SENSORY STIMULATION FOR IMPROVING SPATIAL NAVIGATION

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Background: Spatial Navigation (SN) skills integrate several basic skills like working and episodic memory, spatial positioning, sensorimotor coordination and executive control, among others. Due to its social relevance, a number of authors have tried to understand the neural processes underlying our ability to navigate through space. In particular, in the last decades, a number of studies have linked theta brain oscillatory activity with SN in both invasive and non-invasive studies. Theta oscillations have been also linked to memory processes suggesting that the impact of theta in SN could be mediated solely by its impact on episodic or working memory. Interestingly, the connection between theta oscillations and memory has been observed not only in correlational studies but also in causal studies using non-invasive sensory stimulation: audio-visual sensory stimulation in the theta range has been found to improve episodic memory in healthy humans.

Aims: The aim of current study is to improve SN skills in realistic VR environments by means of sensory stimulation in the theta band.

Method: We recorded behavioral and electrophysiological data of 30 subjects navigating through realistic Virtual Reality T-junction mazes in which visual rhythmic stimulation in the theta range (4 Hz) was used to modulate behavior.

Preliminary results: Although Steady State Visual Evoked Potential and Cross-Coherence indicated successful entrainment, we failed to observe an improvement in the performance of subjects. However, an exploratory analysis of the data showed a differential effect of entrainment as a function of endogenous individual theta frequency (ITF): the modulation of performance correlated negatively with the distance between the ITF and entraining frequency.

Conclusions: Our results suggest that it may be possible to modulate SN skills by means of sensory stimulation when the frequency of entrainment is close to ITF. This result agrees with recent findings that observed that the use of rhythmic stimulation in neural populations fat from ITF can result in a disruption of endogenous oscillatory activity. In order to further confirm this result, we are at present collecting data of a second experiment using Auditory stimulation at the ITF of the subjects as entrainment signal. We predict that the performance in the condition with entrainment at the ITF will be improved with respect with the other experimental conditions (no entrainment or entrainment at frequencies far from ITF).

Keywords: Spatial navigation, Sensory entrainment, Virtual reality, Electroencephalography, Theta oscillations

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