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# Editorial: Virtual reality for neuropsychology and affective cognitive sciences: Theoretical and methodological avenues for studying human cognition

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## Editorial on the Research Topic

**Virtual reality for neuro psychology and affective cognitive sciences:  
Theoretical and methodological avenues for studying human cognition**

The Research Topic presented here emphasizes the theoretical and methodological contributions of the use of virtual reality to study human cognition. At a first glance, the use of novel technologies, such as virtual reality can be seen only as broader means of providing richer and multimodal stimuli for experimental psychology. However, it should be stressed out that the introduction of virtual reality in the field represents a serious paradigm shift in cognitive sciences. When Wilhelm Wundt established the first laboratory at Leipzig University in 1879, namely “The Institute for Experimental Psychology”, he deliberately created a separate space from other departments in which it could be possible to conduct experiments by isolating several parameters. Wundt was one of the first who recognized that behavior and even the subjective aspects of the mind itself can be observed according to independent variables created in the environment. Thus, he understood that in order to manipulate the variables that he created, he had to control other variables already present in the reality of this space. This is why a dark room was installed in this laboratory for performing psychophysical experiments on visual perception (Nicolas, 2005). This may seem insignificant by today’s standards, but virtually what Wilhelm Wundt tried to do was the manipulation of the physical reality in which modified stimuli have been exposed to participants. His work made that psychology is furthermore established as a full-fledged empirical science.

More than a century after, technological advances in the field of computer sciences have also led to creating a new environment for a new kind of interface, interaction, and immersion: Virtual Reality. Following the democratization of technology, researchers in cognitive science found out that virtual reality can be a real asset for studying neuropsychology and affective cognition experimentally. The fact that it can create any familiar environment without limits

(e.g., public transport, music theater, street . . . ) made it a pertinent technology for mental health studies. But more importantly, in virtual environments, researchers not only are able to manipulate everything, but they can also create new laws of physics, stimuli and objects that don't exist in the outside world. This makes the use of virtual environments a very important paradigm shift in the field of cognitive science. Therefore, virtual reality is also increasingly used in recent neuropsychological studies. Finally, thanks to its immersive and interactive nature, virtual environments are also being popular by the use of affective and reactive virtual agents in social cognition disorder studies (Brunet-Gouet et al., 2016).

Based on these observations, the Research Topic presented here is gathering familiar methodological tools in cognitive science and neuropsychology coupled to the use of virtual reality, virtual environments and virtual agents. A first line of contributions made the use of virtual reality with behavioral measures frequently performed in neuropsychology and cognitive science studies such as electroencephalography (EEG), eye-tracking, heart rate variability. For instance, Cuesta et al., provided a proof-of-concept to assess the potential of coupling virtual reality and EEG in aging individuals with subjective cognitive decline. They highlighted that, older adults did not suffer from cybersickness and reported positive user experience but also highlighted a significant improvement in working memory when comparing virtual intervention groups to the control group. Turbyne et al., studied parameters involved in mitigating acute pain by investigating whether affective and physiological responses to painful electrical stimulation differed between a first and a third person perspective in virtual reality. The results confirm that the participants reported significantly higher tension during the third person condition. In order to investigate authentic, fear responses from a holistic perspective, Kisker et al., provided an immersive experience in which they built a physical replica of a cave while participants explored with a fearful or a neutral version of it in virtual reality. During the experiment, electrophysiological correlates of fear-related approach and avoidance tendencies, such as frontal alpha asymmetries (FAA) were evaluated for the first time for this kind of immersive conditions related to authentic fear.

The second line of contributions consisted of wellbeing and mental health issues. Batistatou et al., used virtual reality to test the impact of colorful floor markings on the spontaneous speed of walking, gaze behavior recorded by eye-tracking, as well as perceived changes in and physiological measures of affective states. Their findings suggest that colors may be a powerful tool to trigger alertness and pleasure in gray urban cities. On the matter of improving wellbeing, Pavic et al., reviewed the scientific literature on how to foster positive emotions through virtual reality. They found out that the positive virtual reality experience consists of

applications for relaxation, stress and pain management, motivation for physical activities, and gives promising results for apathy treatment in elderly users. Chaby et al., also investigated how and why virtual patients can be used in psychiatry and geriatrics in order to train healthcare professionals in social skills required to interact with patients. They also propose recommendations, best practices and uses for the design, conduct and evaluation of virtual patient training sessions. Regarding virtual characters, Stallman et al., proposed a new and innovative methodology article in which they provided a description of the development of a novel paradigm designed to test the efficacy of social emotion regulation with an embodied virtual agent and its virtual environment, and how to anticipate results from typically developing and autistic youth populations. Finally, Oker shed some light on the link between neural underpinnings of embodied social cognition and virtual agents' pertinence for experimental studies in cognitive psychopathology depicting social cognition impairments.

While it is not the first nor the last time in the literature, studies presented in this Research Topic show clearly how virtual reality and virtual agents are pertinent tools for studying neuropsychology and affective cognitive science. We predict that we are just in the beginnings of a real paradigm shift in the field and, following further democratization of the head mounted displays, virtual reality will become an acclaimed and inevitable tool in psychology labs in the next decade.

## Author contributions

AO wrote the first draft. All authors have supervised the manuscript.

## 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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