Virtual numbers for natural gestures:

Masked priming effect with finger-counting in virtual reality

Thesis by

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Abstract

According to the embodied cognition framework, the involvement of body parts influences the acquisition of numerical knowledge. Fingers might be a good candidate since finger-counting is where numerical expressions become most visible and concrete. Indeed, many developmental, behavioral, and neuroscientific studies demonstrated the functional link between fingers and numbers, providing solid evidence of an embodied interaction between body and mind. The present thesis aimed to examine the functional link between fingers and numbers in a virtual reality environment using a hand motion tracker. It presented a novel and promising method to investigate the association between finger configurations and numerical representations. Participants had to imitate visually presented finger configurations preceded by masked (and thus invisible) Arabic numerals from 1 to 9 (i.e., cross-notation priming task). A two-phase experiment was conducted with 20 adult participants from the University of Potsdam. Phase 1 used an adaptive measurement method to calculate each participant's appropriate prime durations in a virtual target detection task. Phase 2 aimed to investigate whether prime numbers can speed up participant's finger-configuration imitation performance and investigate the effects of prime, distance, and starting hand. In line with the embodied view, the results showed that participants imitated small number configurations faster than larger number configurations except for number 4. Additionally, the study revealed individual differences in priming durations and underlined the importance of using an adaptive experimental design. These results support the idea that virtual reality technology and motion trackers are suitable experimental tools to examine how visual and motor systems influence cognition and how finger-counting contributes to the development of the embodied framework of numerical cognition.

Keywords: Numerical cognition, Embodied cognition, Finger-counting, Finger-based representations, Virtual reality, Hand motion tracking