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Analysing the influence of visualisations in global environmental governance

Piero Morseletto

Institute for Environmental Studies (IVM), Faculty of Earth and Life Sciences, VU University Amsterdam, 1081 HV Amsterdam, The Netherlands

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ABSTRACT

Visualisations can highly contribute to the importance and authority of new ideas, concepts, and knowledge claims. Among the many visualisations, few become well-known and influential in environmental governance. Whilst these have been objects of specific research, this study questions what constitutes and underpins their influence. For this, the paper codifies influential visualisations and defines criteria for studying their visual characteristics. The criteria are applied to two case studies, the "traffic light" and the "planetary boundaries" diagrams. To increase the validity of the findings, the study also introduces two "failure cases" as a plausibility check.

1. Introduction

The perspective of the science-policy interface is particularly relevant for considering knowledge production and interactions in the environmental field (Wesselink et al., 2013). At this interface, certain propositions – whether they are ideas, concepts, or knowledge claims – spread broadly and acquire more authority and relevance than others. The explanation lays in the process of knowledge manufacturing and accreditation, but also relates to intrinsic factors like the quality of a proposition, the legibility of the information provided, the novelty in content, or advancement in knowledge. Ideas, concepts, and knowledge claims receive their credibility and recognition by a community of peers on the basis of shared interpretive frameworks (Knorr-Cetina, 1981). Latour (1987) shows that, regardless of its validity, the establishment of a concept is determined by the number and strength of connections it engenders among otherwise heterogeneous ideas. This associative power attracts experts (also from different disciplines), whom tend to form alliances and networks; through these, a concept is stabilised and enforced. Diffusion and notoriety occur within knowledge networks and actors transfering/circulating knowledge (Stone, 2001, 2013; Michaels, 2009). Another essential element for a concept or a problem to be recognised in the scientific and political sphere is good timing. Kingdon (2003) emphasises the relevance of a broad public "mood" – a bundle of interactions among elite ideas, public opinion, political events, and media attention – that defines a climate receptive to certain ideas/positions in governance affairs. This mood favours "policy windows" that are opportunities opening up when an issue captures political attention and moulds into the political debate. Differently, Heath and Heath (2007) underline how ideas stick when simple, unexpected, concrete, credible, emotional, and delivered in story form. Huber (2008) shows the applicability of these principles to writing articles, though recognising that new knowledge remains the main factor behind articles that stick. Finally, the scrutiny of huge data sets extracted from the internet is defining new affirmation patterns of ideas (Pentland, 2014).

This introductory account evidences how there are several concurrent elements in making a proposition prominent. In this study, I analyse some renowned visualisations (here called influential), produced by experts, published in the environmental literature, and associated to new concepts or scientific evidence. I argue that they can fundamentally contribute to spread concepts, and knowledge claims enabling them to gain momentum and political traction. This can happen, for example: when new ideas are formulated, when there is a greater demand for succinct knowledge, when immediacy is required for exchanging information, or when it lacks the time or background to absorb an original research (Boehme-Neßler, 2011; Wesselink et al., 2013; Michaels, 2009).

Indeed, different disciplinary perspectives consider visualisations in the production and diffusion of knowledge. Particularly, science, technology, and society (STS) studies explore the trajectories of representations – from construction to adoption in different social worlds – analysing the methods, practices, technology, actors, and networks involved (Burri and Dumit, 2008). Environmental visualisations are also examined in geography, sociology, communication, cultural, and cognitive studies. In more detail, some influential (although not named so) visualisations in environmental governance are investigated in

E-mail address: piero.morseletto@vu.nl.

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relation to risk and uncertainty (Mahony and Hulme, 2012; Schneider, 2011), perception and knowledge (Grevsmühl, 2016; Cook and Balayannis, 2015), communicative and rhetorical power (Walsh, 2014, 2015), constructing ideas (Liverman, 2009; Mahony, 2015), and shared meanings in science/policy (Schneider and Nocke, 2014; Lidskog, 2014). Yet, what makes a visualisation influential in environmental governance is a little explored issue. The current study aims at closing this research gap by first defining visualisations and their role in global environmental governance (Section 2). Second, the paper proposes a framework for the analysis of influential visualisations (Section 3) applied to two cases (Section 4). These are the "traffic light", which refers to the emergence of the 2 °C target of the climate convention, and the "planetary boundaries" which is part of the current debate on earth system transformations. The framework is also tested on two failure cases as a plausibility check (Section 5). The final section summarises the findings.

2. Visualisations and influence

The term visualisation varies across knowledge domains. I define visualisation as any message presented in a format suitable for the eye, displayed on a physical support, which provides evidence or explanation to viewers. The functions of visualisations span from being purely descriptive to highly symbolic. In between, visualisations can have aesthetical, instructive, explanatory, interpretative, evaluative, and persuasive intents (Tufte, 2001; Polman and Gebre 2015; Hegarty, 2011; Gordin et al., 1996). Furthermore, visualisations can function as 'boundary object' – an entity favouring common understanding despite users' different views (Star and Griesemer, 1989), but can also work as an 'epistemic thing' – "a question-generating machine" (Rheinberger, 1997, 32).

Besides intellectual functions, visualisations fulfil practical communicative purposes while curbing an ancestral predisposition for visual objects, a sensorial and epistemological preference named visualism or ocularcentrism (Chandler and Munday, 2011). Indeed, vision is the sense with the largest bandwidth: 100 megabyte/s versus 100 byte/s of audition (Fekete et al., 2008). Visualisations accompany human history; as knowledge and technology progressed, they took the shape of graphs, diagrams, maps, illustrations, pictographs, photographs, infographics, and computer/digital images. Among these, experts visualisations are often diagrams, which are drawings intended to describe in a simplified fashion the structure or the functioning of something. Selecting and organizing the components of a representation (data, words, images, graphics, pictograms, etc.) and combining elements like size, colour, shape, diagrams entail an artificial process that ideally reconfigures knowledge in synthetic and codified terms.

Accumulation of visual tools occurs in every domain. Visualisations are highly-employed in science, allegedly since its outset. For example, Galilei's diagrams proved to be crucial for kinematic discoveries (Cheng and Simon, 1995); centuries after, the Hubble diagram changed astrophysics (Borne, 2013) and the Feynman diagrams quantum-electrodynamics (Jishi, 2013). Making data visible (Rheinberger, 1997; Ware, 2013), visualisations are inextricable to the practice of science, whether they are complementary, or fundamental to the scientific endeavour, that is when they integrate textual propositions, or when they build a system of interpretation for understanding (Griesemer, 1991). This is exemplified by the DNA double helix that trespassed the boundaries of science to become a universal topos of visuality.

In environmental governance, many visualisations are policy-relevant: they magnify environmental conditions of societal value worth of policy consideration, and are applicable to policy contexts or decision points. However, many policy-relevant visualisations are created for delimited purposes and few survive contingency. Others last in time, spread over different contexts, and are highly considered and represented, up to acquiring an iconic status, meaning that these representations act as landmarks assisting orientation in the environmental science-policy debate. Examples are: the Keeling curve, the sustainable development scheme, the Hansen projections, the traffic light diagram, the hockey stick graph, the burning embers diagram, the ozone hole images, the planetary boundaries diagram, the great acceleration charts (see the Appendix Figs. A1 – A10 in Supplementary material). All these concisely depict concepts or new evidence about global environmental change, deal with the interwoven system of human activities and natural processes, and pose governance challenges at the global and local level. The term 'influential' is chosen to define these visualisations. Influence – from Latin *influere*, flow into – is the capacity to produce perceivable effects without direct action nor coercion. The concept is wide enough to encompass elements like prestige, notoriety, impactfulness, persuasiveness, which can all co-produce or increase influence. Influential visualisations illustrate and explain a compelling environmental issue, and lay at the heart of the debate generated by that issue. They are oftentimes discussed, recalled (also verbally), and replicated in the academic literature and events. Moreover, influential visualisations are able to crosscut specialists' communities and talk to different audiences, even if made for a disciplinary community and for reaching the attention of policymaker. But what makes a visualisation an influential one?

An expert visualisation is not influential per se, but in association to an environmental concept or evidence of major societal concerns and/or high on the policy agenda. However, this is not a sufficient condition. In fact, many visualisations do not become influential even if associated to problems in the spotlight, also in relation to unprecedented evidence, cutting-edge concepts, or prominent authorship. Influence can be interpreted as a result of circulation or visibility/popularity of a visualisation. Yet, these are effects rather than causes of influence, or eventually amplifiers for further influence. As seen in the introduction, influence depends by the interplay of intrinsic and contextual factors like quality, timing, fecundity of links/alliances, or involvement of knowledge broker/networks. All these intertwine with the influence a visualisation has. Connectedly, Knaggård (2015) advances that persuasive frames depend on knowledge, values, and emotions (recalling Aristotelian logos, ethos, and pathos). Knowledge refers to what an issue is about; this needs to be connected to values in order to demonstrate what is at stake. Then, an issue is recognised as believable and important. Emotions complement these aspects linking knowledge and values with the less rational aspects of feelings. For example, collective fear can prompt a sense of urgency moving an issue up in the political agenda. Although hard to measure, emotions can be the decisive element to have a frame accepted (Knaggård, 2015). Similarly, some expert visualisations can explain a concept or knowledge claim to be recognised by visually summarising knowledge, connecting the representational elements to values, and so triggering emotions. These considerations lead to focus on how a visualisation is made, its visual characteristics, which allow it emerge and grow big.

3. The visual characteristics of influential visualisations

Although influential visualisations are studied from different angles, there are no straightforward criteria for appraising their visual characteristics. Nonetheless, scholars form different disciplines have elaborated criteria and principles to illustrate how good representations work. For instance, "effective design" studies (Tufte, 2001; Hegarty, 2011) define principles and techniques for improving the comprehension of visually-encoded information. The fields of "information visualisation", and "knowledge visualisation" (Fekete et al., 2008; Eppler, 2013) explain how representations convey knowledge and meanings. Complementarily, "perceptual studies" (Ware, 2013) show how visualisations are seen and what effects they produce. Other studies identify issues areas in different disciplinary approaches. For instance, Blackwell and Engelhardt (2002) classify four main groups in the study of diagrams: signs (i.e. graphic components), graphic-structure, meaning, and context (the interactions and cognitive implications). For