

Applying eye-tracking for interpreting map legend use by professional decision makers

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Abstract:

Traditional map use manuals and instruction inevitably suggest that maximum efficiency in interacting with any map (and indeed any positive benefit from such map use) is achieved by initially locating and understanding the map legend and its context. The design, construction and usability of a legend has been regarded as a fundamental aspect in all forms of map creation, production and use.

However, such issues have not been examined thoroughly in cartographic research and practice. Simple questions such as whether, within a legend, to place a map symbol first followed by its descriptor or vice versa, have rarely been considered from a user perspective; whilst the nature of ‘natural legends’ and their impact on usability has also not been fully assessed. The role of dynamic legends in supporting map displays, and the flexibility inherent in the digital environment, is only occasionally addressed; and the major issue of whether cartographers should aim to create maps which do not need legends at all is not a focus of contemporary map design research.

It is suggested that measurement and assessment of time spent gazing at, and attention to the detail of, the legend, especially when directly compared to the map face itself would be a valuable addition to map use studies. We are particularly interested in how this varies dependent on the tasks undertaken by the map user.

Thus, the study presented here focusses on how map users interpret and apply the legend supplied with a sample set of digital maps, and in particular tries to determine the extent to which user behaviour is task dependent. The overall aim of the research was to understand how employees, from a major engineering consultancy, use map elements to make decisions, and whether these uses and decisions change based on the individual's background (including education, job grade, working team affiliation, and experience of geospatial data handling). User interaction was examined and tested in detail. Previous studies have considered the distinction in map use between experts and novices. Here, although the pool of participants was reasonably sized with a range of individuals from relatively different roles within a commercial company, their skills, knowledge, and experience in absolute terms was actually very similar. All worked for an engineering consultancy, all dealt with geospatial data regularly and were familiar with the scenarios which were presented to them. The emphasis was, therefore, on tasks and decision-making using the maps, rather than on user differences.

A limited set of interactive maps was developed and exposed to the group of engineering and environmental decision-making professionals. Eye-tracking was chosen as the means whereby interaction could be monitored. Several previous eye-tracking studies have focussed on the legend in terms of its layout (Gołębiowska, 2015), position (Edler et al., 2020) and design (Çöltekin, Brychtová, et al., 2017). Here we look at the relative importance of the legend and the map face; but the eye-tracking experiment in addition identified specific zones within the map face – sites where differing decisions (in this case environmental impacts on a locality) had to be made by the engineering consultants.

The metrics obtained from the eye-tracking system used included time of gaze, fixation frequency and visit count. Such measures can improve understanding of how a map user relies on a legend throughout different tasks, how accumulated memory can affect legend usage and map interaction, and how different tasks and data properties (e.g. uncertainty) govern the relative times spent on the legend and on the map.

Results indicate an expected decrease in legend attention as succeeding tasks were given using the same map and data, but also improved search efficiency as users became accustomed to the display, and increasing levels of confidence in map use and positive interaction as tasks became more complex. A better understanding of the nature of legend interactions can also be derived from the ordering and subsequent use of categories within the legend, and of the availability, visibility and use of layers, and combinations of layers, by the user. It is clear that interaction with the legend also varies dependent on whether it, and/or the map itself, is static or interactive.

References

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