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Gender Differences in Wayfinding Abilities in Real-World Geographic Environments: Insights from Eye-Tracking Analysis

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Abstract:

Wayfinding, a fundamental activity in daily life, involves four subprocesses: self-localization, spatial orientation, route choice, and monitoring. Depending on the environment, wayfinding can occur in unfamiliar or familiar settings. This study aims to examine gender differences in wayfinding strategies and performance using eye-tracking. A two-factor experimental design (male/female × unfamiliar/familiar environments, the experimental areas as illustrated in Figures 1 and 2) was employed to explore variations in visual behavior and cognitive strategies during wayfinding tasks. Key metrics, including information search, information processing, task load, task efficiency, and path complexity, were analyzed using two-way ANOVA.

The results revealed significant differences between males and females in wayfinding behavior in unfamiliar environments. Males demonstrated shorter total fixation durations and fewer AOI (areas of interest) transitions, indicating more efficient self-localization and spatial orientation through rapid identification of salient landmarks such as road signs, buildings, and road networks. Their shorter first fixation times on AOIs and reduced number of turns reflected faster attention allocation and more direct path choices. Conversely, females exhibited more frequent fixations and revisitations on landmarks, along with higher wayfinding accuracy. This behavior suggests a reliance on detailed environmental information and the use of robust and cautious wayfinding strategies.

In familiar environments, no significant differences were observed between males and females in average fixation time, saccade frequency, or task completion time. However, gender-specific mapping differences were evident. Females' sketch maps contained more detailed and accurate representations of building information, whereas males' maps emphasized road networks and provided clearer overall layout descriptions, albeit with lower accuracy.

This study contributes empirical evidence to understanding gender-based variations in spatial cognition and navigation strategies. The findings may offer implications for human-centered design of environmental landmarks and navigation aids to accommodate diverse cognitive styles.

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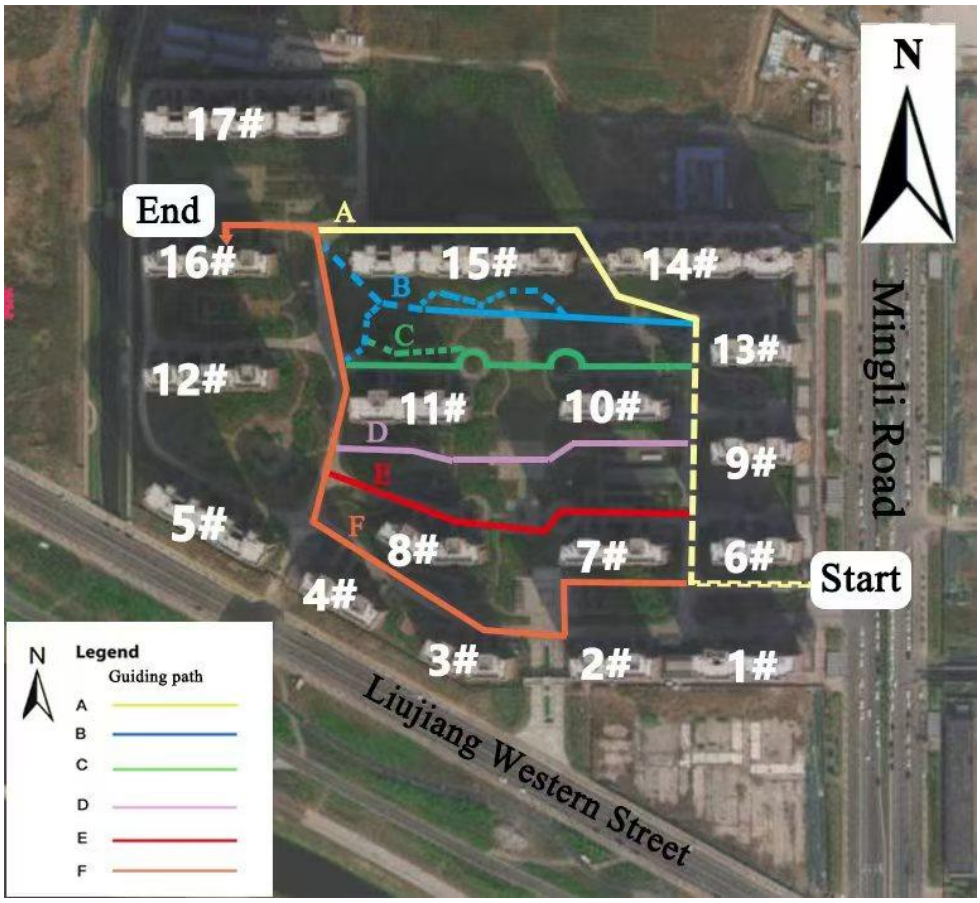

Figure 1. Experimental Area for the Unfamiliar Real-World Geographic Environment (The experimental site was located in the Mingde Residential Complex, situated opposite the west gate of Henan University's Zhengzhou Campus. The complex contains a general site plan, directional signs, building numbers, and unit numbers. All participants were unfamiliar with the experimental area.)

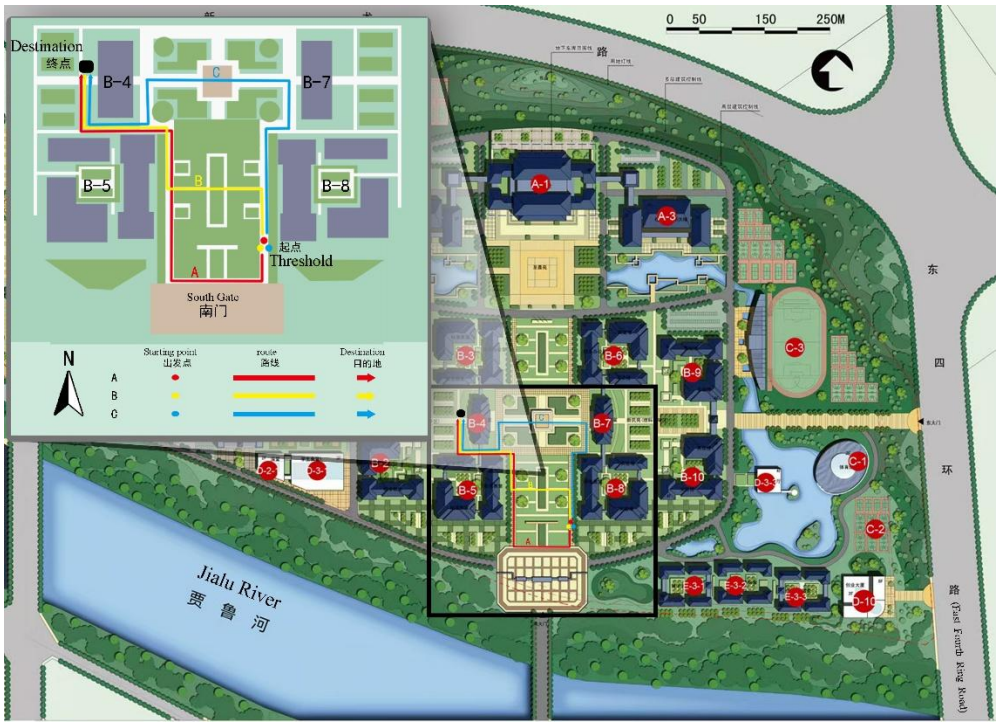

Figure 2. Experimental Area for the Familiar Real-World Geographic Environment (The experimental site was located within Henan University's Zhengzhou Campus. Participants were all students from Henan University's Zhengzhou Campus, ensuring familiarity with the area.)

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