

Visual attention and neuro-cognitive processes in map use

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Abstract:

Maps (e.g., Google maps), as visual abstract information of the geographic environments, have irreplaceable roles in our life. Understanding where we look at the map, and how our brain copes with the daily map tasks, are long-standing challenges for fields of GIScience/Cartography and cognitive science (Montello, 2018), which help design better/usable maps.

State-of-the-art studies on map cognition mainly employ eye-tracking with conventional empirical methods (e.g., think-aloud and task analysis) (Kiefer et al., 2017). Eye-tracking allows researchers to measure individuals' visual attention, which only reflect the overt aspects of users' cognitive processes. However, the covert aspects (e.g., neural activities) of the cognitive processes during map use, which are not visible from outside, are still largely unexplored. To close this research gap, this research aims to investigate user's cognitive processes in different map tasks, integrating both overt (e.g., eye movements) and covert (e.g., neural activities) perspectives.

The hypothesis of our study is that different map tasks lead to distinct eye movements and brain activities. The independent variables are four popular map tasks in daily use (i.e., global search; distance comparison; route following and route planning), and the dependent variables are eye movement metrics and brain activities metrics. We will recruit 50 participants and conduct a map-use experiment in laboratory, using eye tracker and Electroencephalography (EEG). The stimuli are state-of-the-art map products (e.g., Google maps). For EEG data, we will focus on frequency-based features (e.g., band-limited power), time-frequency metrics (e.g., ERD/ERS) and cognitive-affective metrics (e.g., cognitive load). For eye movement data, we will process user's blink/fixation/saccade and pupil sizes metrics, as well as their spatio-temporal distribution. These metrics will be compared between tasks to investigate the similarity and differences of the cognitive process (Figure 1).

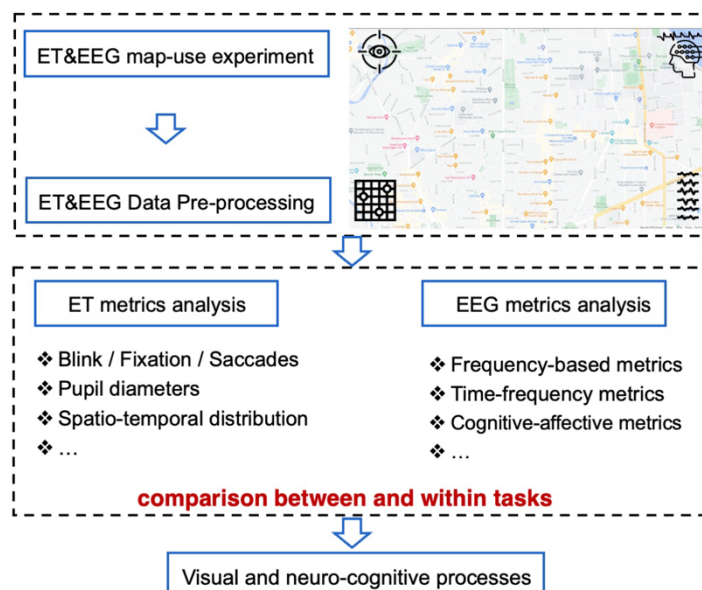


Figure 1. Experimental framework

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