Investigating the impact of Landmarks on Spatial Learning during Active Navigation

Abstract

It is well accepted that landmarks play a significant role in spatial navigation but their effects on spatial learning and the accompanying brain dynamics in actively moving participants have not been explored yet. This study proposes a systematic approach to compare the brain dynamics during active physical navigation addressing spatial knowledge acquisition based on allocentric and egocentric reference frames using local and global landmarks. To this end, different spatial navigation tasks will be utilized using high-density electroencephalography (EEG) synchronized to head-mounted virtual reality (HMD VR). in a pilot experiment we investigated participants' behavior during active exploration of a medium scale VR environment called "Sydney park" (see Figure 1). The environment consists of local landmarks (e.g. bench, lake, table etc.) and global landmarks (lighthouse, Sydney Opera House, Sydney Tower Eye) combined with roads, junctions, bushes, trees etc. similar to the environment of Sydney Royal Botanical Gardens. In this experiment scenario, participants were asked to explore the "Sydney Park" following auditory navigation instructions. The route was defined in a way that balanced participants' exposure to local and global landmarks. At the end of a navigation phase, we asked participants to perform a map drawing task followed by combined wayfinding and pointing tasks to test their spatial knowledge about the navigated environment. The collected data was analyzed using the Gardony Map Drawing Analyzer and customized Matlab scripts.

The results from behavioral data suggest that the participants were able to explore the "Sydney Park" effectively as shown by the quality of their map-drawings. It can thus be concluded that participants were able to develop a mental representation of the "Sydney Park" and that the scenario is acceptable for a full study with EEG. In a next step, we plan to perform the actual experiment with EEG and other physiological measures (eye tracking, HRV, skin conductance) to investigate the impact of landmarks on spatial learning and its neural correlates.

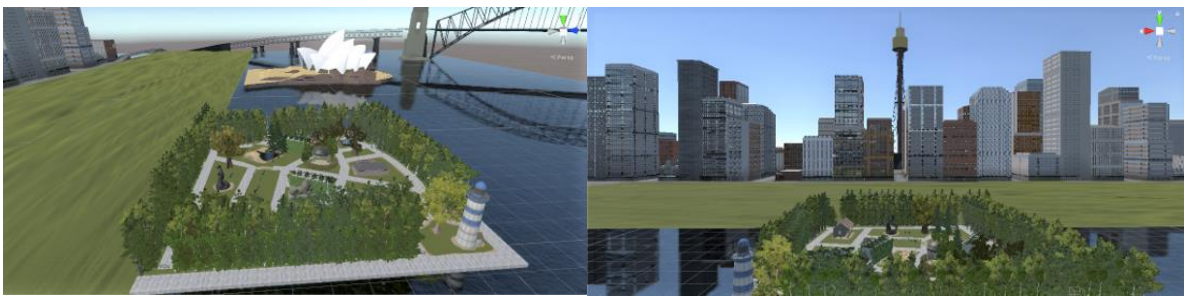

Figure 1. Sydney Park scenario: top view of scenario (left); side view of scenario (right)