

A Breakdown of Subjective Reactions in Geo-Social Media and a Review of Their Cartographic Visualisation

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Abstract:

The methodologies of thematic mapping are based on various systems of graphic representation methods that have been evolved since the 17th century and were influenced by cartographers such as Arnberger, Imhof, Pillewitzer and Salitschew. Geometrical spatial structures form the basis of these visualisation methods, as is the case for the subdivisions published by Koch (2005) or Kraak & Ormeling (2015). At the top level, point-, line-, area- and surface-based representation methods are being distinguished in Koch (2005). However, today's cartography has diverse and multivariate data available in large quantities for visualisation, which are considerably different than at the time when the cartographic representation methods described above were being shaped. A good example are geo-social media data containing people's reactions. In many scientific publications, geo-social media data are modelled by using several dimensions (e.g. Di Minin et al. 2015; Dunkel et al. 2019; Yuan et al. 2013). Although the terminologies in these models are different, the dimensions can be referred to as spatial ("Where?"), temporal ("When?"), thematic ("What?") and social ("Who?"). In addition, geo-social media data can be examined in terms of "How?", which is addressed in these models not nearly as detailed as the other dimensions and appears vague because of not being factual. All dimensions have an inherent intricacy and therefore are subject to particular methods for describing, identifying and categorising them. This already implies the complexity that arises when it comes to visualising these data. The presented work focuses on the How-dimension of geo-social media data and its visualisation.

The How-dimension represents the subjective side of geo-social media data, whose gathering and modelling is challenging. Based on existing definitions, a semantic analysis of the terms "reaction" and "subjectivity" led to differentiated aspects, allowing a subdivision of subjective reactions into perceptions, emotions, opinions and behaviours. Perception is a psychological process that organises incoming information from the physical process of sensation, and assigns meaning to these sensory impressions. An emotion describes a person's inner state, which is also manifested by physical signals, amongst others. An opinion is a non-conclusive judgment or belief that a person forms through reasoning about a matter and which, unlike facts, cannot be verified by evidence. Behaviour represents the actions and deeds of an individual in interaction with the environment, thus being a process to achieve something. Breaking down subjective reactions in geo-social media in such a nuanced way is plausible from two perspectives: firstly, the distinction is consistent with psychology theories, which would actually allow an even more detailed breakdown. Secondly, existing publications on geo-social media confirm this categorisation from a data perspective.

In order to investigate the (geo-)visualisation of subjective reactions in geo-social media, 44 publications published between 2015 and 2022 on a corresponding topic were reviewed and the included illustrations were assigned to the cartographic representation methods described above. During this process, the classic taxonomy of cartographic representation methods had to be combined with that from the field of visualisation, which distinguishes between visualisations with an implicit and an explicit spatial reference (Schumann & Müller 2000). This is relevant insofar as, despite having a spatial reference, data from geo-social media are often presented disconnected from that, for instance as time charts. Thus, geo-social media data are multivariate data whose multi-layered complexity demands the use of non-cartographic visualisation methods complementing cartographic representations, as is also common with dashboards.

Figure 1 shows that among the visualisation methods with an explicit spatial reference, it is noticeable that the dot map method is most often used, which is due to the fact that geo-social media data usually come with a point coordinate and are therefore regularly treated and visualised as point data. Less eye-catching, but revealing, is the use of the heat map, which is likely due to its ability to reflect the uncertainty and fuzziness of this data. The heat map is a surface-related representation method, but it cannot be classified as an isoline method (which is according to Koch (2005) the only surface-related method) because, unlike the heat map, it uses sharply defined value classes. The heat map therefore

constitutes a modern extension of the classic cartographic representation methods. Among the visualisation methods with an implicit spatial reference, the time chart is by far the most widely used, especially for emotions and opinions, as their development over time is usually of interest in respective studies.

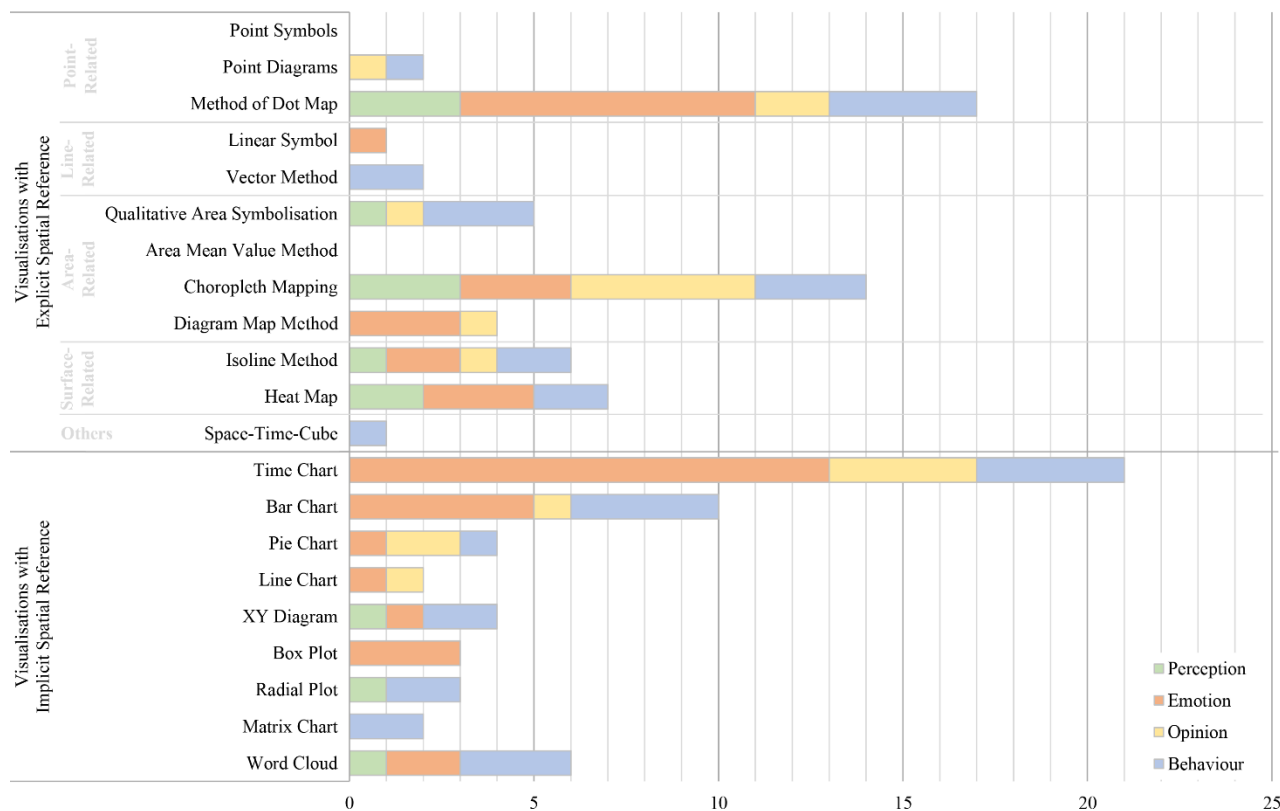


Figure 1. Counted use of visualisation methods for each of the four categories of subjective reactions in geo-social media.

The psychologically sound breakdown of subjective reactions in geo-social media into perceptions, emotions, opinions and behaviour facilitates on the one hand a greater depth, and on the other hand greater breadth in capturing and investigating these reactions, both promising a more insights. The review of the visualisations of these reactions, which go beyond the classical cartographic representation methods, emphasizes the data's multi-dimensionality, that denotes their complexity, but at the same time their richness of information content.

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