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# The Prostheticity of the Network. Humanities and Scientometrically-Born Cyborgs

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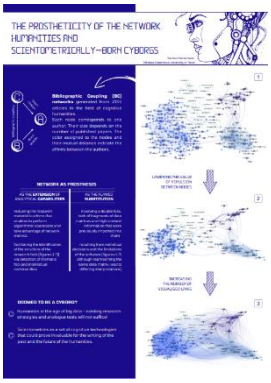


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## Abstract

Although there have been many efforts in the last decade to reconcile the humanities and the information sciences, they have not radically changed the research standards prevailing in most humanistic departments. Against all appearances, the abrupt opening to quantitative methods in the digital humanities still has the character of a minority avant-garde movement. The article looks at the scientometric tradition, largely forgotten by the humanities, which may prove to be another interface bringing the two academic cultures back together. An account of scientometric networks highlights the advantages and disadvantages of this orientation. The broader implications regarding the use of visual networks in the humanities are framed by the category of prostheticity, which aims to encapsulate their ambivalent status as both substitutes and cognitive enhancers.

**Keywords:** cognitive prosthesis; data literacy; network visualization; science mapping; scientometrics

## 1. Introduction

In the 1960s, when Vasily Nalimov coined the term *naukometriya*, later known in Anglo-Saxon academia as *scientometrics*, he had in mind the quantitative study of any scientific endeavor, regardless of its disciplinary provenance (Nalimov, 1966; Nalimov & Mul'chenko, 1969)[1]. Little did he know how tenuous this vision would be with the fate of scientometrics in the decades to come. Thriving in the disciplines of the sciences, to which it has been keenly applied in order to measure, evaluate and assess research output, at both the macro and micro level, but largely forgotten and neglected by the humanities. This discontinuity of scientometric thinking in the humanities has been extensively described by Radhamany Sooryamoorthy. In a monograph published in 2021, the first and so far only one on the subject, Sooryamoorthy identifies a number of possible reasons for this remoteness. These include issues of the very perception of scientometrics as not particularly relevant to the humanities, but also as requiring too high a level of mathematical and statistical competence. Sooryamoorthy furthermore traces the reasons to barriers arising from the peculiarities of the humanities publishing culture: its intrinsic diversity arising from disciplinary pluralism, as well as the underrepresentation of humanities works in indexing databases, due to both the internal policies of these databases and the privileged position of monographs, which continue to play a paramount role in the transmission of knowledge (2021, p. 61-62). By documenting the rare 64 cases of the application of scientometric methods in HSS disciplines, Sooryamoorthy shows that the difficulties mentioned above are indeed real and often require the methodological unconventionality to which researchers must resort in order to achieve meaningful results. Nevertheless, he proves that the peculiarities of the publication culture in the humanities are not insurmountable obstacles, and those who choose to confront these difficulties are rewarded with non-trivial and inspiring outcomes (pp. 76-111).

Among the many methods and techniques of scientometrics, the one that has received the most attention in recent years is undoubtedly science mapping. At its core is the creation of graphical representations of the structure and dynamics of scientific knowledge in the form of scientograms, i.e. directed or undirected networks depicting relationships between bibliometric units (Petrovich, 2021). Such units can range from individual authors and research papers to entire institutions, universities, or countries. Depending on the unit chosen, maps of science take the form of reference-based networks (bibliographic couplings, co-citations), term-based networks (co-occurrence of keywords in titles or abstracts), or co-authorship networks (between researchers, institutions, or

[1] While it is customary to credit both Nalimov and Mul'chenko with authorship of the term by referring to their joint 1969 book, as Ronald Rousseau convincingly argues, Nalimov had already used the term three years earlier, and for this reason authorship should be attributed to him alone (Rousseau, 2021, pp. 213-214).

countries). As the entry threshold for conducting scientometric analyses has been significantly lowered in the last decade by user-friendly open access software (Osińska, 2021, p. 13), there could hardly be a more opportune moment for humanists to validate the applicability and efficiency of scientometrics for pursuing their own research agendas. A number of prerequisites for a successful alliance of the humanities with scientometrics and network science could be listed, but it is clearly not feasible to cover each and every one of them in this brief poster article. The intention is therefore much more modest. To use the case of bibliometric networks—as described in the accompanying poster—to demonstrate the merits and shortcomings of (such) visual representations as modes of knowledge production and dissemination. Thereby laying yet another building block in the already initiated process of reconciliation.

## 2. The (Re)discovery of Network

And the time has come for the network, that much-vaunted metaphor among humanists, to finally be transferred from the linguistic to the visual realm. This is how one could succinctly recapitulate the guiding idea of the *Network Turn: Changing Perspectives in the Humanities* (Ahnert et al., 2020)—a book about the curious state of the network in the humanities. A network that seems ubiquitous even though it is almost invisible. Utilized as a mean of description and interpretation, but not for graphical representation of the phenomena under study.

*Network Turn* has passed almost without echo in the humanities. The causes can be attributed to a certain oversupply of publications in the field of digital humanities (Spinaci, Colavizza, & Peroni, 2022), or to the ever-present ideals of disciplinary purity and the consequent reluctance to embrace mathematical and statistical approaches (Kirschenbaum, 2014; Brennan, 2017). Regardless of the underlying reason, the postulate that the objects of humanities research should not only be described and metaphorized as a network, but also visualized and quantified through it, continues to elicit an ambivalent response. In the following section, I will argue that this ambivalence is not merely related to humanists' attitudes toward the network, but rather constitutes an integral property of network visualizations as such.

## 3. Equivocal Prosthesis

Networks reveal and conceal with equal ease. For they make visible relations that the unarmed eye of the researcher would not be able to detect, although they tend to do so through selective disclosure. I call this property prostheticity, understood in two ways:

I. As an extension of analytical capabilities

The above claim derives from the preceding reduction of the research material to a form that allows for a series of computational operations and their subsequent visual representation. This is exemplified by the bibliographic coupling networks shown in the poster (Figures 1-3), which represent the citation patterns of authors who have published in the field of cognitive humanities. Such networks act as cognitive prostheses that streamline or enable certain exploratory or analytical procedures involved in systematizing a wide range of scholarly activities. Their use facilitates the clarification of the structure of the research field by identifying its thematic and publication foci, or by assessing its degree of (de)centralization. On this account, scientometric networks provide a prospective alternative or supplement to the more common in the humanities approach of close reading, which appears meticulous and nuanced, but because of its highly time-consuming nature, tends to be inadequate for assessing the scope and state of development of vast research areas. Hence, it allows for a multifaceted characterization, in contrast to close reading, which, while allowing for a much more comprehensive understanding of the content of a single article, leaves one blind to the complex relationships that occur between hundreds or thousands of articles. In this sense, scientograms serve as a tool for more efficiently navigating the maze of burgeoning research fields, which seems to be urgently needed in the wake of a post-paradigmatic humanities that eschews grand theories in favor of small methodological and conceptual shifts.

The same can be said for virtually any kind of textual or visual data, the sheer volume of which precludes in-depth qualitative analysis. The research entries to the annual international *Digital Humanities Awards* exemplify the ways in which networks contribute to the readability and overall quality of analyses of temporally and thematically expansive cultural material. One of the flagship projects is the award-winning *Tudor Networks* by Sebastian and Ruth Ahnert in collaboration with Kim Albrecht, who designed the visuals (2020). *Tudor Networks* were created from more than 100,000 letters written by more than 20,000 people covering the period from the accession of Henry VIII to the death of Elizabeth I. The temporal and geospatial data captured on the networks provide information about the date and location of the recipient and sender. The interactive feature also allows the user to view the content of the letter. In fact, this was not the only large-scale analysis Ahnerts has conducted on historical material dating back to the Tudor dynasty. Their previous studies have demonstrated that network signatures can be a valuable source of information about the roles individuals played in communication, as well as enabling the identification of those belonging to a conspiracy or illicit information (Ahnert & Ahnert, 2019; Ahnert, 2020).

II. As a substitution of the data matrices from which they were generated.

The bibliographic coupling networks (Figures 1-3) are visualizations of exactly the same matrix. A single change in the software parameters, as in the case of variants 1 and 2, which differ in the value of the repulsion between the nodes, can lead to the production of significant discrepancies in the shape of the network and consequently to erroneous/incorrect interpretations (e.g. misjudging the similarity relationship between authors or the degree of decentralization of the research field). Such discrepancies are sometimes also caused by individual user decisions (the difference of 9,000 connections between the 2nd and 3rd network) or by software limitations regarding the maximum number of visualized elements (out of 25,475 calculated connections, VOSviewer is only able to display 10,000 of them).

Network analysis therefore involves a double loss—both of the substantial portions of the data matrices and of the high-context information that had previously been reduced in order to construct the network and exploit its metrics in the first place. Metadata-based networks are an excellent example of how this double loss occurs. In addition to the aforementioned loss of information that results from converting a data matrix into a visualization, the scientific literature itself must be downgraded to a set of highly decontextualized attributes. While scientometricians occasionally use natural language processing (NLP) methods to examine complete scientific documents, these are primarily applied to the natural sciences, which have a much higher semantic density than humanities texts. This is due to their comparatively higher frequency of use of specialized terminology, as in the case of medicine, where text mining can be used to find connections between specific biomarkers, disease entities, or pharmaceuticals. Content analysis in the humanities typically relies on article titles, keywords, or abstracts. For obvious reasons, these provide only limited insight into the content of the arguments. Networks constructed on their basis allow us to gain a general overview of the subject matter, but cannot reveal in what sense recurring terms were used in the texts, given the relatively high conceptual ambiguity of humanities discourse. Reference-based networks suffer from the same affliction, where we cannot infer whether a work is linked to others because it is argumentatively related or because the intention of citing it was to criticize and refute them. In appreciating the potential of the network to facilitate the research process and expand our cognitive capacity, we should never lose touch with this flip side of the network as prosthesis metaphor. A network that is so often both a necessary and a deeply flawed substitute.

## 4. Doomed to be a Cyborg?

The era of big data, including that produced within the academy, requires humanists to either modify established strategies or develop entirely new ones-tailored to the volatile and ever-expanding horizon of information. As members of the Cyberinfrastructure for Network Science Center at the University of Indiana have urged, we stand before the challenge of delivering the very next wave of literacy (Börner, Bueckle, & Ginda, 2019). Only this time, it will be tied not to the skills of understanding and expressing oneself in language, but through graphical forms. The changing distribution of power between the verbal and the numerical, the visual and the linguistic, makes the acquisition of data visualization literacy not a privilege, but a necessity. If only to be able to constructively examine and critique them, to question their naively imposed objectivity, and to propose alternative (visual) narratives. Humanists are no exception here. Not even those who may never decide to produce visualizations themselves. Although the odds that this necessity will not befall them are diminishing year by year. Debates about the importance of new ways of analyzing research results are gaining momentum, and visual abstracts are already becoming the new standard rather than the eyebrow-raising exception in some academic disciplines (Ibrahim et al., 2017; Ramos & Concepcion, 2020). While more than 30 years have passed since the pictorial turn was heralded by W. J. T. Mitchell, the humanistic interest in visual culture has not directly translated into active participation in the production of that culture itself. One only has to think of the poster sessions at humanities conferences, which serve a rather ornamental purpose, since they are often seen as a space of expression suitable for budding academics and not necessarily appropriate for senior scholars. Putting this form of scholarly expression on the same footing as endless textual passages is undoubtedly a good start in re-establishing visual forms as equal, or at least complementary, means of research communication.

Outlining the idea of the natural-born cyborg, Andy Clark argued that "the fortress of skin and skull [...] has been built to be breached" (2001, p. 18), to be connected to the body and the external world, and to the cognitive technologies that co-constitute the complexity of our minds. Networks, like once sheets of paper and pens, and later word processors, thesauruses, and bibliography management tools, are poised to become part of yet another of our extended cognitive systems, whose "problem-solving profile" (p. 20) may well change the way we develop and reason about an object of our inquiry. If being a cyborg is fated rather than chosen, then this symbiotic alliance with scientometrics and network science should not pose much difficulty. Better spare parts will soon be found.

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