Positive Effects of VR Technology on Human Behavior

Matthias Rauterberg
Department Industrial Design, Technical University Eindhoven, 5600MB Eindhoven, Netherlands
g.w.m.rauterberg@tue.nl

Abstract

The pros and cons of VR technology and their impact on human behavior are intensively discussed (e.g., in the context of computer games). In Western countries the discussion is focusing on violent game content. A lot is already discussed on the harmful and negative effects of VR game-based technology on human behavior, therefore we decided to focus primarily on the positive effects of VR based technology. In this paper a first overview over positive effects of VR based technology on human behavior is presented and discussed. The drawn recommendations can support developers and designers in VR industry.

Key words: virtual reality, positive effects, therapeutic treatment, human behavior

1. Introduction

Entertainment technology in general, and VR technology in particular covers a broad range of products and services: interactive TV, video and music on demand, computer game, game console, video arcade, internet (e.g. desktop VR applications, MUD), and upcoming therapeutic VR applications [1] [9] [13]. This paper focuses on the growing use of VR technology for therapeutic treatments. The presented results are based on an intensive literature study [11].

2. Overview over Positive Therapeutic Effects

Cancer: Schneider et al [14] could show the promising positive effects of VR applications throughout cancer treatment. This research aims to explore the use of VR as a distraction intervention to relieve symptom distress in women receiving chemotherapy for breast cancer. The empirical investigation is carried out as a crossover study. The study is launched at an outpatient clinic of a mid-western comprehensive cancer center in the US. Twenty women (18–55 years of age) were investigated. Using a crossover design, the 20 subjects served as their own controls. For two matched chemotherapy treatments, one pretest and two posttest measures were employed. Participants were assigned randomly to receive the virtual reality distraction intervention during one chemotherapy treatment and received no distraction intervention control condition during an alternate chemotherapy treatment. An open-ended questionnaire elicited each subject's evaluation of the intervention. The main research measures are: (1) symptom distress, (2) fatigue, and (3) anxiety. As one main result a significant decreases in symptom distress and fatigue occurred immediately following chemotherapy treatments when women used the VR intervention.

Phobia: Using a low-cost commercial computer game VR application with head mounted display applied to phobic and non-phobic persons resulted in a sufficient amount of immersion and presence for the phobic patients to be useful for therapeutic settings [12]. In 'SpiderWorld' (made with software from Division LTD) patients touch a furry toy spider which is electronically cued to a 'virtual' spider image. As the patient touches the virtual spider with their cyber hand, their real hand touches the furry toy spider in the real world. The brain unifies the sensory input from sight and touch into a single experience, giving the patient the odd sensation that they are physically touching a virtual tarantula. The phobia relief results were very promising.

The first VR application used for therapeutic treatments was SpiderWorld. Spiderworld was originally designed to treat spider phobics, but has also proved quite distracting for burn patients.

Pain: One of the major VR application with tremendous positive effects is 'pain treatment'. With the help of simulation software from Multigen-Paradigm, Hoffman is giving a whole new meaning to the concept of "playing through pain." []. Hoffman, Patterson and Carrougher are [4] using a virtual reality system to reduce the extreme pain that burn victims experience while undergoing burn treatment and rehabilitation. Because the pain is so severe that burn patients often resist the regular treatments that are needed to fully restore function to the burned parts of their bodies. This new application field seems to be ideal for the use of VR technology. It turns out that the experience of pain

is strongly affected by how much attention the patient pays to it. Pain signals coming in from the nervous system to the brain can be interpreted as more painful or less painful, depending on what the patient is thinking about, and where their attention is focused. More distraction means less pain. Therefore, Hoffman and Patterson decided to test the attention-getting power of putting patients into VR during treatment.

In several carefully controlled empirical studies [4] [5], the burn center team around Hoffman found that using VR dramatically reduced their patients' awareness and experience of pain. Using a pain index which ranges from 100 (most experience of pain) to 1 (least experience of pain), one group of patients went from a 60 pain index to a 14. This important result has huge implications, and not just in treating burn patients. Patterson describes the expected potential this way:

"Burn wounds are widely considered to be among the most painful injuries a person can endure. So, techniques that prove effective for treating burn pain will likely prove effective for dental pain, pain from brief painful cancer procedures, situations where the patient needs to be conscious, or where the medical procedure is too frequent to use general anesthesia. These preliminary results support the notion that VR might prove invaluable for pain control." ([2], p. 13).

Hoffman, Patterson, and their team are developing the next generation of VR pain-fighting environments. Since a burn treatment can last 30 to 45 minutes, one of the most important technical requirement is the development of a sufficiently long running VR session so that patients can do VR throughout a treatment. Hoffman has developed a new VR world (called 'SnowWorld' using MultiGen-paradigm's Vega software) for experience of flying a virtual fighter jet through an icy 3-D canyon, including shooting virtual snowballs at snowmen and igloos. 'SnowWorld' includes head tracking (e.g., patients see the sky when they look up, a canyon wall when they look left, etc), 3-D sound effects, texture mapped icy canyon walls, an animated river with a waterfall, and animated explosions when their snowballs hit a target. Patients wear a virtual reality high resolution HMD with a 60 degrees diagonal field of view, which allows some peripheral vision of the virtual world. In addition, the HMD completely blocks their view of the real world.

In a controlled laboratory study using undergraduate volunteers, Hunter and colleagues manipulated the degree of 'presence' [8] in SnowWorld. One group experienced the 'high tech' version described above, which is designed to elicit a strong illusion of presence in the virtual world. A second group experienced a 'low tech' version of SnowWorld (with no head tracking, no sound effects, no animations, no texture maps, and no snowballs). This comparison study showed that the stronger the illusion of presence in the virtual environment was, the more pain reduction happened. Hoffman says of the study:

"In our next systems, we are going to focus on increasing 'presence'–the level of patient attention–and realism. New virtual worlds, custom built to be attention-grabbing, could produce even larger reductions in pain, and for longer durations. So that is what we're going for." ([2], p. 13).

One technique for increasing 'presence' is to allow patients to personalize their VR sessions by creating their own virtual events using MultiGen Creator and Vega software. Using a computer cart that is wheeled to their bed, and with some assistance from a staff member, each patient have the opportunity to customize their VR session with their own creations. Later, during painful wound care, the patients will experience their own created VR world.

Another project by Hoffman and Patterson is a VR setup that can withstand water to treat burned patients in 'scrub tanks'. Applying water prove VR technology to them will require the use of fiber optics to send images directly to the HMDs so that there are no electrical cables in the tank. Talking about the important role that VR software technology plays in all this, Hunter says:

"Because the burn patients are often groggy from medication, we are completely dependent on good simulation software to enable the patients to build increasingly attention-grabbing VR systems. Vega and MultiGen Creator are great products to work with. For ex-ample, patients can make a virtual avatar start running along an invisible path, stop, look around, and change directions, just by clicking a couple of buttons on the graphic user interface in Vega. Next time the patient goes into VR, the avatar displays this new behavior they just 'programmed'." ([2], p. 13).

Due to simple use of MultiGen-Paradigm software, clinical researchers can develop new VR worlds where game-like activities helps patients fight pain.

A preliminary case report from Patterson et al [10] explored the use of hypnosis induced through a 3-

dimensional, immersive [6], computer-generated VR world as a means to control pain and anxiety in a patient with a severe burn injury. On hospitalization Day 40, after reports of uncontrollable pain and anxiety, the patient underwent hypnotic induction while immersed in a VR world and received posthypnotic suggestions for decreased pain and anxiety during subsequent wound-care sessions. The patient's pain and anxiety each dropped 40% after VR hypnosis on a Graphic Rating Scale for his Day 41 wound care. Pain dropped similar levels on Day 42 with an audio-only version of the intervention and then returned to baseline without intervention on Day 43.

3. Recommendations

Cancer treatment: The distraction intervention decreased symptom distress, was well received, and was easy to implement in the clinical setting. Nursing interventions to manage chemotherapy- related symptom distress can improve patient quality of life and increase chances for survival by reducing treatment-related symptom distress and enhancing patients' ability to adhere to treatment regimens and cope with their disease.

Phobia treatment "The phobogenic effectiveness of the inexpensive hardware and software used in this study shows that VR technology is sufficiently advanced for VR exposure therapy to move into the clinical mainstream" ([12] p. 475). Robillard et al. conclude that low cost, therapeutic VR applications based on desktop VR games are superior to their expensive commercial counterparts.

Pain treatment: The effects whether VR based pain treatment has a positive result on the healing outcome for burn patients appear very promising, but require further investigations [7]. The avoidance of patient suffering is a key objective as under-treated pain in burn patients can result in noncompliance with hospital treatment. This can disrupt care and increase the risk of post-traumatic stress disorders. In burn management the issue of pain at dressings changes is generally overlooked [7]. An optimal burn care lies in ensuring appropriate control of pain from the outset of care and application of the first dressing, through to the end of treatment.

4. Conclusion

At the end of a comprehensive overview article Hodges et al [3] conclude: "Although less than 10 years old as a discipline, clinical VR has rapidly progressed from an academic exercise to a robust area of VR practice. Outside of entertainment, there's currently no other application of VR that is as successful in terms of actual use beyond research demonstrations as clinical VR. VR applications are routinely used for treating anxiety disorders at numerous clinics in the US and in Canada, Israel, Australia, Korea, Italy, Spain, and Argentina." ([3], p. 31)

The presented and discussed studies have shown that using VR for therapeutic treatments (e.g. pain distraction and rehabilitation), although not yet sufficiently commercial available to clinicians, is clinically recommendable. Beyond from being entertaining (almost video game-like), these applications are often patient-based and track patient performance. The context of use (e.g., rehabilitation procedures) must be flexible enough to address the particular conditions of a given patient, and vary certain simulation parameters, (e.g., difficulty index). Another characteristic of therapeutic VR is its potential to be used in assessment, treatment, and rehabilitation. In addition to the literature presented, different research communities are starting envisioning and exploring new areas of therapeutic VR. Relatively low-cost VR technology are very promising and can produce more improved therapeutic results than current expensive commercial counterparts. Close cooperation and communication among engineers, computer scientists, and clinicians is required to create effective new VR applications with positive effects on human behavior.

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