

‘Natural’ and Digital Virtual Realities

by Barbara Rauch

Introduction

I started to develop my PhD research proposal in 1999 [1] and enrolled with the University of the Arts London in January 2000.

I first proposed a practice-based research project, developing a series of case studies which set out to investigate dreaming processes on the one hand and Virtual Reality (VR) [2] on the other. During the writing of my Master’s thesis I established contact with Dr Antti Revonsuo [3], a neuroscientist in Finland. He delivered a paper at ‘Toward a Science of Consciousness’ [4] in which he discussed his research on consciousness, dreams and virtual realities. In sum, he had formulated a “world simulation metaphor” of consciousness by relating dreaming to VR technology. He analyzed both experiences as “being-in-the-simulated-world” [5]. In his work, Revonsuo uses VR theories such as presence and full immersion.

My personal take on the subject of dreaming and VR is directly related to his approach, though in contrast to his scientific and philosophical approach as a cognitive scientist, I act as an artist practitioner and use multiple case studies to explore the terrain. Furthermore, I shifted the focus on the VR side from a full immersive VR experience to the ubiquitous online telepresence experience of the internet and World Wide Web.

I likened the dream reports to chat room experiences, since I had come across a rating report on several MUDs and MOOs [6] in an Internet magazine (NetUser 1996). Each rating had a screenshot with some of the conversations in these environments. When I then read the narratives I was reminded of dream reports I had been working with for some time. They consisted of descriptions of places, conversations with other users and some casual chatting. I could not figure out exactly where the resemblance was, but it was a convincing-enough new idea to pursue.

I began my PhD research in practical terms in the studio. In parallel to the practice I continued with the background reading to gain further insights in critical theory, digital theory and dream research. In the process of the four years of study, my research into the dreaming brain focused on neuroscientific studies and deliberately excluded the older science of psychoanalytical research in the field. I felt that the findings of this relatively new science were in accordance with my approaches to online technologies, where the priority of my research directed me towards MultiUser Domains, e-mail and chat room facilities. The research comprised a series of practical art works. I have chosen to describe the collaborative works *tête-à-tête* and *Physical_Chat* in the essay below.

“Natural” and Digital Virtual Realities

My practice-based research explores the concept of the dreaming brain as a unique model for a particular level or state of consciousness. In considering this, I have researched how new technologies, in particular online communication technology, can contribute to a new understanding of human consciousness, the self, reflective thought and creativity. I consider thinking, reasoning and decision-making to be activities which partly define what it is to be human. Studying altered states of consciousness is useful to understand mechanisms underlying normal consciousness. Thus an examination of the altered functions of the dreaming brain helps us understand the “normal” thought process. I therefore compare the activity of the dreaming brain to that of the waking brain, and here in particular to the state of being “online”.

Research into the dreaming brain in the context of art usually triggers two associations:

Surrealism for the arts on the one hand and Psychoanalysis for science and philosophy on the other. However, as a practicing artist and researcher, I have made a deliberate decision to investigate other models of the dreaming brain. In this context, this research project relates the dreaming brain to contemporary online VR models. The models I am working with stem from contemporary cognitive neurosciences and critical theories (Digital Theory).

A Unified Model of Consciousness.

Alan J. Hobson claims that most researchers do not have a definition of what dreaming is and so concludes that similarly consciousness is not yet definable [7]. According to Revonsuo’s keynote speech at the ASD conference in June 2003, we seem to come closer to a concept of consciousness (with the help of concepts for dreaming.)

Furthermore, Revonsuo explains that dreaming is a good example of an ASC and because there is little input from the outside world dreaming becomes an ideal model for explaining how consciousness comes into being. If to be conscious is to have a sense of presence in a world, in the waking state this constitutes presence in the real world, while in a dream state a presence in a virtual world of virtual objects [8]. He confirms that the rehearsal of more ‘primitive’ behavioral responses to threatening stimuli might go back to the hyperactivity of the amygdala and draws the conclusion that the dreaming brain counts as the principal model system for the unified program on consciousness, the empirical way to isolate consciousness from everything external. [9]

“World Simulation Metaphor” by Antti Revonsuo.

“Now we have arrived at the very core of the World Simulation Metaphor of consciousness. Whenever the phenomenal level of organization is generated inside the brain, the outcome is a natural form of Virtual Reality: the sense of presence in and immersion into a world that seems to be outside the brain.” [10]

Professor Antti Revonsuo offers a unique research program on consciousness, based on the theory of biological realism. His idea of a “World Simulation Metaphor”, which explains the simulated world model in

the brain, integrates philosophy and empirical studies of consciousness to bring empirical research into a new transdisciplinary realm, integrating philosophy, psychology and cognitive neuroscience.

The human brain's capacity to simulate a representational model of the world seems to be similar to the world of online gaming. Revonsuo discusses his theory of a natural virtual reality capacity in the brain, mainly referring to immersive VR projects, where computer simulations allow for a simulation of movement through a virtual space. Revonsuo's primary research prediction is a Threat Simulation theory (TST) for the function of dreaming; the idea that the world-simulation we know as "dreaming" is specialized in the simulation of dangers and threatening events. Revonsuo presents an understanding of these mental fictive worlds that make us understand the real world, and even assumes that this function might go back to early stages of human development. He also argues that a model representation is needed for matching real and imagined memories and details. He argues that creativity and flexibility are required in the brain to find possible answers to match old ideas with new incoming data/ experience to be able to rebuild the model of the "world-for-me". [11]

Threat simulations in dreams are activated mostly when they are needed, i.e. when something threatening or stressful has been perceived. In these circumstances we construct an artificial situation within which to rehearse for emergencies. This is to practice, in advance, for any potential threats in the real world. Revonsuo claims that the "world-for-me" is primarily a "navigational device in the brain". With this, Revonsuo offers an understanding of "reality as an illusion" made entirely by the brain. The human body is understood as an interface which delivers a model of this "world-for-me". He further proposes that a personal view of the world exists in the brain as a model where we can rehearse dangerous situations, including obviously also social threats; he points out that we are in the end social animals. [12]

Revonsuo insists that this natural virtual reality model is also used to navigate real situations, since we cannot, every time we encounter something in the outside world, reinvent the experience itself. It is easier to build on our existing model as representation of the real. This model, of course, is constantly being updated, and it is also applicable to the model of self. See my discussion below of the work *tête-à-tête*, where the construction of self is the key issue.

Context and Concept behind the Installation *tête-à-tête*

To comprehend the concept of self is, I feel, one of the most difficult subjects in consciousness research. This might in fact be one of the reasons why artists feel particularly attracted by phenomena such as self, self-representation, person, and other identity issues.

Present ideas of self can be seen to evolve from the major achievements of psychologist William James to overcome dualism and the idea of the Cartesian theatre. His concept that each thought is linked to the next thought has formed the frequently used expression 'stream of consciousness'. With James the concept of self was freed from the idea of 'the little man in the head' who had the control function.

Following the above assertions Galen Strawson put forward his own new idea of the 'Sesmet' [13], a theory of self where, like pearls on a string, selves are 'Single Mental Things'. According to this view, selves exist as

many mental things, one self replacing the other. Strawson's introspection into his own conscious self led him to the view that there are many gaps in the conscious self: it fades, disappears and restarts again.

Strawson's theory denies a persistence of self, and yet Daniel Dennett's work goes even further in that he calls the self an illusion on the whole. "The astonishingly persistent conviction that there is a Cartesian Theatre is the result of a variety of cognitive illusions [...], and the self [...] turns out to be a valuable abstraction, a theorist's fiction" [14]. Dennett describes the self as a construct; he says that it only feels as if there is a continuous self, though all there is a "centre of narrative gravity" [15]. He confirms that selves exist as evolutionary products, which appear gradually in each person's life. He suggests that each person spins a web of words like a protective net, a net of narratives and discourse: "Our tales are spun, but for the most part we don't spin them; they spin us" [16].

This particular quote led to the work *tête-à-tête* which is a collaborative artwork developed together with Liz Chandler [17] consisting of two large digital prints on acetate and including a sound piece. It was presented in Gallery 70 at the Victoria & Albert Museum in London as part of 'Digital Responses' [18]. The Victoria & Albert Museum (V&A) can be considered as two kinds of meeting place: a meeting of things and of people. The visitor is confronted with objects from all over the world. There is no fixed path through the galleries; people make their own routes and their own connections between the objects and the cultures represented.

At any time of the day, the entrances, foyers and cafés are dotted with people waiting for their friends and the galleries become a backdrop to these meetings. Throughout the galleries, separated by time, geography and belief systems, statues gather. Around them visitors wait, meet, consult the map and move on.

The idea behind this work is very simple; to draw attention to the function of the V&A as a meeting place of people, of things and of ideas by imagining the conversations that would take place if the figures represented by these statues were really to meet in this space. The intention was that viewers would recognize in these conversations the dialogues of their own meetings - both in the spaces of the V&A and between the cornucopias of objects around them.

One could imagine a silent discussion between sculptures in the gallery when all the visitors are gone. At night, when the light fades, the sculptures recall what they have heard during the day from visitors passing by. Dreamlike in the sense of taking on board what was said during the day and letting it enter a brain which is used to making sense and narrative out of the flood of information. The main interest would be to confirm the nature of the statue's identity. And that is exactly what Rachel or Pandora would wonder about. Who are they? Is it possible that they were only invented by their makers in physical or even in mythological terms? What did they look like in real life and how could they reinvent themselves in the 21st-century where people can have more than one identity?

For the tone of the conversation, the museum's virtual relative, the Internet, was drawn upon. The Internet, like the museum, is a place of strange juxtapositions of ideas and knowledge and a gathering place for people. This tone reminds one not only of a possible chat between visitors in the galleries but it also takes on board the chat communication between people online or via mobile phones.

Visually, the focus was on the almost non-material void of the prints. The speakers were hidden and the sound came out of the wooden floor. The images of the two sculptures Rachel and Pandora were printed digitally on large acetates. The shadow on the board behind the prints was enhanced by hanging the prints about 10cm proud of the back panel to create a ghost-like mood between the two surfaces.

To act as a counterpart to the large print installation **tête-à-tête**, a display cabinet was filled with 40cm-high transparent rolls, holding images of sculptures from the V&A collection. They were grouped as if to be able to chat with each other. The glass shelves and transparency of the spacious cabinet suggests a fluid space where the figures might move around. The figures were freed of their original photographic background to appear as if they were floating on a transparent stage.

Each print-sculpture held additional information drawn from the Internet. Information on the original figures or the saga being represented was again printed as text information on clear acetate and rolled inside the image prints. The models in the cabinet build on Revonsuo's theory of the model world in the brain; they are constructs and need constant updating. The figures in the cabinet are digital representations of mythical figures: they need constant reinvention. Furthermore the updates from the Internet are rolled text sheets which are like transparent representations of the figures' thoughts about themselves.

The work **tête-à-tête** and the cabinet display can be considered precursors for the performance work **Physical_Chat**. While the former work exemplifies online chat situations and the construction of self, the latter addresses the altered state of being during an online chat experience.

Contemporary art practice can serve as an interface drawing together different disciplines. New technologies have been used to initiate collaborative practice providing an arena for unexpected collisions and insights. Theoretical review of existing work tests the concepts while presentation of investigative and collaborative work opens further research that uses new creative technology as a tool to provoke new thought.

The Work **Physical_Chat**

Physical_Chat was developed in collaboration with the artist and researcher Dr Dew Harrison [19], whom I had met during my residency at CAiiA in 1996. While my work concerns the dreaming brain and online thought, her work relates to the thought-trails of the awake and rational mind. We have kept in touch and collaborated on a number of projects.

Physical_Chat is the result of our first collaboration. It was a digital performance activated as two events which explored new forms of communication and consciousness generated by models such as forums and chat rooms. The first event took place at the Watershed Media Centre in Bristol and was an offline performance filmed as a contribution to the second event, which played out online across the globe as part of the 'Consciousness Reframed' conference at the 2002 Biennale of Electronic Art (BEAP) in Perth, Western Australia. A third event is planned to take place at 'Nuit Blanche' in Toronto, Canada on 29th September 2007.

Physical_Chat_I was a real-space event with eight participating artists involved in the weaving together of two narratives - dream and reatke - into one consciousness. Two characters, Ms Dream (Rauch) and Ms Real (Dew Harrison), presented an inverted fragmented conversation and produced a unique merging of minds by some worldwide intervention.

In the original invitation to *Physical_Chat_I*, we invited the physical audience to intervene in the event. The intention was to take the chat room idea of the WWW back into the physical space. In this instance it was the Digital Café at the Watershed Media Centre in Bristol.

We documented the first performance with video and still images in order to feed the first performance into and discuss as part of the future event which was to take place online across the globe.

Before the event at Watershed, Ms Dream and Ms Real had exchanged fragments of emailed thoughts to be connected into whole stories as the core confrontation area for further activity in the chat room. These two texts were to be typed into the chat room by our real-life avatars piece-by-piece with or without any interruptions in their robotic conversation.

Report of *Physical_Chat_I*, offline.

Following *Physical_Chat_1* we read our woven narrative and were pleased with the poetic nature of the text. Oddly enough, this was apparent whether read bottom-up, as it was actually written, or top-down, which is the conventional way to read pages of writing. Both readings produced some form of meaning. In this respect it mirrors the process of mind activity in the dream-state, i.e. our minds build narratives out of the extraordinary as it occurs and we naturally try to make stories out of fragmented, scrambled and disassembled information.

We asked for interlopers to disrupt and enrich the evolving narrative on the screen according to a set of rules, which were cracked at times, if not broken. Perhaps due to the 'lab' conditions of the event, all participants were silently focused on reading the text onscreen. Concentration was necessary in order to respond and intervene. At the end of the half-hour online chat the silence erupted into a crescendo of talk; the end of the restrictions brought a sense of freedom and it was liberating to talk, move and make noise.

Methods of intervention were limited due to the physical space of the closed room, but through the 'hold' that the screen narrative had, the onus was to be part of that story and somehow to infiltrate it through the keypad. The intimate situation meant no-one interfered physically with the human avatars or the other artists. The three terminals originally logged on as Computer 1, Computer 2 and Computer 3 began to change identity eventually becoming Ms_Real4, Ms_Dream17 and a_real_painting. Harrison and I didn't know who was who nor who was at each terminal and we couldn't relate the physical persona we knew and could see to the invisible creator of the text. We were only sure of Ms Dream and Ms Real. Our interlopers had worked at corrupting our belief in the original identities rather than creating new personas.

Interestingly, as the main form of intervention was to be through text, we were asked to include SMS

messages, which Harrison read into the microphone for all to hear but not see. These messages began to give us orders in an attempt to control Harrison and me as creators of the original narrative. This effect is evident on the video documentation of the event, but not so apparent in the archived text. This was a rather sinister and insidious form of intervention which we had not anticipated.

Our interlopers in this offline event were of different persuasions, ages, lifestyles, and had not met together before. They worked as individuals united for thirty minutes to impact on a screen text. We are still unsure who wrote what and agree that this is now irrelevant.

***Physical_Chat_II*, online.**

Physical_Chat_II concerned the nature of the online chat arena, the issues of identity and authorship involved in a pure text environment and the challenge of the semantically-associated but fragmented dialogues and discourses, which were then interwoven and reconstructed through the process of time delays and differing mind states. Where *Physical_Chat_I* focused on physical intimacy, *Physical_Chat_II* played out live across the internet for totally unpredictable global interventions and anonymity.

The Event.

Physical_Chat_II was planned to run in parallel to the 'Consciousness Reframed' conference as a performance with online intervention. For technical reasons (time zone difference: access to the building was restricted), we had to alter the idea slightly because the server with the chat room (hosted again by the Watershed) was only available for the second part of the presentation. While Harrison was reading our joint paper, the video documentation was projected as a backdrop on a large screen. Meanwhile I set up the chat-room link with Bristol and signaled to the audience as soon as we were connected to the online chat.

Several members of the audience gathered around the terminals that we had arranged and started chatting to the online participants and to each other on screen.

A Summary of *Physical_Chat* and Future Developments of this Collaboration.

Physical_Chat_I was a game, a staged play. We produced an outcome in the form of a digital performance mixed with real people: the players or interlopers and two sets of human automatons. Everything was controlled by rules to keep a rational set-up, governed and orchestrated; a collaboration with a limited amount of intrusion. The breaking-point was when the tone of the conversation shifted from the automated text to the conversation provided by the human interlopers.

The video documentation of the event_I acted as a backdrop for *Physical_Chat_II*. The purpose was to weave together given narratives and real interventions. The intimacy of the connectedness in the room, the contact and interaction helped to produce a fluid and spontaneous narrative sequence. Like a folk tale, it was set up in such a way that the order mattered less; it became improvised. Akin to oral storytelling, you might start anywhere and find the end while talking. This non-linear aspect became a lived spontaneous experience.

It is a story that works in either direction and in both cases the interwoven chat room text could be seen materializing top-down to be read bottom-up on a large screen. The text left over as a trace of the event - a printout off the screen - was read backwards from the end to the beginning, in the same way that a sleeper awakes from her dream and works backwards from its end to make sense of it. Breaking from the narrative linear form enabled the component ideas to become more apparent; our work was an abstract concept about non-linearity.

We are now considering extending our activities towards a conclusion in images and sounds. Our next explorations will result in a meeting of shared interests combined into one mindset through the space of consciousness defined as the 'daydream'. We are currently engaged with ideas of paralleling daydreaming with Paul Virilio's work on inertia and picnolepsy and wish to create a 'daydream' experience as our next *Physical_Dream* [20].

On the Merging of Different Styles of Reports.

The chat room was considered to be a testing ground. The new forms of communication and consciousness generated by models such as chat rooms and MUD forums were compared with earlier natural formats. Like the dream report the digital text suggests a reporting on states of thoughts, being and consciousness. More generally, global communication merges a private and a public identity. The fantasy, the real and the virtual are also entangled with a self that might be an agent or a constructed self, making reality become an altered and extended reality that is fluid and dreamlike. Cyberspace can be considered an extension of human consciousness; an arena in which our worlds of objects have become a world of possibilities and simulations [21], where code and text have become reality.

Physical_Chat suggests a turnaround of Revonsuo's theory of "being in the simulated world". Revonsuo discusses the virtual reality model in the dreaming brain with simulated virtual reality spaces, while our practice constructed a model situation in an actual space by drawing on the concepts of virtual worlds and dreams.

Conclusion

When I embarked on this practice-based research my aim was to explore dreamstates and online-states. This was not a scientifically-driven project to find out about the function of sleep or dreaming. A scientist would perhaps approach the problem of sleep with a top-down list of questions such as "What is the function of sleep? Why has evolution encouraged dreaming during sleep?" I was interested in the stories and narrative experiences that a dream produces. I wondered where the dream came from and how the brain creates these narrative thoughts and imaginings. I was particularly interested in the fact that we often find creative answers to peculiar problems during sleep when no new information can be input into the mind [22].

An interest in consciousness research and in particular the mechanisms of the brain was a major driving force behind the investigation. The other equally important research interest was the impact of new technologies on human consciousness. The research can be seen as another attempt to update McLuhan's proposition that with each new technology our human understanding of reality and our sensibility changes [23]. My question throughout was whether the new online communication technology further expanded and

altered our human understanding of the virtual, the real and the imagined.

Because of my specific interest in new sciences, I had deliberately chosen to investigate neuroscientific models of dreaming and parallel models and theories from media theory and critical theory. Perhaps the clash of different opinions and approaches encouraged more dialogue, reflection and insight. This collision of the different theories is similar to when the brain, in a dream state, creates new links between unrelated issues and likewise can be considered a creative encounter or process.

In **tête-à-tête** we created a platform for virtual persona to rehearse their invented selves in an online chat manner. In **Physical_Chat** we developed a theory of online writing by comparing the practice of writing a dream report to online writing processes. In this respect I proposed a speculative theory for the backward tracing of thoughts and states of being. This might be developed even further by considering this process as a creative act of reflection. The many threads of this research come together when suggesting a correlation between online writing processes, the reporting of a dream state and creative reflective action research.

My investigation into Antti Revonsuo's theory of the virtual reality model in the brain and his concept of the dream as a unified model for consciousness studies had not merely illustrated the practical work but triggered an entire reflexive investigation into new technologies, virtual reality and consciousness studies. It led me to collaborative practices that had additional levels of reflections build in, naturally leading to the communication of ideas and new thoughts.

References

[1] Barbara Rauch, **Natural and Digital Virtual Realities: a practice-based exploration of dreaming and online virtual environments** PhD thesis (London: University of the Arts London, 2005).

[2] See glossary for the definition of VR and how I use it in this context.

[3] Antti Revonsuo, Ph.D., European Editor of **Consciousness and Cognition** (Elsevier); Visiting Professor of Cognitive Neuroscience, School of Humanities and Informatics, University of Skövde, Sweden and Director of the Consciousness Research Group, Centre for Cognitive Neuroscience, University of Turku, Finland.

[4] Antti Revonsuo, "Towards a Cognitive Neuroscience of Consciousness", in Stuart R. Hameroff, Alfred W. Kaszniak and David Chalmers (eds.) **Towards a Science of Consciousness III: The Third Tucson Discussions and Debates** (Cambridge, MA: MIT Press, 1999) pp.87-97.
<http://cognet.mit.edu/posters/TUCSON3/Revonsuo.html>

[5] Antti Revonsuo, **Inner Presence: Consciousness as a Biological Phenomenon** (Cambridge, MA: MIT Press, 2006) p.119.

[6] See glossary for the definition.

[7] Though Hobson comes up with a very good definition which asks for perfect synchronicity: "Consciousness is currently best conceived as the brain's awareness of its own activity".

Alan J. Hobson, *The Dream Drugstore: Chemically Altered States of Consciousness* (Cambridge, MA: MIT Press, 2001) p.88.

[8] See Revonsuo [5] p.242.

[9] See Revonsuo [5] p.420

[10] See Revonsuo [5] pp.115-6

[11] Revonsuo's expression. See Revonsuo [5] p.182

[12] See Revonsuo [5] pp.418-9

[13] Galen Strawson, "The self and the Sesmet", in *Journal of Consciousness Studies*, Vol. 6, No. 4, pp. 99-135 (1999).

[14] Daniel C. Dennett, *Consciousness Explained* (New York: Little, Brown & Company, 1999) p.431.

[15] See Dennett [14] p.418

[16] See Dennett [14] p.418

[17] Liz Chandler, MA digital arts, programmer/artist; currently working as head of Creative at Two Way TV. I met Liz Chandler during the study at CEA, Middlesex University in 1998. We have collaborated in several works before.

[18] 'Digital Responses', ribbon event at the V&A, May 2002 - March 2003; curated by P. Coldwell, co-curated by B. Rauch, CD ROM documentation ISBN 1 85177 414 9.

[19] Dew Harrison, *Hypermedia Systems: The Creation and Interpretation of Concept-based Art* PhD thesis (Newport: University of Wales, Newport, CAiiA, 1998).

[20] B. Rauch and D. Harrison, "A Merging of Mindsets through Collision and Collusion", in *Technoetic Arts:

A Journal of Speculative Research*, Vol.5, No.1, pp. 55-65 (2007).

[21] Kathrine Hayles, an online lecture, http://blog.humlab.umu.se/archives/20050921_hayles.mpg3, last accessed 28 January 2007.

[22] “When Kekule, the organic chemist, was wrestling with a problem of the structure of the benzene molecule, he dreamt of a snake biting its tail and awoke with the discovery of the benzene ring. His dream turned out to correspond to something real; the archetypal image supplied one of the very few possible basic answers to a problem in which he had immersed himself for a very long time.”

W.D. O’Flaherty, *Dreams, Illusion and other Realities* (Chicago: The University of Chicago Press, 1984) p.242.

[23] Marshall McLuhan, *Understanding Media: the extensions of man* (New York: Mentor, 1964) p.3.

Glossary

Avatar - An image representing the user of a visual chat or virtual reality program. Avatars range from simple images to complex, personalized three-dimensional models. In Hinduism an avatar is an incarnation or materialization of a god. D.A. Downing, *Dictionary of Computer and Internet Terms, 8th Edition* (New York: Barron’s Educational Series, 2003)

chat room - A private virtual space in which a group of people can converse electronically by typing text messages to each other in real time. To avoid hundreds of people all trying to ‘speak’ at once, online chat systems are divided up into many separate rooms, each containing a small group with some shared interest. D. Pountain, *The Penguin Concise Dictionary of Computing* (London: Penguin Books, 2003)

MUDs & MOOs - Multiuser domains, dungeons, dragons, or dimensions in which the users can participate in structured games or unstructured spaces on the Internet. These are currently text based and graphically based, but not fully immersive experiences.

MOO (MUD, Object Oriented) - A type of MUD, internet game or interaction environment. See MUD.

MUD (multi-user domain or multi-user dimension, formerly multi-user dungeon) - A type of real-time Internet conference in which users not only talk to each other, but also move around and manipulate objects in an imaginary world. Originally conceived as multi-user adventure games, MUDs have developed into a promising format for collaboration and education through the Internet. To access a MUD, the user must, in general, TELNET to the computer that hosts it.

D.A. Downing, *Dictionary of Computer and Internet Terms, 8th Edition* (New York: Barron’s Educational Series, 2003)

virtual - A term used generally to describe any entity that does not really exist, but is simulated by the action

of a computer. It is frequently applied to graphical simulations of real world objects, as in virtual reality or virtual community. Equally, it may refer to objects within the computer itself. For example, virtual memory refers to a computer's ability to swap data rapidly between memory and disk storage so that it appears to have more memory than it actually has. The term is borrowed from the field of optics (from 'virtual image') and its opposite is physical, i.e. having material existence. D. Pountain, **The Penguin Concise Dictionary of Computing** (London: Penguin Books, 2003). P. Lévy (1998) explains the word "virtual" as it derives from the Latin word **virtualis** and **virtus**, meaning strength or power. In scholastic philosophy it meant that which has potential. Lévy explains that the virtual tends toward actualization, and so concludes that "the virtual should not be compared with the real but the actual, for virtuality and actuality are merely two different ways of being". P. Lévy, **Becoming Virtual: Reality in the Digital Age** (New York: Plenum Press) p.23.

Virtual Reality (VR) - In the less ambitious, non-immersive form of VR, the 3D scene remains confined behind a conventional VDU screen. The observer can travel through it at will, navigating with a mouse, joystick or other steering device. Again the display is continually adjusted to the correct viewpoint, giving the impression that the VDU is the widescreen of a vehicle travelling through the scene. This form of VR is used extensively by architects and planners to allow people to walk through models of new developments, and in simulators for training aircraft pilots, soldiers and sailors. D. Pountain, **The Penguin Concise Dictionary of Computing** (London: Penguin Books, 2003).