Sensory entrainment for improving spatial navigation

ABSTRACT:

Spatial Navigation (SN) is a complex skill essential for many animal species, including animals that requires coordination of several cognitive processes, for instance episodic and working memory. At present, both invasive and non-invasive neuroimaging studies in animals (specially rodents) and humans have revealed the relevance of the hippocampus and a wide-spread brain network in SN. Theta brain oscillatory have been proposed to be the responsible for the organization of SN information into cognitive maps and to be crucial both for encoding and retrieval of SN information. Recent studies suggest that Theta oscillatory activity can be entrained by means of rhythmic sensory stimulation and result in improved associative memory. The aim of current study was to improve SN in humans in a realistic SN task by means of rhythmic sensory stimulation in the Theta range. To do that, we developed a VR tool for generating realistic scenarios while sensory (visual or auditory) stimulation was provided. In addition, electroencephalographic activity of subjects was recorded during the SN task in order to verify successful entrainment of brain oscillations. We performed 3 experiments and we concluded that, although we found evidence of entrainment of brain oscillatory activity in the EEG recordings, this entrainment did not result in a behavioral benefit in any of the experiments. Therefore, we conclude that sensory (audio or visual) entrainment cannot be used in VR applications in humans to improve SN skills either at short or long term.

Keywords
Spatial navigation, Electroencephalography, Brain oscillations, Sensory entrainment, Virtual Reality

Published Work:

Torralba Cuello, M., Marti-Marca, A., Pápaia, M. S., & Soto-Faraco, S. (2025). Single-trial characterisation of frontal theta and parietal alpha oscillatory episodes during spatial navigation in humans. *Cerebral Cortex*.

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