Editorial
The Tower of Babel: Virtual Reality Revisited

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Over the last decade, virtual reality (VR) has become virtually ubiquitous in our lives. The first versions of what we today call VR technologies emerged in the mid 1960ies and sparked attention when Ivan Sutherland (1965) published his seminal work 'The Ultimate Display'. He was also the first to use a head mounted display (HMD), which, unlike its modern descendants, had to be hanged from the ceiling due to its weight and was therefore cheekily called the *Sword of Damocles*. Since then, technologies have undoubtedly evolved to be more sophisticated, more comfortable, and – since the introduction of the *Oculus Rift* in 2016 – more affordable. Accordingly, interest in VR has increased, and the publications on VR have skyrocketed (see Cipresso et al., 2018).

The intensified focus on VR and its expansion from the field of computer science to education, medicine, psychology etc., has not only brought more knowledge with it, but arguably also more questions. Just as the various types of VR technologies have grown, so have the designations. 'Virtual Reality' now seems to constitute a catch-all term for a variety of software and hardware systems, including not only computer games on the smartphone or interactive multi-user environments presented on a 2D-desktop monitor, but also 3D-virtual worlds delivered via HMDs, *Cave Automatic Virtual Environment*s (CAVEs) and complex multisensory training-simulations (e.g., Di Natale et al., 2020). This babel of taxonomies calls for taking a step back and for re-evaluating the foundations of the term "virtual reality".

On the one hand, VR may be conceptualized from a techno-centric perspective. This approach categorizes technologies according to their level of immersiveness (see Slater, 2018). Immersiveness means the degree to which the technology perceptually surrounds the user (e.g., by covering the field of view) and immerses him/her in the virtual environment (for a categorization of VR technologies according to their level of immersiveness see Di Natale et al., 2020). Some researchers argue that a "key feature of virtual reality is immersion" (Steffen et al., 2019, p. 687). As such, the term VR embraces technologies like HMDs, but excludes 2D-monitors (e.g., Girvan, 2018).

On the other hand, VR may be understood from a user perspective. One of the first definitions of VR entails an exclusively human point of view, stating that VR is "a real or simulated environment in which a perceiver experiences telepresence" (Steurer, 1992). This definition covers all technologies as long as they are capable of eliciting a sense of presence (IJsselsteijn, 2004). This may include all kinds of computer-generated worlds which provide a certain level of interactivity (e.g., multi-user environments, learning platforms) but which are not necessarily immersive in the above-mentioned sense.

What adds even more to the complexity of defining VR is the advent of augmented reality (AR). AR means superimposing or overlaying digital stimuli on the physical environment. As such it is regarded a variant of VR by some researchers. Others, however, see it as a unique form of blurring the boundaries between what is 'real' and what is 'virtual' (see Kardong-Edgren et al., 2019). Moreover, the term mixed reality (MR) is used to describe a hybrid between VR and AR. And finally, the rather

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newly introduced concept of extended reality (XR) is an umbrella term for all, VR, AR, and MR (Stanney et al., 2021).

What may help in shedding light on these different categories of technologies is the *virtuality continuum*. It was introduced by Milgram and Kishino in 1994 and has since then been updated and adapted by Skarbez and colleagues (2021). According to it, the real environment is at one extreme of the continuum, whereas the fully immersive virtual environment is at the other. In between lie technologies like Augmented Reality (AR) and Mixed Reality (MR).

Overall, to date no standardized definition of VR has been found. Researchers may therefore choose to categorize a technology as "virtual reality" based either on its level of system immersiveness, or on the extent to which it is able to elicit user presence. Yet, laying out the chosen definition and operationalization in every study manuscript, and supporting it by theoretical frameworks should be a matter of course.

In this issue, three papers deal with 'virtual reality' in one way or another: Based on focus group interviews, Wahl et al. (p. 27) discuss design principles and provide recommendations for the use of immersive learning environments (AR and VR). Knaust et al. (p. 7), in turn, explore whether the immersiveness of a VR technology has an effect on relaxation, and whether this effect is mediated by spatial presence. Finally, the letter by Felnhofer and Kothgassner (p. 3) comments on the terminological misconceptions surrounding the concepts of immersion and the sense of presence.

And while VR technology continues to evolve and with it the ways to categorize it, we shall keep in mind that reality – and hence, virtuality – cannot be understood without the people and the peculiarities of their perceptual systems. Wijnand IJsselsteijn (2002) eloquently puts this notion in a nutshell, by stating that "[…] all reality is virtual. […] Reality is not "out there", it is what we take to be "out there" (p. 245).

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References

Cipresso, P., Giglioli, I. A. C., Raya, M. A., & Riva, G. (2018). The past, present, and future of virtual and augmented reality research: a network and cluster analysis of the literature. *Frontiers in psychology*, 2086.

Di Natale, A. F., Repetto, C., Riva, G., & Villani, D. (2020). Immersive virtual reality in K-12 and higher education: A 10-year systematic review of empirical research. *British Journal of Educational Technology*, *51*(6), 2006–2033.

Girvan, C. (2018). What is a virtual world? Definition and classification. *Educational Technology Research and Development*, *66*(5), 1087–1100.

IJsselsteijn, W. (2002). Elements of a multi-level theory of presence: Phenomenology, mental processing and neural correlates. *Proceedings of PRESENCE*, *2002*, 245–259.

IJsselsteijn, W. A. (2004). *Presence in depth.* Eindhoven University of Technology, Eindhoven, The Netherlands.

Kardong-Edgren, S. S., Farra, S. L., Alinier, G., & Young, H. M. (2019). A call to unify definitions of virtual reality. *Clinical Simulation in Nursing*, *31*, 28–34.

Milgram, P., & Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE TRANSACTIONS on Information and Systems*, *77*(12), 1321–1329.

Skarbez, R., Smith, M., & Whitton, M. C. (2021). Revisiting milgram and kishino's reality-virtuality continuum. *Frontiers in Virtual Reality*, *2*, 647997.

Slater, M. (2018). Immersion and the illusion of presence in virtual reality. *British Journal of Psychology*, *109*(3), 431–433.

Stanney, K. M., Nye, H., Haddad, S., Hale, K. S., Padron, C. K., & Cohn, J. V. (2021). eXtended reality (XR) environments. *Handbook of human factors and ergonomics*, 782–815.

Steffen, J. H., Gaskin, J. E., Meservy, T. O., Jenkins, J. L., & Wolman, I. (2019). Framework of affordances for virtual reality and augmented reality. *Journal of Management Information Systems*, *36*(3), 683–729.

Steuer, J. (1992). Defining virtual reality, dimensions determining telepresence. *Journal of Communication, 42*(4), 73–93.

Sutherland I.E (1965) The Ultimate Display, Proceedings of the IFIPS Conference, 2, 506–508.

Conflict of interest

The Editors-in-Chief declare no conflict of interest.