Chapter 8.5
The Use of Virtual Reality in Clinical Psychology Research:
Focusing on Approach and Avoidance Behaviors

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ABSTRACT

This chapter presents research that is laying a foundation for new simulation applications that promise learning-oriented treatments for mental health conditions. After presenting background on their technologies and measurement techniques, the authors describe experimental applications of this approach. Analysis of negative and positive responses to virtual reality (VR) stimuli, as well as their complex composites, can lead to a better understanding of patient responses, including fundamental perceptual and cognitive causal relationships. Measuring patients' dynamic parameters in VR simulations can possibly lead to new treatment approaches for psychopathologies The biological and behavioral feedback obtained by virtual mediation, based on parameters of the perceptivo-motor dynamics such those described in this chapter, represents a promising avenue for future investigation.

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INTRODUCTION

This chapter presents research that, while outside the domains of most *SAGE* research presented in this volume, is laying a foundation for new simulation applications that promise learning-oriented treatments for mental health conditions. Using virtual reality (VR) immersive technologies with tracking of ocular and physical movements, this work makes possible more in-depth recording, analysis, and understanding of patient responses, eventually leading to more successful simulation-based treatments. After presenting background on our technologies and measurement techniques, we describe experimental applications of this approach.

BACKGROUND AND TECHNOLOGY

Capturing Perceptual-Motor Dynamics in the Virtual Reality's Loop of Data

Since the first prototypes proposed by Morton Heilig, Myron Krueger and especially Ivan Sutherland in the 1950s and 1960s, the essentials of understanding technological assembly required by VR have hardly changed (Ellis, 1995; Rheingold, 1991; Stanney & Zyda, 2002). Starting from to the simulator machine, we can arbitrarily identify VR's technical assembly according to both the *inputs* transmitted to the computer through reactions recorded from the human operator, and the *outputs* transmitted to the human operator' different sensory channels.

Inputs are produced via a series of sensors and transducers that transform behavioral and physiological variables into physical ones, which are in turn stored in the computer's register. Motor displacements in particular are recorded by a tracking system (generally magnetic, using infrared and/or ultrasound) that isolates the coordinates specific to where the sensors are found on the human operator's body (Ellis, 1995; Foxlin, 2002). The operator is localized within a defined sensory space and his movements are registered across a series of orientational and positional changes. As the operator moves and orients himself in a simulated area, he can perform hand, head, eye, or full body movements. Physiological measures that characterize the state of the human operator in virtual immersion can also be transmitted to the computer (Palsson & Pope, 2002; Wiederhold, Jang, Kim, & Wiederhold, 2002; Wiederhold & Rizzo, 2005). In most cases, the inputs' main function is to vary the parameters that control the state of the virtual environment (VE), i.e., the multimedia arrangement of stimuli oriented towards the human subject.[1] Furthermore, they can help analyze the behavioral dynamics that contribute to interactions with simulated objects in virtual reality for experimental or clinical purposes (Foxlin, 2002; Renaud, Bouchard, & Proulx, 2002a; Renaud et al., 2002b; Renaud, Singer, & Proulx, 2001).

After the fashion of chronophotography— a technique developed by Étienne-Jules Marey (1830-1904) during the 19th century and described in Paul Virilio's *The Aesthetics of Disappearance* (1980) —virtual reality's technical assembly enables a systematic analysis of motor sequences. This assembly allows for an unusual incursion into the motor activities that support kinematic variations of the subjective viewpoint in virtual immersion, i.e., an analysis of the human subject's first-person experience while interacting with the simulated content. In VR, the field of vision that is developed by the subject varies simultaneously in terms of displacement and orientation following the movements that are recorded directly or indirectly using a head-mounted display or stereoscopic glasses. Variations in Cartesian coordinates (x, y and z) and in Eulerian coordinates (yaw, pitch and roll) modify in a coherent way the subject's visual experience. Registering these coordinates allows us to establish an index concerning the spatial relationship between this viewpoint and the