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Split legend or split attention? Evaluating layout designs of geodashboard interfaces

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Abstract:

Analytical geodashboards in a form of multiple, and typically coordinated views are meant to support the exploration of complex multivariate georeferenced data. Such interactive tools integrate several views presenting data with the use of different visualisation types, including maps. However, the visual and information complexity of geodashboards can be challenging for users, and properly designed explanatory elements should support them. Even though explanatory elements such as legend design for maps are guided by well established and empirically tested recommendations (*e.g.*, Çöltekin *et al.* 2016, Dykes et al. 2010, Edler 2020, Gołębiowska 2015), these are not often applied in the design of analytical geodashboards. The advice of functional grouping, recommended by Schnürer et al. (2015) based on a single view atlas interface evaluation, suggests gathering all explanatory elements in one place within the interface. Although this advice is in line with the common legend solution applied in geographical atlases in which symbols from several maps are explained in one place, it contradicts the Gestalt principle on proximity that is often recommended for legend placement (Mayer 2001). As Horrower (2007) posits, violating this principle may result in split attention (i.e., the need for integrating information from different sources that may be a cognitive effort for users), since it results from, e.g., a spatial contiguity effect of materials separated by space. Therefore, to counteract this issue, one may split explanatory elements across the interface to locate their relevant parts close to corresponding views that need to be explained.

In this study, we compare two interface layout versions of the analytical geodashboard Climres (Opach & Rød 2018) in an empirical user experiment: The *single-legend layout* presents explanatory elements gathered in one place (Fig. 1a), whereas the *multiple-legend layout* presents explanatory elements and control buttons split all over the layout, next to corresponding views (Fig. 1b).

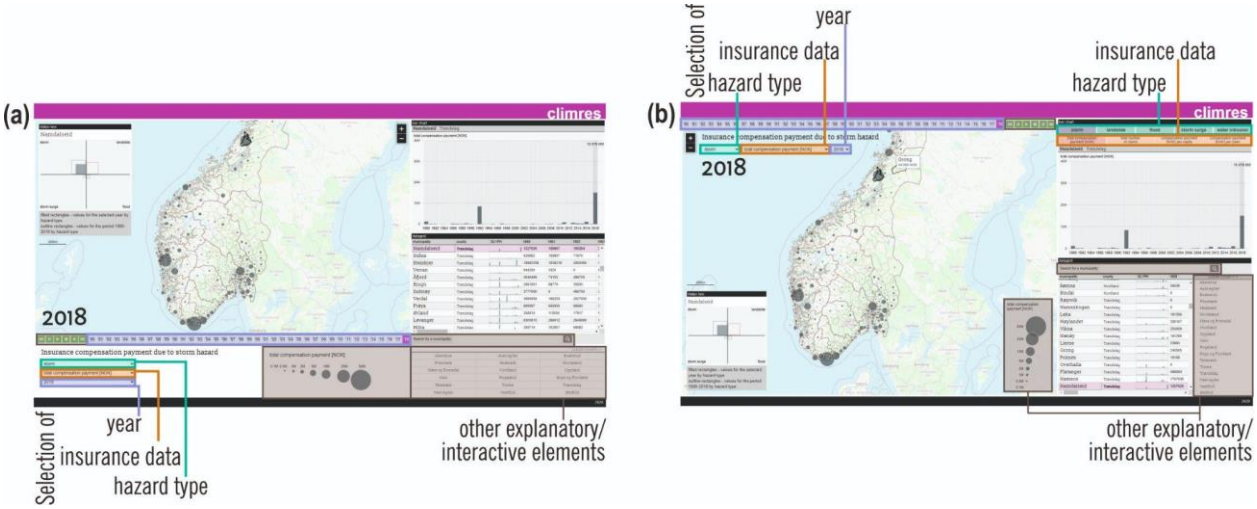

Figure 1. Tested geodashboard interface design solutions: (a) single-legend and (b) multiple-legend layouts

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Thus the independent variable in the study is single- vs multiple-legend layouts, and various objective (response time [1a], response accuracy [1b], eye-tracking metrics [1c]), and subjective (preference [2a], response confidence [2b]) metrics are our dependent variables. Layout and questions were within-subject factors. In total, 42 participants took part in the empirical study (aged 23-30, average 25.7 years old, SD 1.96), counterbalanced for biological sex (52% female, 48% male). All of them were graduate students in geoinformatics at the University of Warsaw. The participants solved eight tasks representing four analytical operations adopted from Knapp (1995): identify, locate, compare, and associate.

Our results revealed that the two versions of the legend layout did not affect the performance, i.e., neither the response time [1a] nor the response accuracy [1b]. However, participants' opinions (both [2a] and [2b]) supported by eye movement analysis [1c] strongly favour multiple-legend layout (Fig. 1b). A clear majority of the participants preferred multiple-legends and justified their preference with, among others, proximity of legend to the explained element. The proximity was convenient for the users as they quickly referred to it when needed. As demonstrated by the eye movement analysis [1c], participants when using the multiple-legend layout had more visits, shorter visits in the AOI *Legends* as well as more transitions between the AOIs *Legends* and *Views* compared to use of the single-legend layout that gathered all explanatory elements in one place. Taken together, the key findings (i.e., lack of difference in response time and response accuracy, clear user preference toward split legend, and differences in eye tracking metrics) show that, even though the performance was not affected by layout type, the viewer strategy, i.e., the process of using the two dashboards is affected by the design choices. A more streamlined visual processing with the split legend (as evidenced by eye movement metrics in this study) might have implications for user comfort. We believe the legend elements placed close to the explained views in the multiple-legend layout helped participants to avoid split attention. Thus, the alternative solution, even if it led to the same performance outcomes, might have been cognitively more demanding. Broadly, our findings confirm the importance of considering the split attention while designing complex geodashboard interfaces. Further details of the study are discussed in a recent publication (Gołębiowska et al. 2023).

With a well-examined interface design, the use of analytical geodashboards can be more helpful, convenient and/or engaging for users. Our study thus contributes towards an increasing understanding of how explanatory elements can be successfully designed.

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