

The Island of Pain: a Virtual Reality Experience for Patients with Chronic Pain

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ABSTRACT

Millions of people around the world suffer from chronic pain. Chronic pain can be managed with drugs or psychological techniques. However, drugs have side effects and psychological treatment is expensive. In our Virtual Reality experience patients learn how to manage their pain by following voice-over instructions of a clinical psychologist and through interaction with a virtual pain character. This Virtual Reality experience mimics one of the sessions from a psychological intervention tailored for chronic pain sufferers. The objective of our work is to develop a self-contained training program that would supplement the clinical psychologist and would be more entertaining, scalable and accessible than traditional therapy.

CCS CONCEPTS

• **Computing methodologies** → *Interactive simulation*.

KEYWORDS

Virtual Reality, pain relief, chronic pain

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1 INTRODUCTION

The experience of pain is mediated by biopsychosocial factors [Schug et al. 2016]. Traditional therapy for chronic pain involves analgesic medications and invasive pain procedures. Both of these methods are associated with numerous complications and known side effects. Another alternative to pain relief is psychology therapy. As a non-pharmacological treatment it is useful as it minimises these side effects by reducing reliance on standard therapies: complementing but not increasing the burden of medication therapy.

Traditional pain psychology teaching is conducted using didactic information packs, videos and direct sessions. It is directed at modifying unhelpful behavioural, emotional, and cognitive responses to



Figure 1: A Patient Interacting with our System

chronic pain [Schug et al. 2016]. If properly followed, pain psychology therapy reduces reliance on medications and the frequency of side effects, in particular of complications associated with opioid-based analgesics. Unfortunately, psychology therapy is expensive and does not offer fast results. Many patients who turn to this technique lack motivation to continue after the initial session and turn to medications instead. One of the key benefits of pain psychology, however, is that it aims to improve functional outcomes, which are patient-centred and important to an individual's quality of life.

In this project, we encoded pain psychology therapy in Virtual Reality. We can thus educate and provide patients with opportunities to practice these therapies in an engaging and immersive environment. Using Virtual Reality is novel, as patients are transported into a computer generated world that is captivating; this encourages participation, retention, and willingness to use therapies in real life.

In the past 10 years, Virtual Reality has been explored as non-pharmacological pain management. Our research group recently published a systematic narrative review [Chuan et al. 2020] of 18 studies using Virtual Reality for acute and chronic pain in adults. This complemented another systematic review of 19 studies in paediatric patients [Eijlers et al. 2019]. The majority of these combined 37 studies used Virtual Reality as simple distractions (movie or game) diverting attention away from the painful stimulus. However, such transient interventions are not effective for chronic pain such as cancer-related peripheral neuropathy.

For chronic pain sufferers pain psychology therapy is a more suitable technique to be performed in Virtual Reality. By teaching longer-term behavioural, cognitive, and emotional adaptive responses, pain psychology is better suited for persistent pain

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syndromes. Two previous studies have attempted Virtual Reality-delivered pain psychology [Garcia-Palacios et al. 2015; Konstantatos et al. 2009], and only one aimed at chronic pain [Garcia-Palacios et al. 2015]. In contrast, our program was designed as a multidisciplinary collaboration between pain specialists, pain psychologists, cognitive scientists, and computer scientists. Arousal prevention therapy is taught using relaxation techniques. Cognitive behavioural therapy is taught using pain visualisation techniques.

2 OUR APPROACH

In our prototype we present patients with an introductory psychological intervention that aims at educating them about the importance of accepting the pain and learning how applying various relaxation techniques can help decrease the perceived pain intensity. This experience mimics one of the sessions from a psychological intervention that is proven to offer effective treatment.

In a traditional session patients had to imagine the pain being an angry red ball with spikes, had to perform the mental exercise of punching it (and seeing how it grows and becomes angrier in response) and then, later, had to mentally transport themselves to a tropical island next to a waterfall, where they had to learn relaxation by listening to the sounds of imaginary birds and trees moving on the wind. They had to pretend that they are touching butterflies and walking on the beach. All these elements became real in our simulation¹ and some of them (such as fighting the pain or interacting with butterflies) have been transformed into fun interactive experiences. The virtual pain character (shown in Figure 2) played an important role in educating the patient about the importance of not fixating on the pain, learning to notice details of the surrounding environment and finding relaxation in simple mental exercises that can be performed anywhere.

Validation of our software is being conducted with volunteers and patients (see Figure 1). Our validation study had to be temporary suspended due to COVID-19, so no statistically significant results can be reported. Initial anecdotal evidence looks very promising.

3 SIGNIFICANCE AND INNOVATION

Chronic pain is a debilitating condition with severe impact on health, quality of life, and ability to participate in workforce and society. Most attention is devoted to pharmacotherapy and pain procedures, but pain psychology therapy is relatively under-researched. Benefits include reducing dependency on opioids and other medications, and providing patients with self-management tools. There is also focus on functional outcomes and reducing disability.

A Virtual Reality program is highly accessible, as the constriction is on availability of hardware. Currently, access to pain psychologists is limited due to small numbers and high workload. Patients in non-metropolitan and remote communities are disadvantaged. Virtual Reality hardware is easily transportable and easily setup in any space. If patients can undergo Virtual Reality pain psychology training at home, this enhances the value of tele-health programs, an especially important feature in the current COVID-19 situation. A Virtual Reality-delivered pain psychology program may also be cost effective as multiple sessions and multiple patients can use the one hardware setup.



Figure 2: The Virtual Pain Character

Of the 2 studies previously using pain psychology in Virtual Reality, one used hypnosis for burns dressing changes [Konstantatos et al. 2009] while the other study used a passive calming scene for chronic fibromyalgia pain control [Garcia-Palacios et al. 2015]. Our program instead encourages patients to interact with the virtual psychologist to learn muscle relaxation techniques and guided pain visualisation. These techniques are frequently used in treating chronic pain. Our multidisciplinary team combined psychology content with computer and cognitive science to inform an immersive, engaging experience that enhances learning by patients. We used gaming theory to increase participation and buy-in, effectively making learning more fun. Our methodology is robust to provide conclusive results. Previous studies were limited: lack of blinding, heterogeneous patient population, insufficient data collection, short duration follow-up inconsistent with chronic pain trajectories (our group's systematic review [Chuan et al. 2020]).

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¹A video showing our prototype is available at <https://youtu.be/oRtituFa4bw>.