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SPECIALTY SECTION
This article was submitted to Virtual
Reality and Human Behaviour,
a section of the journal
Frontiers in Virtual Reality in Medicine

RECEIVED 14 August 2022
ACCEPTED 07 September 2022
PUBLISHED 29 September 2022

CITATION
Harvie DS, Smith RT, Martin D, Hirsh AT
and Trost Z (2022), Editorial: Novel
applications of virtual and mixed reality
in pain research and treatment.
Front. Virtual Real. 3:1018804.
doi: 10.3389/frvir.2022.1018804

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Editorial: Novel applications of virtual and mixed reality in pain research and treatment

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KEYWORDS

virtual reality, pain, rehabilitation, extended reality, embodiment

Editorial on the Research Topic

Novel applications of virtual and mixed reality in pain research and treatment

Introduction

Virtual Reality (VR) was first proposed as a distraction-based analgesic over 20 years ago (Hoffman et al., 2000). While powerful, distraction is only one possible use of VR in pain-related research and practice (e.g., (Harvie et al., 2015; Harvie et al., 2018; Harvie et al., 2020a; Harvie, 2021; Trost et al., 2021; Kelly et al., 2022)). Moreover, short-term effects of distraction are less relevant when pain is persistent. As such, new approaches are needed if VR is to have utility beyond acute pain.

The last two decades have seen increased understanding of the multidimensional nature of pain. Central sensitization (Woolf, 2011), cortical re-organization (Moseley and Flor, 2012), perceptual processes (Tabor et al., 2017), psychosocial and behavioral factors (Vlaeyen and Linton, 2012), altered body image (Levenig et al., 2019; Harvie et al., 2020b), and neuro-immune upregulation (Grace et al., 2021) are now recognized as important considerations. And while progress has been made in multidisciplinary management of chronic pain, intervention effect sizes are typically modest, indicating a need for innovation. Innovation is also needed in the domain of acute pain management, particularly considering the increasing push for opioid alternatives (Volkow and Blanco, 2021). In this domain, improved acute pain management aims to alleviate immediate suffering and prevent persistent pain (Gan, 2017).

Unique features of virtual reality for pain research and treatment development

Clearly, there is work to be done to improve acute and chronic pain care. Towards this aim, VR affords a unique set of tools that enable new ways to interrogate pain and develop potential new treatments. This editorial will highlight these features with reference to the papers included in this special issue and their contribution to this field.

VR: The medium, not the manipulation

Some reviews have pooled data from diverse methods to examine whether “Virtual Reality” can reduce pain (e.g., (Goudman et al., 2022)). This approach is conceptually and empirically fraught. VR has many potential applications and may operate via diverse mechanisms. As such, in undifferentiated pooled analyses, the effects of one approach may be diluted by the limited (or opposite) effects of another. We contend that it is better to conceptualize VR as the medium, thus drawing attention to specific applications and mechanisms. This point is certainly exemplified in the diversity of uses for VR included in this special issue.

Attentional focus: Presence and engagement

Presence is the perception of being physically present in a non-physical world (Slater, 2018). With this sense comes engrossment in the experience, to the exclusion of other internal and external stimuli. This intense attentional focus has been harnessed for analgesic and anxiolytic effects during medical procedures. In this special issue, Smith and colleagues (Smith et al.) undertook a systematic review and meta-analysis of pain alleviating effects of VR-based distraction during burn care. VR was found to reduce pain, more so than standard distraction methods and standard medication care. Interestingly, there were not differential effects between immersive VR and less immersive multimodal distraction interventions. As such, the degree to which increasingly engaging VR techniques might further augment analgesia remains open. Here, we support the focus on the effects specifically in children since pain and VR might interact, and be expressed, differently in adults and children.

Interaction and role play

VR allows for the creation of life-like interactive scenarios. Among other effects, this feature may aid in maintaining motivation and engagement with content, such as for health education and self-management (e.g., (Harvie, 2021)). In this special issue, Bartlett and colleagues outlined the design process

of a VR-based avatar designed to mentor patients in self-management interventions for chronic pain (Bartlett et al.). The authors put forth key considerations and recommendations to aid in future work, as well as present ideas around enabling working alliances with non-human agents and identifying features of effective delivery of expert advice.

Embodiment

In VR, a digital avatar can be substituted for a participant’s real body and displayed from a first-person perspective. Moreover, virtual and real movement can be tethered. This visuomotor congruence results in the illusory “embodiment” of the avatar (Kilteni et al., 2012) and can have remarkable effects. For example, the avatar’s characteristics may bias self-perceptions or behaviors relevant to chronic pain (Kelly et al., 2022). Moreover, it is possible that the effectiveness of VR in inducing analgesia is associated with the sense of embodiment; however, this has not been well investigated. Ziabari and colleagues, in this special issue, made strides toward addressing this question by outlining a protocol to address the impact of embodiment on pain (Ziabari et al.).

Altered visual feedback

Several prior studies have used manipulated visual feedback to interrogate pain. For example, visual feedback techniques to simulate movement and touch have been used in empirical and clinical applications (Harvie et al., 2015; Harvie et al., 2017; Harvie et al., 2020a; Harvie et al., 2022). In this special issue, two papers capitalised on this affordance of VR to interrogate aspects of sensory processing in two poorly understood chronic pain conditions—Fibromyalgia and Complex Regional Pain syndrome (Dagenais et al.). In one study, Dagenais and colleagues found that a feature of sensory processing known as “visuomotor” adaption was unaffected in people with Fibromyalgia. In the other study, Brun and colleagues found that VR-induced sensory conflict evoked different experiences in people with CRPS compared to controls. Such studies are important to inform theories that attempt to explain persistence of pain via altered body-related sensory processing (e.g., (Moseley et al., 2012)).

Overcoming barriers to access

Many people with chronic conditions face barriers to accessing multidisciplinary face-to-face interventions that promote self-management. These include a shortage of local clinicians with appropriate expertise, as well as limitations related to disability, transportation, time, or finances. Digital health and telehealth interventions can help overcome these barriers. They may also address individual and social constraints. For example, cultural

norms and stigma may prevent some patients from seeking mental health care. The semi-autonomous mentoring avatar approach to self-management in chronic pain, presented in the paper by Bartlett et al., makes a meaningful step towards applying VR in this space (Bartlett et al.). However, while the costs of VR hardware has diminished over time, head-mounted displays and associated software, nonetheless present a cost that may prevent use particularly in developing economies. In this light, we certainly encourage research employing devices and approaches that limit costs and support greater access.

Progress in VR-based pain research and treatment

This special issue highlights the diversity of potential applications of VR in pain research and practice. As demonstrated by the included studies, VR is not a unimodal tool. Rather, it is a medium capable of delivering a range of interventions and experimental manipulations. This elevates the potential of VR to play a key role in progress toward better understanding and treatment of acute and chronic pain.

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Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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