

Evaluating the Effect of Spatial Qualities, Openness and Complexity, on Human Cognitive Performance within Virtual Reality

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Abstract : Architects have developed a series of objective evaluations, using spatial analysis tools such as Isovist, that show how certain spatial qualities are beneficial to specific human activities hosted in the built environments. In return, they can build more adapted environments by tuning those spatial qualities in their design. In parallel, virtual reality technologies have been developed by engineers with the dream of creating a system that immerses users in a new form of spatial experiences. They already have demonstrated a useful range of benefits not only in simulating critical events to assist people in acquiring new skills, but also to enhance memory retention, to name just a few. This paper investigates the effects of two spatial qualities, openness, and complexity, on cognitive performance within immersive virtual environments. Isovist measure is used to design a series of room settings with different levels of each spatial qualities. In an empirical study, each room was then used by every participant to solve a navigational puzzle game and give a rating of their spatial experience. They were then asked to fill in a questionnaire before solving the visual-spatial memory quiz, which addressed how well they remembered the different rooms. Findings suggest that those spatial qualities have an effect on some of the measures, including navigation performance and memory retention. In particular, there is an order effect for the navigation puzzle game. Participants tended to spend a longer time in the complex room settings. Moreover, there is an interaction effect while with more open settings, participants tended to perform better when in a simple setting; however, with more closed settings, participants tended to perform better in a more complex setting. For the visual-spatial memory quiz, participants performed significantly better within the more open rooms. We believe this is a first step in using virtual environments to enhance participant cognitive performances through better use of specific spatial qualities.

Keywords : architecture, navigation, spatial cognition, virtual reality

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