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Visual analysis of the collection : cross-examination and sense-making

Section four, introduces a selection of visualisations, designed as tools for cross-examination and questioning.

The section is organised as a sort of *vis à vis* dialogue between a common sense question or assertion (eg. "recent transformations are better understood than old ones") and a visual answer. The whole section should be understood as illustrative of a method, rather than as conclusive on this or that theory, hypothesis or scientific position.

Visual analysis of the collection : cross-examination and sense-making

In a work entitled *De Docta Ignorantia* (On Learned Ignorance) and published in 1440 [1], Nicolas Krebs (*Nicolaus Cusanus*) describes the *inquiry process* as an intellectual, cognitive process based on *comparative relations* that analysts draw between what is *certain*, and what is *uncertain*. Among the practical applications of Krebs's vision is the construct of universal concepts through a systematic comparison of individuals.

Infovis (Information visualisation) and its outgrowth *visual analytics* are scientific fields that strongly rely on this same vision: gaining insight into a phenomenon through an in-depth cross-examination of massive data and information sets. Within these fields, a large variety of visualisation methods have been introduced (before or after the computer age) that are based on this capacity of creation of *comparative relations*. Although not in today's mainstream research, visual solutions that could help analysts better compare what is considered as certain, with what is understood as uncertain, can be particularly fruitful in historical sciences.

Infovis is about *visual thinking*, and one of the particularities of *visual thinking* is its *non-verbal* character, its independence from ethnic languages. According to Kobrzycki the capacity of perception (and of abstraction) of humans is primarily organised in three non-verbal levels (silent, un-speakable levels: *happenings*, their *nervous impacts* and *reactions* such as feelings). Only then, as a fourth level, does language intervene, as a way to picture reality for ourselves, and to describe it for others. The way we "understand" on the non-verbal level differs from what we can "think" on the verbal level – because we then have to band reality to the structure of the language we use. [2]

Building a visualisation is, briefly said, trying to capitalise on our natural ability to use *non-verbal thinking* (not to say that there should be no verbal expression in a visualisation, naturally – a visualisation reflects a structure, and relations, explicated through comments, legends, *etc.*). Supporting the human capacity of non-verbal thinking implies designing adequate, efficient, distortion-free visualisations – and this is a challenge by itself.

As demonstrated by some major authors in the infovis community – E.R Tufte, R. Spence, M. Friendly, W. Kienreich (*etc.*) - different types of data require different visualisations – different problems, different questions necessitate distinct visual solutions. It is important to understand that an ineptly designed visualisation will not allow us to discover unsaid relations within the data [3]. When carelessly designed, or intentionally deceptive, a visualisation can even lead to faulty conclusions.

The first role of design in data/information visualisation is to improve cognition whilst providing certain aesthetic consistency. E.R Tufte [4] verbalised a set of "rules" that speak for themselves:

- Graphical excellence begins with telling the truth about the data,
- Graphics must not quote data out of context,
- Graphics should draw the viewer's attention to the sense and substance of the data, not to something else,
- Decorative elements lacking the content should be avoided,

Note 1. *…Therefore, every inquiry proceeds by means of a comparative relation, whether an easy or a difficult one. …*
cf. On Learned Ignorance (De Docta Ignorantia) by Nicholas of Cusa, translated by HOPKINS J., second edition 1985, [on-line] <*http://jasper-hopkins.info*>

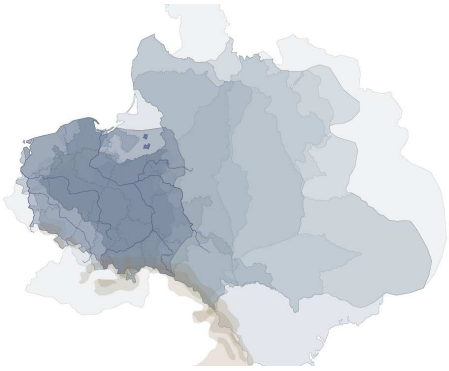
Note 2. *… There is a tremendous difference between "thinking" in verbal terms, and "contemplating," inwardly silent, on nonverbal levels, and then searching for the proper structure of language to fit the supposedly discovered structure of the silent processes that modern science tries to find. If we "think" verbally, we act as biased observers and project onto the silent levels the structure of the language we use, so remaining in our rut of old orientations which make keen, unbiased observations ("perceptions"?) and creative work well-nigh impossible. In contrast, when we "think" without words, or in pictures or visualisations (which involve structure and, therefore, relations), we may discover new aspects and relations on silent levels, and so may formulate important theoretical results in the general search for a similarity of structure between the two levels, silent and verbal. Practically all important advances are made in that way. …*
cf. KOBRZYCKI A., *The role of language in the perceptual process*, [in] *Perception: An Approach To Personality*, edited by BLAKE R. and RAMSEY G., New York. 1950

Note 3. A number of eloquent examples showing both intended and unintended design errors are listed in one of the chapter's of E.R Tufte's landmark book on data visualisation.
cf. Graphical Integrity [in] E.R. Tufte*, The Visual Display of Quantitative Information,* Graphics Press, Cheshire, Second Edition, 2006, pp. 55-77

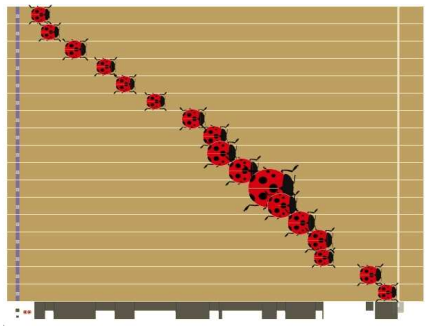
Note 4. *cf.* TUFTE E. R., *The Visual Display of Quantitative Information*, Graphics Press, Cheshire, Second Edition, 2006
Idem, *Envisioning Information*, Graphic Press, Cheshire 1990
Idem, *Visual Explanation*, Graphics Press, Cheshire 1997

- Moiré vibrations can contaminate the entire graphic,
- The representation of numbers, as physically measured on the surface of the graphics, should be directly proportional to the numerical quantities represented,
- Greys, as opposed to colours, have a natural visual hierarchy,
- Graphical elegance is often found in simplicity of design and complexity of data.

Visualisations as we have defined them are tools meant to support analysts in their reasoning tasks. But the complexity of the tasks, the public targeted, the very objective of the visualisations can vary. As solutions to organise large collections of data and allow meaningful comparisons between different parts of data, visualisations may rather be intended at telling a story [5] (story visualisations – more of a teaching or communication tool than of an analysis tool) or be intended at cross examinations, in-depth answers to specific expert questions (data visualisation, infovis, visual analytics). This duality of purposes of graphics was already discussed in Bertin's Graphic Semiology – graphics used both for communication (presenting knowns) and as an exploratory tool (revealing unknowns).



Note 5. The two visualisations *recount a story* for didactic purposes: this of the frontiers of Poland over time (16 key moments considered).
Top, a *temporal density map* – the deeper the blue, the more often the area was part of Poland. Bottom, the *ladybug race metaphor*: the bigger the ladybug, the bigger the country's surface – the horizontal axis stands for time.
[*J.Y. Blaise, I.Dudek, 2006*]



In the following section the reader will find a selection of visualisations designed as the latter group : as tools for cross-examination and questioning. But in today's world a visualisation is rarely designed for paper. This is true also for those that we shall present and discuss. Accordingly, a number of classic features that computers allow – zooming, selecting, highlighting, *etc.* - will not be available in the paper publication. Yet, although these printed versions are here still life images of interactive systems, we wish they can shed an unexpected light on some aspects of the collection of edifices. So with no interaction possible, we have chosen to comment on these visualisations, and more precisely to try and show in real terms what their possible benefits are, through examples showing how they can serve *information discovery*. The section is organised as a sort of *vis à vis* dialogue between a common sense question or assertion (e.g. "recent transformations are better understood than old ones") and a visual answer. The whole section should be understood as illustrative of a method, rather than as conclusive on this or that theory, hypothesis or scientific position. We therefore make no claim on the actual scientific relevance of the questions that are listed – our intent is basically to demonstrate that, when facing large amounts of information, when facing *inquiry* processes based on *comparative relations*, such visualisations can be fruitful (if not unavoidable).
Yet it should be said that a visualisation does not provide sense-making answers if relevant questions have not been figured out in the context of an expert's analytical process on the long run. In that specific context, expected *and* unexpected relations among individuals inside a collection, among parameters that model an individual's behaviour, can be unveiled thanks to carefully designed visualisations. Thereby, our understanding of how a complex system – a city centre's evolution over time – can be amplified.