

Which map do you prefer and why? A subjective users' multivariate maps evaluation in the empirical study.

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Abstract:

Multivariate mapping is a form of visualization that represents complex data using multiple visual variables simultaneously, combined within a single map (Nelson 2020, Šašinka et al. 2021, Stachoň et al. 2023, Korycka-Skorupa, Gołębiewska 2021). Yet, it can convey a large amount of data, it can also cause a cognitive load leading to decreased user satisfaction.

An empirical study on multivariate maps examined the readability of multivariate maps presenting large amounts of information, and using various cartographic representations (e.g., proportional symbols and choropleth maps). The study was conducted with a group of 42 undergraduate students in geography at the University of Warsaw (Poland). Participants were asked to complete twelve tasks involving identification, association, and comparison operations, using four maps with varying levels of information (Figure 1).

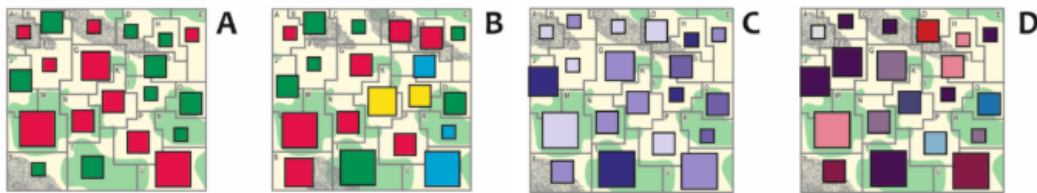


Figure 1. Maps used in the empirical study with qualitative background and: A. one qualitative thematic dataset, B. two qualitative thematic datasets, C. one quantitative thematic dataset, D. two quantitative thematic datasets (source: own elaboration).

The primary research questions addressed in this study were as follows: (1) to what extent are users able to effectively interpret large amounts of information presented within a single map? and (2) how effectively can users extract additional information encoded with colour scales or value scales in graduated symbols? The results indicate a clear preference for maps characterized by low graphical and informational complexity, as well as simplified legends. Higher task performance was observed in cases where a single dataset was represented using a single cartographic method. Moreover, participants achieved better results in comparison tasks than in tasks requiring data identification or the detection of relationships.

During the study, usability metrics (response time, response accuracy, task difficulty) and eye-tracking metrics were analysed, and participants were also asked to evaluate the maps and to express users' preferences. Subjective evaluations focused on several dimensions, including graphical complexity (rated on a scale from 1 – very complex to 5 – very simple), informational complexity (1 – very complex to 5 – very simple), and readability (1 – very poor to 5 – very good). Participants also performed pairwise comparisons of the maps and were asked to rank them according to graphical complexity, informational complexity, readability, and overall preference.

A key objective of the study was to examine the extent to which users' subjective evaluations corresponded with the empirical findings derived from usability metrics and eye-tracking data.

References

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