Preattentive features of cartographic symbols in animated mapping

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Abstract:

Animated cartography has developed the so-called dynamic point symbols (Lai & Yeh 2004; Xiaofang et al. 2005). They allow for the transfer of quantitative and qualitative information employing dynamic changes of visual variables (Cybulski 2014). These are symbols that are a graphic presentation of spatial objects and their value on the map (Koch 1998). So far, several variables such as orientation (rotation), size (pulsation), and transparency (blinking) have been distinguished for presenting quantitative changes. The most influential and effective is the dynamic change in size (Cybulski, Wielebski 2019).

There are also picture symbols that can also be dynamic (https://www.esri.com/arcgis-blog/products/arcgis-online/mapping/bring-your-points-to-life-with-gif-symbols/), visible in Figure 1. However, there is more than one dynamic object on these types of maps. There are as many objects as there are cartographic symbols. We know from psychological research that movement is crucial in attracting attention among static objects. However, we have limited knowledge about what is crucial when all objects are dynamic. We know that direction of motion is one element that is preattentive (Driver et al. 1992; Huber & Healey 2005).

Figure 1 – Examples of pictorial symbols that can be dynamic on an animated map.

According to Feature Integration Theory (Treisman & Gelade 1980), preattentive features (individual features) are quickly identified (the low-level visual system), in separation to distractors which are perceived automatically, in parallel across the visual field. Preattentive vision is an early stage of visual processing that can be performed in 250 milliseconds (Julész 1981; Green 1998). It is an analogy to the immediate sing perception (Bertin 1983). Another is the Guided Search Theory presented by Wolfe (1994). This theory assumes that searching for an object is "guided" by both bottom-up and top-down information. Wolfe (1994) and Treisman (1985) agree that early vision is dividing an image into individual features. The visual search system is filtering each feature individually (e.g. different orientations) (Wolfe et al. 1992). The bottom-up search occurs after feature categorization within parallel vision and searches for the difference between the target object and neighborhood. There is also a top-down search that is user-driven. It is an attempt to locate a specific object within serial processing. Therefore, the visual search system is a combination of bottom-up, and top-down processing.

On the map, dynamic point symbols do not change their position, but only graphic features. Although, the velocity of motion is one of the preattentive features (Hohnsbein & Mateeff 1998) that can be applied to dynamic point symbols. When presenting quantitative data employing dynamic point symbols, the differences in, for example, the rate of change of size are natural and result from the very nature of the data and the methods of cartographic presentation

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(Medyńska-Gulij 2014). Nevertheless, in cartographic design, we need detailed guidelines regarding speed classes e.g. size or orientation changes. Thanks to this, the cartographic message remains effective.

The research objective consists of two parts. The first part of the main objective is to determine if dynamic point symbols can be found preattentively among other dynamic point symbols on a map. The second part of the main goal is to determine ‘guidance’ of dynamic point symbols in accurate detection (confirmed by clicking) of extreme values. The basis of the research will be a series of research experiments with participants, maps with dynamic point symbols, and eye tracking technology. The preattentive processing methodology assumes map reading in the 'top-down' and 'bottom-up' processes. According to it, to detect preattentive processing, the map has to be displayed rapidly (up to 250 ms). However, due to its nature, the animated map must be displayed for a longer time (up to 1.5 seconds). Noticing a given symbol or not is done by displaying the map and then the user's response. In addition to answering, the user may also indicate (if noticed) the location of the symbol. Thanks to this, it is possible to find out not only whether the user noticed the symbol, but also whether he can correctly indicate it on the map.

At the time of presentation the study will show the study idea and partial results.

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