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Emerging Trends in CyberTherapy Introduction to the Special Issue

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ABSTRACT

According to the recent reports presented by IST Advisory Group (ISTAG) the evolutionary technology scenarios in support of the Knowledge Society of the 2010s will be rooted within three dominant trends: (a) Ambient Intelligence, the pervasive diffusion of intelligence in the space around us; (b) B3G, "Beyond 3rd Generation" mobile communication system; (c) Shared Virtual Reality, with the increase of the range, accessibility and comprehensiveness of communications.

The convergence of these trends manifests itself as the next frontier of Information and Communication Technologies. This convergence *stimulates a change in the way health care is carried out, making it an embodied experiential process in* which communication and collaboration of geographically dispersed users may also play a key role.

In this special issue we will try to outline this process and its potential for the future of cybertherapy. We suggest that a key role will be played by the attainment of "*Immersive Virtual Telepresence"* (IVT). In IVT tools, *distributed virtual reality systems are combined with wireless multimedia facilities* - real-time video – *and innovative input devices* – tracking sensors, biosensors, brain-computer interfaces

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1. Introduction

According to the recent reports presented by IST Advisory Group (ISTAG) - the Unit within the European Union providing an independent advice concerning the strategy,

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content and direction of research work to be carried out in the domain of Information and Communication Technologies (ICT) (http://cordis.europa.eu/ist/istag-reports.htm) - the evolutionary technology scenarios in support of the Knowledge Society of the 2010s will be rooted within three dominant trends (ISTAG, 2002):

- Pervasive diffusion of intelligence in the space around us, through the development of network technologies and intelligent sensors towards the objective of the so-called "*Ambient Intelligence*" (AmI);
- increasingly relevant role of mobility, through the development of mobile communications, moving from the Universal Mobile Telecommunications System (UMTS) "Beyond 3rd Generation" (B3G);
- increase of the range, accessibility and comprehensiveness of communications, through the development of multi-*channel multimedia technologies*.

The convergence of AmI, 4G and multi channel multimedia technologies manifests itself as the next frontier of ICT, *making it an embodied experiential process in* which communication and collaboration of geographically dispersed users may also play a key role. Specifically, we suggest that in reaching this goal a key role will be played by the attainment of "*Immersive Virtual Telepresence"* (IVT). In IVT tools, *distributed virtual reality (VR) systems are combined with wireless multimedia facilities* - real-time video – *and innovative input devices* – tracking sensors, biosensors, brain-computer interfaces (Riva, Vatalaro, Davide, & Alcañiz, 2004).

In the following paragraph we will try to outline this process and its potential for the future of cybertherapy

2. Embodiment: From cognition to virtual reality technology

For a long time cognitive science considered action, perception, and interpretation as separate activities. A recent trend in cognitive science is instead seeing cognition as *embodied* (Prinz, 2006). This is a rethinking of the idea that cognition is primarily a matter of performing formal operations on abstract symbols and has little or nothing to do with the sensorimotor activity and environment in which it occurs (Freeman & Núñez, 1999).

The *Embodied Cognition* paradigm takes as its starting point the idea that cognition occurs in specific environments, and for specific ends (Clark, 1997, 2001; Haugeland, 1998). Moreover, the *Embodied Cognition* approach underlines the central role of body in shaping the mind (Clark, 2001, 2003; Gallagher, 2005; Gallese & Lakoff, 2005; Garbarini & Adenzato, 2004; Lakoff & Johnson, 1980; Ziemke, 2003). Specifically, the mind has to be understood in the context of its relationship to a physical body that interacts with the world. Hence human cognition, rather than being centralized, abstract, and sharply distinct from peripheral input and output modules, has instead deep roots in sensorimotor processing.

In this picture, what is the role of "Virtual Reality" (VR)? The basis for the VR idea is that a computer can synthesize a three-dimensional (3D) graphical environment from numerical data. Using visual, aural or haptic devices, the human operator can experience the environment as if it were a part of the world. For these features, VR is described as a "*simulation technology*" with, and within which, people can interact. In summary, VR provides a new human-computer interaction paradigm in which users are no longer simply external observers of images on a computer screen but are active participants within a computer-generated three-dimensional virtual world (Riva, 2005; Wiederhold & Wiederhold, 2003).

If concepts are embodied simulations, and VR is a simulation technology, apparently should be possible to use VR simulations both for teaching concepts and for modifying them. In particular, as suggested by Tart (1990) more than 15 years ago VR offers "intriguing possibilities for developing diagnostic, inductive, psychotherapeutic, and training techniques that can extend and supplement current ones" (p. 222). Within this framework, VR can be considered an embodied technology whose potential is wider than the simple reproduction of real worlds (Riva, 2003). By designing meaningful embodied activities, VR may be used to facilitate cognitive modelling and change.

3. Immersive Virtual Telepresence: simulation meets embodiment and communication

However, VR is only a first generation IVT tool. As we have seen in the Introduction, in IVT tools *distributed virtual reality (VR) systems are combined with wireless* *multimedia facilities* - real-time video – *and innovative input devices* – tracking sensors, biosensors, brain-computer interfaces (Riva *et al.*, 2004).

In general, the IVT perspective extends the potential of virtual reality by:

- *the widening of the input channel* (Wiederhold & Rizzo, 2005) through the use of biosensors (brain-computer interface, psycho-physiological measurements, etc.) and advanced tracking systems (wide body tracking, gaze analysis, etc.);

- *the induction of a broader sense of "presence" or "telepresence" through multimodal human/machine communication in the dimensions of sound, vision, touch-and-feel (haptics).* Typically, *the sense of presence is achieved through multisensorial stimula such that actual reality is either hidden or substituted via a synthetic scenario*, i.e. made virtual through audio and 3-D video analysis and modelling procedures (Renò, 2005; Spagnolli & Gamberini, 2005). In high end IVT systems, multimedia data-streams, such as live stereo-video and audio, are transmitted and integrated into the virtual space of another participant at a remote system, allowing geographically separated groups to meet in a common virtual space, while maintaining eye-contact, gaze awareness and body language. Presence with other people who may be at distant sites is achieved through avatar representations with data about body movement streamed over a high-speed network (Rettie, 2005).

Since distance learning and e-health are principally involved with the handling and transmission of medical information, *IVT has the potential to enhance their user experience through the expansion of human input and output* channels (Wiederhold & Wiederhold, 2004). The two principle ways in which IVT can be applied are:

a) *as an interface, which enables a more intuitive manner of interacting with information* (Rose, Brooks, & Rizzo, 2005), and
b) *as an extended communicative environment that enhances the feeling of presence during the interaction* (Riva, Castelnuovo, & Mantovani, 2006).

Within this framework, IVT can be considered an "embodied technology" whose potential is wider than the simple reproduction of real worlds (Riva et al., 2006). By designing meaningful embodied activities, IVT may be used to facilitate cognitive modeling and change. Introducing IVT in cybertherapy will provide significant advantages:

- The IVT-based treatment differs from traditional therapy in that computer graphics and various display and input/output technologies are integrated *to provide the patient with a sense of presence or immersion*. More in detail, IVT provide a new human-computer interaction paradigm in which users are no longer simply external observers of images on a computer screen but are active participants within a computer-generated three-dimensional synthetic world. In this world the patient has the possibility of learning to manage a problematic situation (Standen & Brown, 2005).

- Moreover, IVT offers a high level of control of the experience without the constraints usually found in computer systems. IVT environments are highly flexible and programmable. They enable the therapist to present a wide variety of controlled stimuli, such as a fearful situation, and to measure and monitor a wide variety of responses made by the user. This flexibility can be used to provide systematic restorative training that optimize the degree of transfer of training or generalization of learning to the person's real world environment (Rizzo, Schultheis Kerns, & Mateer, 2004).

- Finally, IVT systems open the input channel to the full range of human expressions: in rehabilitation it is possible to monitor movements or actions from any body part or many body parts at the same time. On the other side, with disabled patients feedbacks and prompts can be translated into alternate and/or multiple senses (Morganti, 2004).

4. The contents of this Special Issue

It is interesting to note that this issue of the PsychNology Journal well reflects this trend. Both biosensors, adaptive displays and new interfaces are widening the typical bunch of cybertherapy tools as shown by the following papers. The critical challenge, however, is moving from preliminary studies to real world application. In this context it is critical that the pioneers in this field will both share information about their experience and examine the results of the preliminary trials so that suitable development work will spread up. This is the critical goal of this special issue.

The first paper, by Botella and colleagues, discusses the use of the “Emma’s world”: a virtual environment where a series of tools are available and they can be selected based on the therapist’s instructions. The specific use of the different scenarios will depend on the specific objectives of the therapeutic session and can be selected by the therapist in real time. Initially, the environments have been designed to be related to different emotions. Specifically, the paper presents a case study in which the adaptive display is used in the treatment of a 70 year-old woman with storm phobia.

The second paper, by Jung and colleagues, discusses the possible use of a tangible interaction system based on a virtual reality platform to provide sensory integration therapy to autistic children. The outcome of a preliminary study on 12 autistic children is presented in the paper.

The third paper, by Galimberti and colleagues provides a theoretical model for the ergonomics of advanced cybertherapy applications based on virtual reality. Through the analysis of the pros and cons of the approaches used by two different projects dedicated to the development of clinical virtual reality environments, the paper comments on the concepts of ecology and context of use.

The final paper is a presentation of an ongoing project by Morganti and colleagues, who investigate the technical and clinical feasibility of using an enactive interface in the rehabilitation of reaching and grasping movements of upper-limb hemiparesis. Such interface supports the perception-action interactions with an environment allowing users to learn on how to perform a useful action in a particular context.

In summary, the goal of this Special Issue is to provide a forum for presenting and discussing the emerging processes and tools. The critical goal of the papers presented is to stimulate more clinicians and technical professionals to design and test these tools to improve the overall outcome of cybertherapy interventions.

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