International Cartographic Association
Association Cartographique Internationale

Understanding USE-IT Map Use through Eye-Tracking

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Keywords: USE-IT maps, map usability, eye-tracking, trip planning, real-world navigation

Abstract:

This abstract presents a comprehensive cartographic evaluation of USE-IT maps, maps created by young locals for young travelers, through a mixed-methods eye-tracking study that integrates controlled laboratory testing with real-world navigation. The research focuses on how users perceive, interpret, and utilize these maps, with particular emphasis on cartographic design, visual hierarchy, symbolization, and the communication of specific content, such as the "Act like a local" section, which aims to promote authentic experiences and mitigate overtourism. Beyond general usability, the study examines how specific cartographic elements support or hinder map reading, spatial decision-making, and route planning.

The laboratory phase involved 48 participants who interacted with six USE-IT maps representing different cities. Both paper and digital formats were included to reflect the multimodal nature of contemporary map use. Due to the large format and double-sided design of the maps, two complementary eye-tracking approaches were employed: mobile eye-tracking glasses to capture gaze behavior on paper maps, and a stationary remote eye-tracker for PDFs. Participants first engaged in a free exploration task, allowing spontaneous visual attention patterns to emerge, and subsequently completed a task focused on planning a weekend trip. This design enabled comparison between exploratory and goal-oriented map use. The experiment was further complemented by a questionnaire survey capturing participants' subjective preferences.

Because eye-tracking data for both paper maps and PDFs are primarily recorded as dynamic video sequences, a crucial methodological step is to project gaze data onto static representations of the maps. This was achieved using the Snapshot function in Tobii Pro Lab, followed by careful validation of the projection. Subsequently, Areas of Interest (AOIs) were defined to reflect key cartographic components, such as the map body, legend, textual descriptions, and thematic sections. The data were then analyzed as if they had been originally collected on static stimuli, enabling the application of established quantitative and qualitative metrics. For visualization and deeper interpretation, the developed GazePlotter tool (Vojtechovska & Popelka, 2026) was used. This tool supports advanced visual analytics, including scarfplots, which reveal temporal sequences of attention and allow identification of individual and group-level map-reading strategies (Figure 1).

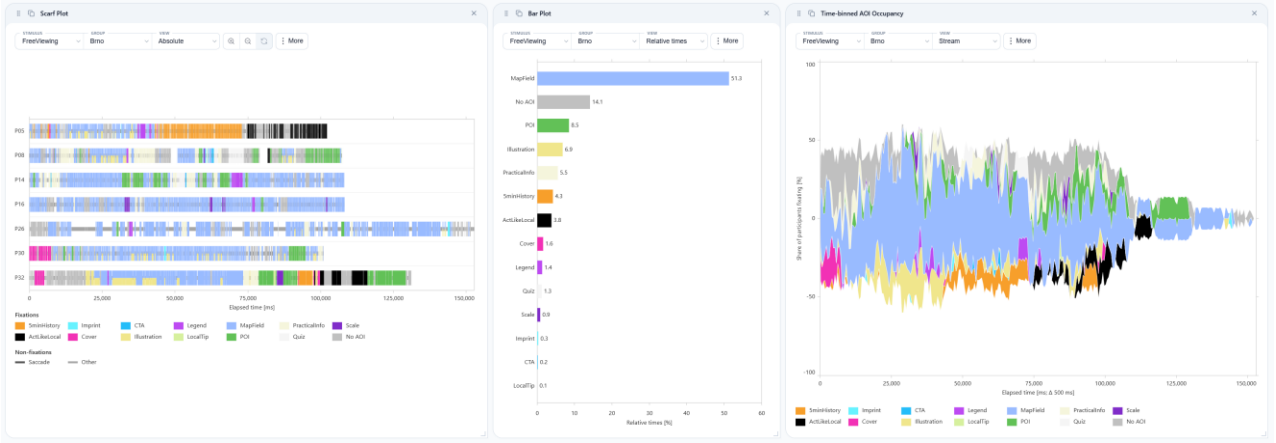

Figure 1. Gaze data visualizations in the GazePlotter software, highlighting the values of "Act like a local" AOI (black). Scarfplot (left), Bar Plot (center), and Stream (right).

https://doi.org/10.5194/ica-abs-12-117-2026

The second phase focused on the USE-IT map of Brno and involved 10 international participants unfamiliar with the city. Similarly to the laboratory phase, participants first engaged in free exploration of the map and subsequently planned a weekend trip; however, in this case, they worked with a newly developed prototype of the digital map. The study then transitioned into a real-world environment in the city of Brno. Participants were placed in a navigation scenario in the city center and asked to explore the environment within 40 minutes using both a paper map and a digital map available on their mobile devices. During this phase, they were equipped with mobile eye-tracking glasses, and their GPS trajectories and mobile screen recordings were collected simultaneously (Figure 2). This approach enabled the capture of interactions between cartographic design, visual attention, and real-world navigation behavior.

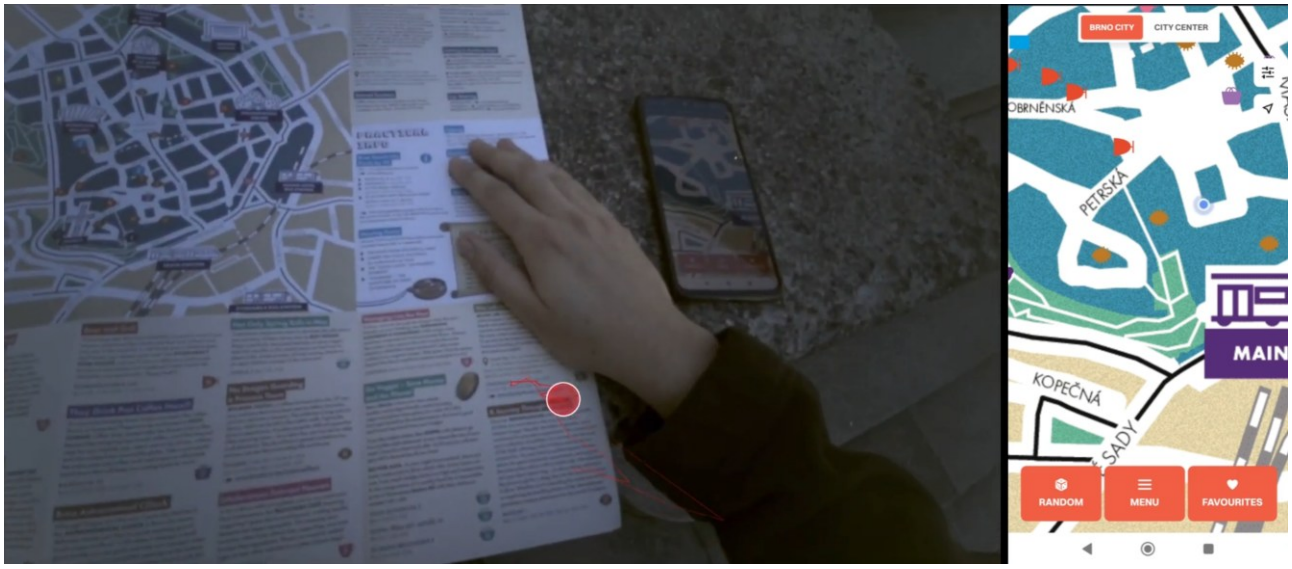

Figure 2. Synchronized view of the participants' gaze from the mobile eye-tracker (left) and screen-recording of the mobile map (right).

The field study was further complemented by qualitative methods, including direct observation and post-task focus group discussions, which provided additional insights into user experience and revealed perceived limitations of the map.

The combined results provide a detailed understanding of how specific cartographic features influence visual attention, cognitive processing, and navigation behavior. The study reveals imbalances in visual hierarchy, identifies elements that attract or fail to attract user attention, and highlights discrepancies between intended and actual map use, particularly in thematic sections designed to guide user behavior. Furthermore, it uncovers challenges users face when translating planned routes into real-world navigation, including difficulties in orientation and information integration.

The insights from both phases were communicated to the developers of the USE-IT map-creation platform, leading to the implementation of several improvements to address identified cartographic and usability issues. In addition, the authors participated in a workshop for USE-IT map creators, who typically lack formal cartographic training, to help them improve the visual quality, structure, and communicative effectiveness of their maps.

By identifying key design shortcomings, proposing concrete recommendations, and actively engaging with map creators, this research aims to improve the overall quality and usability of USE-IT maps and support their more effective use in practice.

Acknowledgements

This work was supported by GAČR – Czech Science Foundation under the "Identification of barriers in the process of communication of spatial socio-demographic information" (23-06187S) project.

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