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

RECEIVED 09 December 2022  
ACCEPTED 19 December 2022  
PUBLISHED 04 January 2023

CITATION  
Li BJ, Peña J and Jung Y (2023), Editorial:  
VR/AR and wellbeing: The use of  
immersive technologies in promoting  
health outcomes.  
*Front. Virtual Real.* 3:1119919.  
doi: 10.3389/frvir.2022.1119919

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# Editorial: VR/AR and wellbeing: The use of immersive technologies in promoting health outcomes

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## KEYWORDS

virtual reality, wellbeing, immersive technologies, health outcomes, physical rehabilitation, healthcare workers, virtual agents, avatar customisation

## Editorial on the Research Topic

**VR/AR and wellbeing: The use of immersive technologies in promoting health outcomes**

Virtual reality (VR) technologies have been used as a tool in various domains with promising results (Jarrold et al., 2013; Ahn et al., 2014; Hamilton et al., 2021; Peña et al., 2020; Meijers et al., 2021). We were interested in the use of VR to promote health outcomes, particularly with COVID-19 throwing a spanner in daily routines. The pandemic saw a drastic reduction in social and outdoor activities such as exercising, travel and mingling, and immersive technologies provided a means for many to improve their physical and mental wellbeing. The goal of this Research Topic was to highlight insightful uses of immersive technologies for wellbeing and understand the feasibility and efficacy of these technologies on personal health outcomes.

Tarrant et al. conducted a study at the height of the COVID-19 pandemic, exploring if a mobile VR plus neurofeedback (VR + NF) meditation experience was more effective in improving moods healthcare workers as compared to an audio-only meditation tool. While the audio-only meditation tool saw no significant changes in the dependent variables, participants in the VR + NF group reported significant decreases in fatigue, confusion and vigor, and significant increases in calmness and happiness. These results suggest that in a time where healthcare workers are at heightened levels of stress and anxiety, immersive technology-based meditation tools can be an effective tool to reduce negative mood states within the healthcare environment. It will be interesting to see if immersive tools like these will be helpful in the long-term and/or see greater adoption in healthcare settings, where healthcare workers are increasingly spending the bulk of their daily lives.

With the pandemic causing a challenge for physical therapists to execute physical rehabilitation for their patients, Elor et al. interviewed 130 physical rehabilitation professionals to understand their perceptions of existing shortcomings of physical therapy mediums and the opportunities of using VR technologies to promote patient evaluation and rehabilitation. Their findings show that existing telehealth solutions are inadequate, with interviewees reporting having difficulties assessing patients' range of motion and strength, as they lost the ability to freely examine patients' movements and injuries. One outcome that arose was that physical therapists ended up giving more verbal advice, acting as "life coaches" to their patients, rather than conducting actual physical rehabilitation. Most agreed that immersive technologies will allow for more effective physical therapy as they allow for a stronger sense of

presence, enable evidence-based measures, and provide immersive clinical practice. The authors conclude by discussing the significant opportunities where VR technologies can expand the capabilities for rehabilitation and preventative care.

As the use of HMD-based VR and physiological computing for stroke rehabilitation is on the rise, Gougeh and Falk conducted a systematic review on the use of VR-based tools for stroke rehabilitation. Among the 12 articles that fulfilled the inclusion criteria, positive outcomes of VR-based rehabilitation protocols identified by the authors include higher patient motivation and adherence, greater rehabilitation effectiveness and faster recovery times. A main limitation of these studies pertains to the overall generalizability of the results due to small sample sizes and unbalanced gender ratios. Overall, the authors conclude that the positive outcomes outweigh the concerns. This suggests that the use of VR tools for stroke rehabilitation could see greater impact through wider implementation in the future.

To understand the effects of being exposed to angry- or happy-looking virtual agents on individuals' potential social avoidance, Kiser et al. conducted an experiment with 58 participants in a Cave Automatic Virtual Environment (CAVE) system. Participants were measured on the time they spent in the room with the virtual agent, levels of social anxiety and perceived presence. Although the authors did not detect an effect of social conditioned place preference, they found participants with higher trait social anxiety spending less time in the room where the angry-looking virtual agent was present. The authors concluded that high levels of trait social anxiety conditioned participants towards social avoidance tendencies. Based on their findings, they suggested directions where VR tools can be further developed as personalized treatment methods for social anxiety.

To round up our Research Topic, Rheu et al. explored the influence of avatar customization and control intuitiveness in a digital running game on participants' running performance. Results of a 2 X 2 experiment with 44 participants showed that while customized avatars increased avatar identification and feelings of avatar embodiment, running performance was lower in the customized avatar and unintuitive controls conditions. The authors

conclude that while avatar customization can facilitate physical activity after gameplay, and feelings of avatar identification and embodiment, unintuitive controls may hamper these relationships due to the sense of frustration or disappointment from the increased cognitive effort to control the game. They then provide suggestions on how findings can be utilized when designing interactive games for healthy behaviours.

Overall, the papers in our Research Topic demonstrate not only the possibilities of immersive technologies in promoting health outcomes, but suggest potential psychological or technological factors that can contribute to the overall efficacy of these tools. We believe that the findings from these studies will lead researchers and practitioners in the field of immersive technologies to understand the use of these tools and develop more effective immersive technologies for health outcomes and social good.

## Author contributions

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

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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