The Human Body* and in the art work *Echo* by Wendy Kirkup. It appears that the ride through the body and the ride through cyberspace are strikingly similar. What does this mean for our understanding of the body, or our understanding of cyberspace? This article will draw out how visualisations in medical science and in fictional cinema mutually shape one another.

An early version of this article can be found online in Dutch: "Space Out. De representatie van virtual reality in sciencefiction films". In: *Eview. Electronisch tijdschrift voor theater, film, televisie en nieuwe media*, 1999, jrg 1, nr. 2: http://comcom.kub.nl/e-view/99-2/smelik2.htm

An updated and revised version of this article will be published in English in: Anneke Smelik and Nina Lykke (eds), *Bits of Life. Feminism and the New Cultures of Media and Technoscience*, 2005.



Tron, 1982

Brainstorm, 1983

Johnny Mnemonic, 1995

The Matrix, 1999

Marnix de Nijs

http://marnix.v2.nl/

Marnix de Nijs is a Rotterdam-based artist who explores the dynamic clash between bodies, machines and other media. His works include mainly interactively experienced machines that play with the perception and control of image and sound, but also humorous pieces such as his bulletproof tent and bulletproof lingerie. Marnix has presented his works at several national and international media festivals and worked with Time's Up, Montevideo_lab, V2_lab and the Krisztina de Chatel Dance Company. He has an ongoing collaboration with Edwin van der Heide.

< '98

In my earlier work, I used architectonic private space as a metaphor for personal experience and physical integrity; experiences and physical integrity that lie under constant external influences. This work mostly took the appearance of life-size cabin-like objects. In the case of some of the cabins, the visitor was invited to enter while others were closed to the public, making people curious as to what was taking place inside. However, none of the cabins could be described as comfortable or reassuring. Other projects followed that continued to examine space from a statistical point of view, researching the private lives of the other, The imagination lies in the surreptitious manner in which this was done: the integrity of the other was violated by inserting monitoring equipment into the home (The Sound Or Neighbors), and in the case of a later project (Time to Kill), also cameras.

In subsequent projects, I pursued an effective confrontation with 'the other'. (Local Penetration and Bob Lee (both 1998)). In Local Penetration, I myself acted as a stalker. A camera followed arbitrary passers-by until they either escaped by running away or forcefully made it clear that I had to stop. The resulting video was presented as an installation where the visitors were continuously followed by a laser.

> '98

From out of the observation that contemporary human life is becoming more and more influenced by the rise of new media and communication technologies, my interest moved to the direct relation between man and machine. As of 1998, my work consists therefore mainly of interactive experience machines through which I examine the direct relationship between people and machines.

My first interactive work was the installation Open Head (1998), where the visitor was challenged to approach a dangerously spinning monitor. The closer the visitor got to the machine the faster the machine turned. Only at the high speeds specific to this installation, manipulated video images became visible on the monitor.

As a result of this piece, I then created the installation Spatial Sounds (2000) in collaboration with the composer/ programmer Edwin van van der Heide. This project arose out of a desire to develop an object with which visitors could build a tangible physical relationship, wherein the primary physical feelings of endearment versus fear and attraction versus rejection played a big role.

When the visitor turned the machine around calmly it would welcome him or her cheerfully and would try to remain close to the visitor. If the visitor initiated contact too wildly or actively, the machine would begin to spin furiously until the visitor took distance.

Aside from these basic 'rules', the machine also had a number of other characteristics that enabled it to interact with several users at the same time. I built a related machine for the dance performance Machine Winks (2001), in collaboration with Edwin van der Heide and the dance company Châtel. In this performance, we examined the possibilities of interactivity in

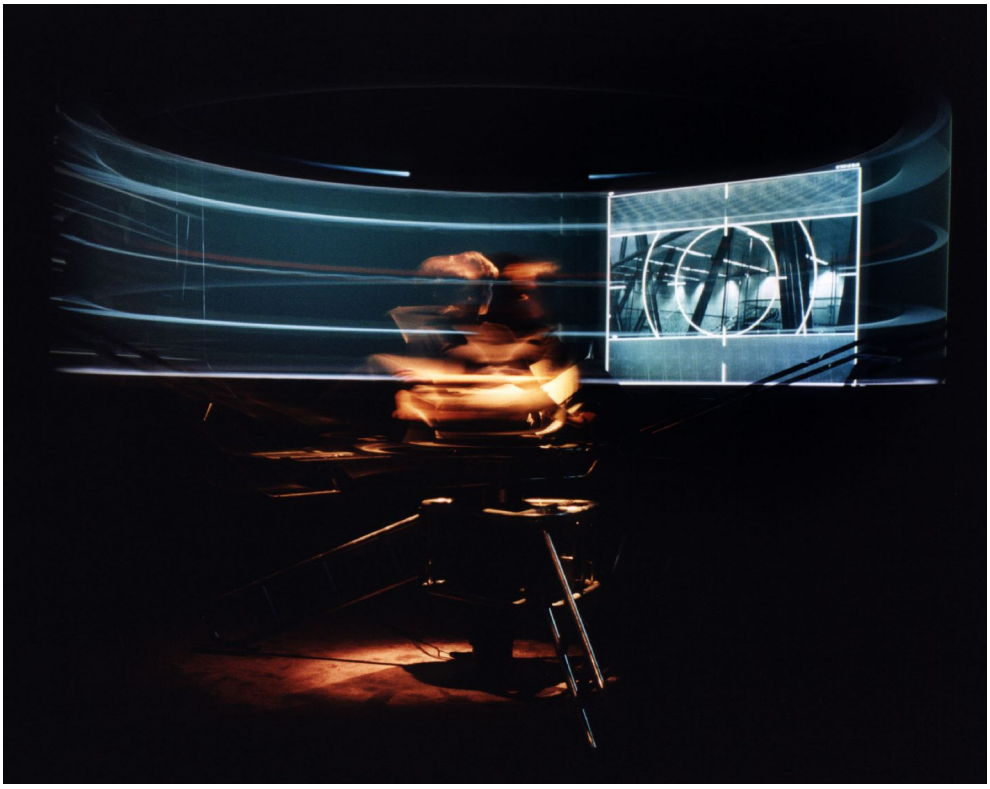
dance, with the machine functioning as an interactive dance partner.

In addition to these works in which I examined the possibilities to develop a physical tangible and controllable relationship with an 'intelligent' machine, I have made a number of works where I examined, in a very literal manner, the physical effects of speed on visual and auditive perception: the CTL Experiments (1998) and the subsequent continuation of these experiments, the installation Panoramic Acceleration (1999). In both cases, the user turns around at a self-controlled speed, with a projection of panoramic-recordings that also spins around in front of him or her at a speed determined by a computer. The user's task was to synchronize his or her physical speed with the rotational speed of the images (the visual speed). If unsuccessful, the brain would receive contradictory information leading to nausea.

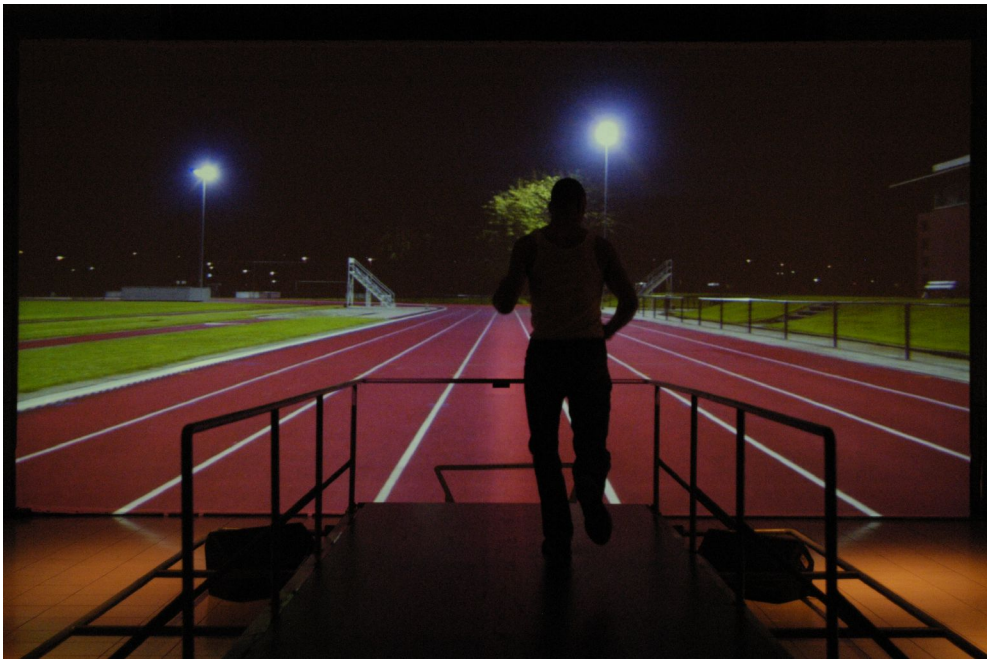
From the perspective that we live in a world in which network communication plays a continuously larger role, I developed a number of works in which the human-machine-human relationship was central. In these works, and obviously in earlier works, the man-machine relationship plays a role, but the emphasis is above all put on the way technology colors communication between different people. That this problem doesn't necessarily need to be depicted by means of complex computer techniques is visible in the installations Cross Controll (2001) and Cross Connected (2001). Cross Controll is a project in which two users are seated in two boats and participate in a race where one boat controls the other boat, and vice versa. In this installation, the user had to look through the eyes of the other in order to lead the boat in the right direction. Cross Connected is an installation that consists of two air beds connected via a thick tube. In this setting, both sleepers feel the other move despite the fact that they are really in separate beds.

A exceptionally complex technical work that I realized, again in collaboration with Edwin van de Heide, is the installation Push / Pull (2003). Push / Pull is an interactive installation that consists of two floating objects on separated playgrounds, floating with the help of an air cushion that is also used by hovercrafts. The objects are round and can move freely in every direction within the field. They can be moved by the audience but also move independently. The public interacts in a very direct and physical manner by pushing the objects, and plays a game with the objects as well as with each other. If the first object is brought into movement by a visitor, the second object will copy this movement. If a second visitor moves the second object, the opposite will happen at the same time. This means that two visitors can communicate with each other by means of the two objects and can literally push against each other while each person is in another spot. This creates a sort of 'Tai Chi' confrontation at a distance. Thanks to the Internet, these objects can even be set up in different countries.

An installation that I recently completed is the interactive chase movie Run Motherfucker Run. In this installation, the visitor finds him or herself on a treadmill with a large projection screen placed in front. While running, images of an alarming city unfold. Depending on his or her running behavior and the choices he or she makes, the visitor determines the progress of the film. This project stems from the desire to introduce an element of 'storytelling' into my work. In the installation Panoramic Acceleration, the images played a mainly functional role, but the images displayed were subordinate to the functionality of the spinning. To fully exploit the elemental possibilities of the story and image in the installation Run Motherfucker Run, I worked together with the cinematographers Reinier van Brummelen and Noud Heerkens, and thanks to a special test run, a script was developed by the playwright and writer Tim Etchells.



Panoramic Acceleration, 2000



Run MotherFucker Run, 2004

Wijnand Ijsselsteijn

http://www.ijsselsteijn.nl/

Wijnand IJsselsteijn is a neuropsychologist working, since 1996, on the scientific investigation of how humans experience and interact with advanced media technologies, such as stereoscopic television, virtual environments, or mobile communication services. His current research interests include social presence, connectedness, and awareness systems supporting intimate social networks; haptic communication interfaces; multisensory (audio-visual) interactions; and stereoscopic display quality. He usually - not always - takes the perspective of applied experimental psychology when studying these areas. IJsselsteijn is specifically interested in how to conceptualize and measure the human experience in relation to media.

Brain Map

Telepresence: Transforming Transparency

Wijnand IJsselsteijn
Eindhoven University of Technology, Eindhoven, The Netherlands

Abstract

The same sensorimotor and brain systems responsible for our sense of bodily boundaries and our sense of spatial location are also remarkably adaptable to include non-biological elements within the perceptual-motor loop, provided reliable, real-time sensorimotor correlations can be established. When we interact with virtual or remote environments using intuitive interaction devices, isomorphic to our sensorimotor abilities, the real-time, reliable and persistent chain of user action and system feedback will effectively integrate the technology as a phenomenal extension of the self. Yet the true added value of telepresence technologies is not its cognitive disappearance but its ability to transform reality into an augmented environment our bodies and brains are better equipped to deal with. In this way, telepresence technologies become 'mind tools' - enhancing our perceptual, cognitive and motor abilities, and profoundly changing our perception of self in the process.

Introduction

Interactive systems that allow users to control and manipulate real-world objects within a remote real environment are known as *teleoperator* systems. Remote-controlled manipulators (e.g., robot arms) and vehicles (e.g., NASA's Mars Exploration Rovers) are being employed to enable human work in hazardous or challenging environments such as space exploration, undersea operations, or hazardous waste clean-up. They also allow for transforming the temporal and spatial scale of operation, as is the case with for instance minimally invasive surgery. In teleoperation, the human operator directly and continuously guides and causes each change in the remote manipulator. Sensors at the remote site (e.g., a stereoscopic camera, force sensors) provide continuous feedback about the slave's position in relation to the remote object, thereby closing the continuous perception-action loop that involves the operator, the master system with which she interacts locally, and the remote slave system. In the context of telerobotics, telepresence is closely associated to the sense of *distal attribution*, the externalisation of the self to include remote tools that phenomenologically become extensions of one's own body, even if they are not physically part of it.

Whereas teleoperation systems enable the manipulation of remote real-world environments and objects within it, virtual environments (VEs) allow users to interact with synthetic or computer-generated environments. In its most well-known incarnation, VEs are presented to the user via a head-mounted display (HMD) where visual information is presented to the eyes via small CRTs or LCDs, and auditory information can be presented using headphones. Importantly, the HMD is fitted with a position tracking device which provides the necessary information for the computer to calculate and render the appropriate visual and auditory perspective, congruent with the user's head and body movements. Haptic information, although not yet usually included in present-day VEs, can be added through the use of for instance an exoskeletal glove or arm, acting both as sensor and actuator.

Telepresence (in relation to teleoperation) and virtual presence (in relation to VEs) both address the psychological phenomenon of *presence* – the sense 'being there' in a mediated environment, or a "perceptual illusion of non-mediation" as Lombard and Ditton (1997) defined it. Perceived transparency of the medium is crucial, i.e. a sense of direct perceptual stimulation and potential for action, without an awareness of the remoteness in time or space of the simulated or reproduced realities.

Forty Part Motet

Recently, I visited the Liverpool Tate art gallery, which had on display an audio piece entitled *Forty Part Motet* by media artist Janet Cardiff. Here was a reproduction of a choir singing a piece by Thomas Tallis, one of the most influential English composers of the sixteenth century. His *Spem in Alium nunquam habui* was originally written to mark the fortieth birthday of Queen Elizabeth I in 1575. It is a choral work for eight choirs of five voices, and Cardiff assigned every single one of the forty voices to a different audio speaker, set at an average head height and spaced around the exhibition hall in such a way that participants could listen to different voices and experience different combinations and harmonies as they wandered through the artist's installation.

The experience of walking amidst a virtual choir while they were singing was a novel and compelling one, but that is not the point. When the choir was silent, I sat down on a bench in the centre of the gallery and was talking with a friend about what we had just heard, with other people talking behind us in the background. Until at some point I turned around and suddenly realized that there were *no people there at all*! Apparently, the artist had also recorded some of the conversations choir members had had during the intervals in practicing, which tricked me into the 'perfect' presence of simply assuming there were people there, behind me. As such, the experience was initially of a trivial, uninteresting nature, precisely *until* I became aware of the mediated nature of the experience, *until* I acknowledged the role the technology had played in engendering my sense of presence for that brief moment in time – an interesting paradox when thinking of Lombard and

Ditton's definition.

To me, this experience illustrated a number of points. For one, it showed how presence research is not just about engineering clever technology, but is as much about human psychology, and the interaction of bottom-up sensory information (the voices of people from the high-quality speakers, at an appropriate volume, and from appropriate directions) and top-down cognitive processes (my assumptions about the media art piece having finished, the assumed presence of other people). But more importantly perhaps, the experience hammered home the point of just how much we take everyday presence for granted. And how, if we would somehow succeed in engineering 'perfect' presence, this may ironically not be detected as something extraordinary. If this perfect simulation is anything like the relatively uneventful lives most of us lead most of the time (I'm quite happy to say), we will not question the reality of what we experience, for what would be the reason? We are only aware of our sense of presence in relation to media systems precisely because it is *not* a perfect representation, not only because we usually detect the limits of current technology, but also, and more positively, because the experience we are provided with is often an unusual one – a *transformation* rather than a replication of reality.

In the event of 'perfect' presence, we may only become aware of the mediated nature through the use of our *media schemata*, our experience and thought cues, judging the likelihood of certain occurrences, for instance (IJsselsteijn, 2004). As with stage magic, or other particularly unlikely (often enervating or dramatic) events, we will tend to doubt our own perceptions ("I couldn't believe my eyes!"). In fact, good presence technologies will have a lot in common with stage magic or sleight-of-hand - covering up the media form factors, attracting little, if any, attention to *how* the media technology accomplishes its feats, and leaving its audience wondering how their eyes can be so convincingly deceived when, clearly, what they see *cannot* be real, or can it?

It seems fair to say that the experience of presence is a complex, possibly multidimensional perception, formed through an interplay of raw multi-sensory data, spatial perception, attention, and motor action, all coupled through a constant dynamic loop of sensorimotor correspondence. What makes presence research unique is that it studies the experience of being in a place or being with someone as it is *mediated* through technology. This is what sets it apart from psychology in general or from research into spatial cognition or consciousness in particular, as a large part of the research focuses on the media conditions under which presence may or may not occur, how to measure this experience if and when it occurs, and how to optimise media accordingly. Thus, the presence research area, by its very nature, requires hybrid, multidisciplinary scientific work. Pure engineering or pure psychology, although each is valuable in its own right, would not bear immediate relevance upon the relation between mind and media in the same way that presence research does.

The level of sophistication of current media systems has the unexpected effect of making us aware of just how much we take our everyday experience of presence in our physical surroundings for granted, as was reiterated by my experience at the Liverpool Tate. In fact, many philosophical and psychological ideas on the nature of perception and experience become more tangible when confronted with the experience of 'being' in a simulated or distant environment. In this way, media technology may help us understand the mind, much like cyclotrons help unravel the nature of matter (Biocca, 2003).

What am I?

Our sense of self-localisation is very much determined by our point of view - the locations of our sense organs - as the essay *'Where am I?'* by Daniel Dennett (1978) entertainingly shows. However, the fact that this sense is highly plastic, and continuously able and prone to adapt to altered sensorimotor contingencies only becomes apparent when these dependencies are changed, sometimes radically. This is the case, for instance, when we consider the amazing adaptation processes that occur in the body-image of people with one or more lost or amputated limbs (Ramachandran & Blakeslee, 1998). A less dramatic and perhaps more obvious example of the negotiability of our body-image is of course the lifetime growth and development of our own bodies, which requires a continuous re-mapping of our bodily boundaries based on the continuous correlations between motor action and sensory feedback. Although body-image adaptations across the lifespan can afford to take their time, it is the relative speed of these sensorimotor adaptations that enables us to experience man-made technology as, quite literally, part of ourselves - be they a blind person's cane or an advanced telerobotic arm. It allows us to feel part of an environment, not just as a passive observer, but as an active participant, changing the perceived environment through our actions, including head and eye movements, in a continuously updated real-time perceptual-motor loop.

Thus, the perceptual-motor mappings involved in answering the question of spatial location - *Where am I?* - are also powerful enough to integrate technologies for remote sensing and operation into our mental representations of what we consider to be our own bodily boundaries - *What am I?* Naive definitions of 'self' as everything contained within our bodily boundaries, and 'non-self' as the world outside our own bodies become much less obvious when we regard the intimate dependencies and co-adaptation we can experience when technology starts working as a transparent extension of our own bodies and minds. As

cognitive scientist Andy Clark convincingly argues in his wonderful book '*Natural Born Cyborgs*' , what 'I' am is not defined by the outer limits of the 'biological skin-bag'. He states: "For our sense of self, of what we know and of who and what we are, is surprisingly plastic and reflects not some rigid preset biological boundary so much as our ongoing experience of thinking, reasoning, and acting within whatever potent web of technology and cognitive scaffolding we happen currently to inhabit" (p.45).

Thus we learn that our relationship with technology is a two-way adaptive process - we adapt the technologies to fit our needs and abilities (a process known as *user-centred design*), but at the same time, our brain adapts itself to the technology, so that the technology becomes part of our extended self – the biological self and all non-biological tools and toys we employ to enhance our performance and pleasure. Dennett (1996) calls these "Mind Tools" as they are not only the result of intelligence but also the endower of intelligence in the sense that they transform problems previously beyond our capabilities into problems our brains are equipped to deal with. Good tools and toys have in common that they enable and challenge the brain to do what it does best - pattern recognition, modeling simple dynamics in the world, and manipulating objects in the environment (Hutchins,1995).

Beyond the Window

This is the basis of what in the domain of human-computer interaction is known as *transparency* - technologies that become so well matched to our abilities, needs, habits, preferences, and limitations that they become, for all practical purposes, invisible-in-use (Winograd & Flores, 1986; Norman, 1998). Just as the act of writing a letter takes very little explicit 'human-pen' interaction, so too should fluent interactions with computers make the computer itself disappear into the background as one of many tools that have the ability to scaffold and leverage our cognitive potential. As Marc Weiser (1991) noted, "the most profound technologies are those that disappear". Of course, it is not the *physical* disappearance of the computer as such that is important here, but its *cognitive* disappearance. That is, whenever people learn to use a tool sufficiently well, they cease to be aware of it. A transparent interaction shouldn't feel like a human-computer interaction anymore, but rather like a human-product or human-task interaction. The focus should be on interacting *through* a computer instead of interacting *with* a computer. Indeed, this would truly engender an 'illusion of non-mediation', to borrow Lombard and Ditton's (1997) phrase. Yet, too much of the current generation of computer tools still require skills and resources that do not come naturally to human users – demanding attention, obstructing the flow of the task, tripping the user up, continuously stressing the mediated nature of the interaction. Computers may have become *ubiquitous* or *ambient*, intelligence certainly has not.

Transparency is, of course, at the heart of presence engineering. Whenever we can design media technology that will not be obtrusive, heavy, cumbersome, and quite literally in-your-face, but will instead be user-sensitive and well-fitted to our sensory capabilities, needs, habits, and rhythms of life, such a technology is more likely to support a rich flow of content through a transparent form. Like a window, the interface should disappear, for the true added value is not in the glass itself, but in the outside world onto which it offers access. Unlike a window however, presence technologies needn't stop at mere replication of what is already there. The human-machine symbiosis has a great potential for sensory, cognitive, and motor enhancements, or *intelligence augmentation* as Biocca (1996) calls it. Thus, in addition to improving the human-machine bandwidth and interactive flow towards transparent immediacy, we also need to explore the exciting potential of presence technologies to transform rather than replicate reality, including our own bodies, enabling us to perceive, think, act, and enjoy ourselves in new, unforeseen ways, such that we may, someday, even *prefer* to be telepresent.

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