

Comparing Paper and Digital Atlas Use

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Keywords: atlas, image schemata, perception, cognition, eye tracking, user interaction

Abstract:

To examine how maps are understood, it is necessary to consider how visual representations interact with users' prior knowledge (MacEachren, 2004). This knowledge may take the form of propositional (objects and attributes), analog (spatial relationships), or procedural (sequences of actions) representations, each potentially associated with different schemata. Building on this perspective, the study adopts the concept of image schemata as introduced by George Lakoff and Mark Johnson (Lakoff et al., 1999; Lakoff & Johnson, 2008), which conceptualizes cognition as grounded in recurrent embodied patterns (e.g., PATH, CONTAINER). These schemata structure how users navigate maps, identify spatial entities, and construct meaning. As they guide perceptual exploration (Neisser, 1976), they can be empirically observed through eye-tracking and user interaction data.

Developments in technology and data processing capabilities open new opportunities for examining the perceptual and cognitive processes underlying map navigation and map reading, particularly through the integration of multimodal data to better understand user judgments.

First, we identified the image schemata most relevant to working with an atlas and further explored how they structure perceptual and cognitive processes. We then compare user behavior when working with paper and digital atlases, with a particular focus on atlas use. Approximately fifty participants took part in the experiment, during which their eye movements were recorded using eye-tracking technology, and their interactions with the atlas were systematically captured.

The analysis focused on the entire process of interaction with both types of atlases, including how users engaged with the interfaces, navigated the index, and selected appropriate maps for specific tasks. Particular attention was paid to how users configured or adjusted the interface prior to task execution, as well as to their overall approach to solving the assigned tasks. In the final stage, we examined the strategies users adopted to arrive at a solution. These strategies were evaluated from multiple perspectives, with an emphasis on how different forms of interaction contributed to the process of extracting information from maps.

Furthermore, the study investigates how interaction with the map influences its interpretation, identifying which map elements shape specific types of user behavior and explaining why certain visual or structural features trigger specific interaction patterns. Eye-tracking data, together with records of user actions such as zooming, panning, and mouse clicks, were synchronized along a unified temporal axis. This integrated dataset enabled us to identify recurring structures in user behavior and to interpret these patterns through the lens of image schemata, providing deeper insight into the cognitive and perceptual processes underlying interaction with both paper and digital atlases.

This research will enhance analytical methods, advance predictive understanding of interactions with paper and digital atlases and maps, support technological innovation, and contribute to user-centered map design.

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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