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Spatial Language in Augmented Reality: An XR Framework for Investigating Visuospatial Cognition

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Extended Abstract

This study focuses on extending previous research on the interaction between language and spatial cognition from virtual reality (VR) environments to the context of augmented reality (AR), aiming to explore the neural circuits involved in visuospatial encoding and semantic processing of spatial deixis ('this' vs. 'that'), with particular attention to the role of the posterior parietal cortex (PPC) [1]. The considered methodological shift is necessary to assess the robustness of neural patterns already observed in VR and to evaluate whether AR, by combining real and virtual stimuli, can provide a more cognitively natural interface, in line with real-world perception [2]. In this work, we developed a novel experimental framework on an AR platform to try to overcome the main limitations related to stable 3D stimulus tracking (words) and high-precision spatial calibration. The system uses carefully designed algorithms and low-latency optimization techniques to enable the controlled presentation of verbal stimuli at predefined distances (e.g., 60 cm and 120 cm), where a lexical decision task with optional gesture-based interaction is present [3].

Although data collection is ongoing, the implementation of augmented reality represents a fundamental advance. It allows studying spatial semantic processing in conditions more congruent with everyday sensorimotor experience and opens new perspectives for the design of intuitive augmented reality interfaces with a high level of performance. Furthermore, this work tries describe how like this platform to understanding how the human brain processes spatial semantic information in mixed environments and how this has clinical relevance: neurocognitive disorders affecting the anterior prefrontal cortex (PPC), such as spatial neglect syndromes or neurodegenerative conditions [4,5], can benefit from diagnostic and rehabilitative strategies based on augmented reality [6].

This work highlights the technical and methodological challenges of translating complex neuroscientific paradigms into extended reality (XR) platforms, try to open the way for a new generation of augmented cognition research with potential applications in clinical, industrial, and educational settings.

Keywords

Spatial Cognition; Augmented Reality (AR); Posterior Parietal Cortex (PPC); Deictic Language Processing; XR Neuroengineering;

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