Virtual and augmented realities (VR/AR) can provide a broad range of possibilities for therapeutic applications. Virtual implementation of classical therapy methods can offer many advantages to both patients and caregivers. My research focuses on validating and improving the use of VR and AR in psycho-and physiotherapy. Moreover, I will employ several physiological measures in order to provide different forms of biofeedback and make the virtual environment (VE) adaptive to the user’s affective states.

Index Terms: Human-centered computing—Human-computer interaction (HCI)—; Applied Computing—Life and medical sciences—consumer health

1 INTRODUCTION

My research has a general aim at using mixed reality (MR), in particular, virtual reality (VR) and augmented reality (AR) for mental and physical health. This paper will describe some of my work on practical usage of VR for psychotherapy (cf. Section 1) and will summarize my research interest in AR applications in physiotherapy.

2 VIRTUAL PSYCHOTHERAPY

VR has enormous potential to be used in psychotherapeutic applications. Exposure therapy (ET) is a typical example of such applications. It is a widely used method in the treatment of several psychological disorders, such as various forms of phobias and anxiety disorders [7]. ET relies on this assumption that phobias are conditioned (i.e., learned) reactions and exposure provides an opportunity for deconditioning (i.e., corrective learning) of phobic responses [3]. Therefore, patients are carefully exposed to the anxiety stimuli, i.e., situations, people, objects, or places which trigger their anxiety, in order to enable them to gradually bring their phobia reactions under control.

In this context, VR can facilitate the therapy by providing a safe, controlled environment for VR exposure therapy (VRET). For example, exposing to a virtual airplane and virtual sense of flying for treating the fear of flying is much safer and less expensive compared to in vivo (i.e., real life) exposure. VR provides also a broader range of control over the course of treatment. For instance, to treat the fear of public speaking one can easily change the number of the virtual agents (VAs) representing the audience from one to 100 or change their behavior. Having the same conditions in real life requires hiring and training of an enormous amount of actors for every single experiment.

In my opinion, the most ambitious goal of the virtual therapy could probably be the standardization of its virtual prescriptions and treatment methods. This way, similar to taking, for example, a painkiller for a headache, one could receive prescribed “virtual medications” for their needs. Equally compared with availability of the standard pharmacological medications all around the world, virtual medications shall become standard and available all around the world as well.

This part of my research focuses on validating and improving the use of VR in psychotherapy and making virtual environments (VEs) more adaptive to the user’s affective and biological states. Since physiological measurements are able to represent the internal affective states of the users [12], several bio-signals (e.g., heart rate (HR), heart rate variability (HRV), galvanic skin response (GSR), etc.) will be recorded and analyzed as well.

In addition, bio-signals can provide a better understanding of the user’s internal states for the users themselves, since they often under- or overestimate their experience during the experiments. The physiological recordings can show, for example, how much a person perceives stress by measuring, for instance, the variability in their heart rate or hormone level. Feeding this information in real-time back to the user (as biofeedback [14]) can help them learn about their reactions to the conditions and hopefully, overcome their discomfort by getting control over their psychological behaviors.

Furthermore, biofeedback can be integrated into the VR, so that the virtual environment changes according to the user’s affective states. For example, in an adaptive VR for treating the fear of public speaking, the VA might show gradually positive behavior (such as giving a smile) according to the user’s stress level.

This hypothesis relies on the function of mirror neurons in primates (including humans) which are activated not only during one’s own sensations and emotions but also during the observation of these acts in others [4]. In other words, when humans see for example that someone is sad or happy, the same neural structures in their brain get activated as if they were themselves sad or happy. Therefore, I will test whether detecting virtual positive stimuli (e.g., a smile in virtual avatars) can trigger the same emotion in humans (i.e. positive mood). And if so, I will use the results for making an affective and adaptive VE for some therapeutic applications such as stress relief and positive mood induction.

In order to examine my hypotheses, I have been conducting some experiments on social anxiety and mood disorders in cooperation with University Medical Center Hamburg-Eppendorf (UKE). In the next section I will briefly describe one of my studies on social anxiety disorder.

2.1 Virtual Trier Social Stress Test

Trier Social Stress Test (TSST) [8] is a widely used protocol for inducing moderate social stress in laboratory settings. It consists of an anticipation and a test period for delivering a free speech and performing mental arithmetic in front of three neutral audiences. Prior studies [6,9,11] support the use of VR for provoking public speaking anxiety. Yet several questions have not been answered. For example, all studies so far have experimented with a fixed number of VA. Therefore, the effects of any change in the number of VA has not been reported yet. I implemented several virtual versions of the TSST (VTSST) for my study, thereby I would like to address the following research questions:

Q1 Can the proposed VTSST evoke the user’s social anxiety as...
the real ones are not visible to the patient) during an intense physical training period could improve the patient’s motor functions.

Several studies support different aspects of this hypothesis. For instance, the classic rubber hand illusion (RHI) experiment has demonstrated that a fake hand can be perceived as own hand [1]. The RHI has been also shown in several VR studies such as [5]. Furthermore, Lanier [10] has used the term “homuncular flexibility” to explain the ability of the brain for adapting to and learning to manipulate different body configurations. Besides proper integration of haptic and visual feedback can enhance the illusion [15] and therefore its application in physiotherapy. A successful example of combining various technologies (e.g. VR, visual-tactile feedback, brain-computer interface) for neurorehabilitation is reported in [2], where eight chronic spinal cord injury paraplegics could gain recovery following 12 months of training.

In brief, the English aphorism “fake it till you make it” can depict very well my hypothesis: we might achieve our desired therapy goals by providing positive and corrective feedback (e.g. bio-visual-haptic feedback) in virtual training programs.

REFERENCES