Visualisation as a Computational and as an Epistemological Practice

When philosophers of science consider the problem of visualisation in the sciences, they conceive of visualisation as a specific form of scientific representation (Kulvicki 2010, Bolinska 2015). This means that they are concerned with how a visual artefact represents a given system, how such an artefact can be used to reason (by proxy) about this system (Suárez 2004, Contessa 2007, Suárez 2010), and want to explain whether and how visualisation can be used to generate insight or understanding (de Regt and Parker 2014, Mößner 2014). Given these goals, it is natural to look at visual artefacts relative to the information they carry or hold about a specific system, and relative to someone trying to exploit that information. We could think of this perspective as a perspective concerned with the functioning of visual artefacts as epistemic artefacts,[1] and note that in the relevant literature visual representation is characterised as a kind of epistemic representation.

Within the fields of information-visualisation and scientific visualisation, visual artefacts are not primarily conceptualised as representations of a system, but as visual displays of data-objects (Chen et al. 2017: 17). Additionally, the relation between data-objects and their visual display is not analysed as a representational relation (e.g. by asking how we can use the visual artefact to reason about the data), but in terms of the data-transformation process[2] that is used to turn the data-objects into a visual artefact (Ward et al. 2015: §1.4.2). Looking at visualisation as a computational (and data-centric) practice instead of an epistemic (and system-centric) practice is continuous with the goal of optimising visualiation-processes, for instance in view of computational limitations, or in view of advantages and limitations of the human visual channel. It is also raises the possibility that visualisation need not be primarily aimed at understanding, but can instead serve the purely computational goal of exploiting the fact that the human visual system can process information in parallel and can therefore be leveraged to obtain a computational speed-up (Chen et al. 2014). This view remains, however, compatible with the possibility of conveying insight or understanding with the help of visualisation.

Combining these two perspectives requires us to bridge the familiar gaps between syntax and semantics, and between epistemology and computation. The hypothesis entertained in this paper is that we can formulate an interface between the two perspectives by distinguishing two levels of descriptions of visualisations, and thinking of visualisation-processes as processes that negotiate the constraints and freedoms that arise from mismatches between these two levels of descriptions.

The main goal of this paper is to make these two levels of description more precise by analysing the pragmatics that underlie our thinking about the exhaustive characterisation of informational objects like visualisations and data-sets, and how we evaluate transformations and criteria for the equivalence of informational objects. As such, we can develop the idea that visual artefacts typically have to be described at a *lower* level of abstraction than the data-objects they visualise. This yields a more generic outlook on visual features that are related to how easy information can be accessed or extracted from a visual representation (e.g. the already mentioned notions of immediacy and salience) and allows us to relate the two perspectives on visualisation

[1] This doesn't make the non-epistemic or non-semantic features of a visual artefact irrelevant, but only puts such features in focus to the extent that they make the epistemic feautures accessible. See e.g. Kulvicki on immediacy as extractibility, syntactic salience, and semantic salience.

[2] Note that not only the nature of the relation changes, but also the preferred order of the relata is changed: how are the data reflected in the visualisation; versus how does the visualisation give us access to the data or the system.

described above.

By thinking of visualisation as a kind of reasoning between levels of abstraction, we can think of the computational perspective as a way to optimize the choices that have to be made to design a visual artefact (a maker's perspective), and of the epistemic perspective as a way to evaluate the inferential process used to reason about a phenomenon or data-set on the basis of a visual artefact (a user's perspective). This can both help us to reintroduce a much needed epistemological reflection within the field of information-visualisation, and to direct the philosophical attention to the technological basis of visualisation-practices.

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