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# Self-Orientation, Eye Movements, and Wayfinding Efficiency in an Orienteering Simulator

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**Abstract:**

Understanding how people orient themselves before making navigation decisions is an important issue in both cartography (Pehkonen et al. 2022) and wayfinding research (Darken & Peterson, 2002; Montello & Sas, 2006). This study investigates the relationships between self-orientation, visual behaviour, and navigation efficiency in an Orienteering Simulator developed in the Unity Engine by MirageDeveloper in 2024. Virtual environments are frequently used in experimental research because it reproduces essential aspects of real-world navigation while enabling a high level of control over environmental conditions, task structure, and presented stimuli (Darken & Banker, 1998). Consequently, it offers a suitable framework for analysing how users interpret cartographic information, establish their orientation, and make route-choice decisions in a standardized yet realistic setting (Fränti et al. 2017; González et al. 2013). A total of 54 participants completed five self-orientation tasks and three route-finding tasks using only a compass and a map, while their eye movements were recorded with a Tobii X2-60 eye tracker. To better explain individual differences in performance, the study also incorporates participant-level variables, including age, gender, education, gaming habits, map experience, prior use of topographic maps, compass-navigation experience, and self-rated orientation skills.

The aim was to examine whether performance in self-orientation tasks, together with selected eye-tracking measures, can help explain and predict the time needed to complete wayfinding tasks.

The preliminary results suggest that participants who made larger errors in the self-orientation tasks also tended to need more time to find their routes. The strongest relationship was found between average self-orientation error and average wayfinding time ($r = 0.50$), while the time spent on self-orientation itself was only weakly related to later wayfinding time ($r = 0.10$). The eye-tracking measures available so far, based on gaze-sample indicators, showed moderate negative correlations with wayfinding time ($r \approx -0.36$ to $-0.39$), suggesting that higher gaze-sample coverage was associated with faster route completion. After adding participant background characteristics, prior map experience also emerged as an important factor (Miola et al. 2021), showing a moderate negative relationship with wayfinding time ($r = -0.42$). By contrast, self-rated orientation skill, prior compass use, and topographic map use were much weaker predictors in this dataset. To move beyond simple correlations, a predictive regression model analysis approach was also applied to predict average wayfinding time. A model based on aggregated self-orientation and gaze-sample indicators showed a weak but promising predictive effect (cross-validated $R^2 \approx 0.10$), and this improved when participant background variables were included, especially prior map experience ($R^2 \approx 0.15$–$0.20$ depending on the model specification). Overall, the results suggest that self-orientation accuracy is more informative than self-orientation speed, and that practical familiarity with maps may additionally support more efficient wayfinding (Medyńska-Gulij & Zagata, 2020).

Overall, the study shows that difficulties in self-orientation can carry over into route-finding performance. It also highlights the value of combining behavioural measures, eye-tracking, and machine-learning methods to better understand individual differences in navigation in simulated cartographic environments and immersive geovisualizations (Zawadzki & Medyńśka-Gulij, 2024).


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