

Exploring Methods for Revealing the Cognitive Structures of Map Information Extraction

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Abstract:

The map-making process is a well-established discipline characterized by a series of systematic steps and has been thoroughly documented throughout history. In contrast, the process of extracting information from the map is not as comprehensively described.

This process involves several key perceptual and cognitive mechanisms such as visual perception, pattern recognition, attention and selection, symbol decoding, etc. (MacEachren, 2004). Moreover, a number of other variables, like the quality of visual stimuli, type of task, and personal ability, play a role in information extraction (Koláčný, 1969). However, until now, most cartographic research has focused on the psychological, semantic, syntactic, or pragmatic aspects of map signs, often in isolation from the map's context. Despite the fact that many of the findings based on this research have been successfully applied to map making, it is important to take into account that it is the relationship and connection between map signs that form the user's spatial conceptions. Current advances in technology and data processing capabilities offer new opportunities for studying the processes of perception and comprehension of map sign relationships and investigating their impact on user judgment formation. Using various analytical methods, we can decompose this process on different levels and understand the image schemas that lead the users to their decisions. Image schemata are pre-established mental templates that simplify complex data, organize sensory experiences, and facilitate learning by linking concrete experiences to abstract reasoning. The concept of image schemata provides fundamental cognitive structures that form a basis for understanding and processing information (Lakoff et al., 1999; Lakoff & Johnson, 2008).

A case study was conducted on an interactive digital atlas of atlas.mapy.cz involving 50 laymen. They solved nine tasks based on the description of the spatial distribution of specific geographical objects. For example, they described the spatial distribution of elevation in Europe according to the physical geographic map. During the solving process, their interaction with the map was recorded by tracking their eye movements using Tobii Pro Spectrum 300. Additionally, user actions such as zoom, pan, and mouse clicks were logged. Participants' verbal expressions during the experiment were also recorded for further linguistic analysis.

Studying image schemata to understand the process of extracting information from a map involves a detailed qualitative exploration of how people perceive, analyze, and interact with maps. First, we identified which image schemata are most relevant to reading and analyzing maps. We further investigated how these image schemas are used in perceptual and cognitive processes. Approaches using syntactic decomposition and semantic networks were also involved to understand the process of information extraction from the map by the user. The contribution explores the possibilities of investigating the process of map information extraction, utilizing the above-mentioned technologies, approaches, methods, and concepts. It demonstrates these exploration possibilities using real case study data and discusses their utility.

In conclusion, examining the process of extracting information from the map is interdisciplinary research at the intersection of cartography, information science, cognitive linguistics, psychology, and human-computer interaction. The main objective of the contribution is to evaluate methods suitable for deconstructing the process of extracting information from maps and for the identification of areas where improvements can be made. This research will lead to the improvement of existing analytical methods, enhancement of predictive capabilities of the map-reading process, development of new technologies and creating maps that better reflect the needs of users.

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