Chapter 56

Immersive Virtual Reality as a Non-Pharmacological Analgesic for Pain Management:
Pain Distraction and Pain Self-Modulation

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ABSTRACT

In the 1990s, when immersive Virtual Reality (VR) was first popular, researchers found it to be an effective intervention in reducing acute pain. Since that time, VR technologies have been used for treating acute pain. Although the exact mechanism is unclear, VR is thought to be an especially effective form of pain distraction. While pain-related virtual environments have built upon pain distraction, a handful of researchers have focused on a more difficult challenge: VR for long-term chronic pain. Because the nature of chronic pain is complex, pharmacological analgesics are often insufficient or unsustainable as an ideal long-term treatment. In this chapter, the authors explore how VR can be used as a non-pharmacological adjuvant for chronic pain. Two paradigms for virtual environments built for addressing chronic pain have emerged – Pain Distraction and what we term Pain Self-modulation. We discuss VR's validation for mitigating pain in patients who have acute pain, for those with chronic pain, and for addressing "breakthrough" periods of higher pain in patients with chronic pain.

INTRODUCTION

Chronic pain (CP) is defined as pain that lasts more than 6 months and persists beyond the healing of its putative cause (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). An estimated 20% of people in North America and 15-20% in industrialized nations (Benjamin, Morris, McBeth, Macfarlane, & Silman, 2000) suffer from CP. As a serious health problem, CP is under-recognized by policymakers (Breivik, Eisenberg, O'Brien, 2013) and is inadequately managed by the healthcare system. In recent years, because of the relative ineffectiveness and potential addictive tendency of pharmaceutical treatments such as opioid analgesics, non-pharmacologic interventions have become a vital part of CP management, as they address the affective, cognitive, behavioral and socio-cultural dimensions of pain. The enormous physical, mental and economic burden that CP imposes on individuals and society demands the need for novel technologies to augment non-pharmaceutical, self-management based interventions.

In recent decades, innovative technologies are being designed and developed to assist individual healthcare, especially for the management of chronic conditions, such as Virtual Reality (VR), wearable computing, immersive 3-Dimensional (3D) sound, and serious games. Among these, immersive VR, which during its emergence was solely recognized for its entertainment value, has become more popular and widely accepted as a non-pharmacological analgesic in medical settings. VR is defined as an artificial environment that is created with computer graphic software and presented to the user in such a way that the user suspends disbelief and accepts it as a real environment.

One of VR's best-known applications in medical field is pain management, especially to attenuate acute pain that occurs during medical procedures. In a number of research projects, VR has been considered successful as a method for distracting patients and reducing their perceived bodily pain, as well as managing emotional disorders, such as overcoming anxiety (Gold, Kant, Kim, & Rizzo, 2005). VR has been applied to help patients with acute pain from dental procedures (Bidarra et al., 2013), cancer-related treatment (Schneider & Workman, 1999), and burn patient wound debridement (Hoffman et al., 2008).

Besides acute pain, there are also studies that suggest CP patients can also benefit from VR applications (Shahrbanian, Ma, Korner-Bitensky, & Simmonds, 2009). CP patients, although requiring long-term pain reduction strategies, also suffer from shorter-term spikes in pain intensity. However, it is not yet known if the analgesic effects of VR persist beyond the VR sessions. Few VEs and VR games have been developed for or researched with CP patients (Li, Montano, Chen, & Gold, 2011).

In this chapter, we will first depict the medical problem and the existing non-technological and technological solutions for health-related Human Computer Interaction (HCI) design. Then we mainly discuss two design paradigms of VR systems for pain management: pain distraction & pain self-modulation. For pain distraction, we created a VR game Mobius Floe (MF). It steers patients' attention outward to reduce pain and anxiety. Our Virtual Meditative Walk (VMW) system is designed to help patient focus inward with pain self-modulation training. It is an immersive VE that incorporates biofeedback sensors and stereoscopic sound. We discuss each VR system, including the supporting medical theory, the design and development approaches we took, and our user testing with patients. Design guidelines that arose from our practice are also offered for the two VR systems. The most crucial point – how to understand the experience of CP patients and communicate such experience – is outlined and discussed in order to inspire more designers and researchers are interested in designing systems for Chronic Pain patients.

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