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QUALITATIVE SCIENTOMETRICS?

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Abstract

When scientometricians are asked about the relationship between citations and quality, they often argue along the lines that citations could be seen as indicators of use and that this implies usefulness and impact on other research, which in turn is an argument for using them as indicators of quality. This paper questions the implicit linearity of such a 'one-dimensional model' of representing quality by quantity from a number of standpoints. First, the use of citations as well as any indicator that is used is performative in the sense that those getting measured by them, i.e. researchers or university administrators, will adapt their behavior to perform well on the scales that are used, either for recognition or for monetary reward. Second, equating citation counts with quality might imply a notion that they scale together such that low citation rates equals low quality and that a high rate implies high quality. Third, and most important, drawing from theories in STS it could be argued that scientometric indicators and measures of scientific achievement are co-produced, in the sense that development of performance based or results based indicators and what is to be regarded as high quality will be found to increasingly coincide with each other as a consequence of the performative idiom mentioned above. It is suggested that more work on the qualitative aspects of scientometric data and is called for.

Introduction

In this paper, I will take as a backdrop for my discussion the classic debate within the Sociology of Science and Science and Technology Studies (STS) regarding the question: Do citations indicate quality of research? This question, of course, is applicable to all bibliometric indicators used on scholarly publication, but it can be argued that the citation represent a special case.

I will then briefly sketch a perspective where the status of the citation is explained due to the specific conditions under which the citation is created – the citation is not a mere mirror image of the cited reference – instead it is a specific entity constructed under certain conditions in and of the citation index. This is what I will label *'the performative perspective on citations'*. Here authors, citers, texts, and the specific conditions of the so-called citation index come to play. This will be followed by an interpretation of the practice of citing references and especially of researchers making themselves "cite-able". As such, this is to be viewed as an interpretation of the practices of the citation as a specific symbolic "entity" in research.

In this paper I will use the example of different *'Disciplinary practices'* of citing references as a general example of aspects of the performative perspective. It consists of a general example discussing typical disciplinary practices of citing references in three idealized areas of research: The "natural sciences", the social sciences and the humanistic sciences.

Additionally, the results will be used to discuss if research in different disciplines could be *realistically* represented, for example in citation-based bibliometric models for evaluation of research at various levels in the research landscape and to what degree a performance based bibliometric funding system will become an incentive for researchers to change their way of publishing and citing.

The citation as indicator of quality

In his well-known article in *Science*, Eugene Garfield proposed the production of a citation Index for science (Garfield, 1955). If we go back to the original discussion regarding the question about the citation as a measure of 'quality', one could note that Garfield did not introduce the *Science Citation Index* for measuring research quality. Instead, he proposed it as an "association of ideas index" for researchers to find literature in a most specific way, namely by looking

forward in the publication history by following references backwards from a certain point in time from cited to citing documents.

This is not to say that *Institute of Scientific Information*, that was founded to promote the index, and later its present owners *Thomson Reuters* did not prosper on such usage, but it could only be hypothesized that it would have been constructed differently if its use in research policy and evaluation was in focus at the start in 1955. For instance in a paper on the usage of SCI data, Garfield noted:

"One purpose of this communication is to record my forewarning concerning the possible promiscuous and careless use of quantitative citation data for sociological evaluations, including personnel and fellowship selection" (Garfield, 1963).

Furthermore it was noted:

"Impact is not the same as importance or significance" (Garfield, 1963)

At the same time, Garfield has suggested that the Science Citation Index could be used for the evaluation of journal performance. This, is based on the usage of the citation based measure of Journal Impact Factor (JIF) (Garfield, 1972).

In spite of these qualifications, today, citation data are regularly used in research evaluation at every level from national comparisons and government funding models to universities, down to the individual level of researchers, for example as a basis for salary-setting or when applying for tenure.

The key arguments for and against using citations in bibliometrics for evaluation could be elucidated from what could be described as a classical debate within sociology of science, research policy studies and Science and technology studies (STS). Here I will not go into this debate in depth, but will only try to spell out some of the more prominent differences that are found in the respective views. A more in depth discussion, focusing on the arguments within the STS community is found in Nelhans (2013). In simplified form it could be staged as a debate between proponents advocating that citations are given to earlier research as a non-monetary reward for work done and opponents that argue that other factors also play a role in when it comes to the citing of earlier literature. From what could be labeled the 'institutional perspective of Sociology of Science', citations are seen as reward in the Mertonian reward system of the norms in science (Merton, 1973 [1942], 1988). From this perspective one could characterize the citation as a measure of *influence* in some way, and then you tend to describe citations as indicators of quality (e.g. Cole & Cole, 1967; Price, 1963).

From a constructivist perspective, citations are described as indicators of *rhetoric* or *persuasion*, and its proponents either deny, or downplay the utility of citations in evaluating research (Edge, 1979; G. Nigel Gilbert, 1977; G Nigel Gilbert & Woolgar, 1974; MacRoberts & MacRoberts, 1989).

Currently, the debate about reward or persuasion is not a very active one. While those who perform work in bibliometrics and research policy studies that use citation data tend to favor the previous solution, researchers within STS who mainly work with qualitative methods tend to have a more critical stance. If one asks a scientometrician today about the rationale for using citations for evaluation, a pretty standard answer is given here:

The observation that citations indicate use, and therefore usefulness as well as impact, is the basic argument for using them as an indicator of quality. (Gläser & Laudel, 2007)

Visibility as a middle ground?

Some have proposed a less excluding position, taking a middle ground in the discussion, arguing for both a content-based and a more context-based social model of citations. It is suggested that citations could be viewed as measures of *visibility* within published research (Cozzens, 1981, 1989; Kaplan, 1965). Here, one could argue that the notion of being visible is an estimation that is easier to match with a quantitative measure than quality, and one that does not have as high stakes as the latter. A notion of visibility as an important aspect of evaluating research could be based on the argument that researchers that do not publish their work to be scrutinized by their peers could hardly claim to have achieved well, although the exact use of citation frequencies as measures of the degree of recognition is more problematic. In the words of Bruno Latour:

However, most papers are not read at all. No matter what a paper did to the former literature, if no one else does anything else with it, then it is as if it never existed at all. You may have written a paper that settles a fierce controversy once and for all, but if readers ignore it, it cannot be turned into a fact, it simply cannot. (Latour, 1987, p. 40)

What seems to be gained by using the concept of visibility is that it is neutral with regards to the interpretation of the perceived sentiment of the cited work and could accommodate both positive and negative interpretations, as well as active and passive notions of the effect of the cited work on the citing author(s).

Performativity or representation?

But here a new dichotomy arises that is worthy of further discussion. While arguing that being visible is an important aspect of gaining recognition within the research community and that citations are a measure of visibility, one question still resides: What does "being cited" mean? If we introduce a division between 'passive' and 'active' modes of citations, one could argue that the reward-based model of citations is grounded in a view where citation patterns that evolve within a research community is a *representation* of the actual research being done. Furthermore, this would imply that highly cited work is indicative of more important work as judged by the community. The author is seen as 'passive' in terms of not having an impact on future citations and the work, so to speak, stands on its own. But if one instead focuses on the author as playing an active role in the 'cite-ability' of the published work as will be explicated below, one could designate this a performative perspective on citations.

Citations as representation

If we start with the passive notion of being cited. This is based on the view that patterns that are seen within the citation index could be viewed as a *representation* of publication and citation patterns. Each work that is published is expected to have the same odds of being cited, and that it is only the quality of the paper, measured as its "usefulness" for the author(s) citing it that will distinguish if it actually will be cited. That this is an oversimplification of the situation was shown already by Norman Kaplan, who discussed the various effects of the 'norms of citation behavior' (1965), and by Merton in putting forth the 'Matthew effect in science' and the role that reputation plays in distribution of recognition in the sciences:

The Matthew effect may serve to heighten the visibility of contributions to science by scientists of acknowledged standing and to reduce the visibility of contributions to science by authors who are less well known. (Merton, 1968, p. 62)

For Merton though, this was not judged a particular problem, at least not at the individual level of scientists since, he argues, from a psychosocial perspective, "eminent men of science... [are encouraged to] ...search out risky but important problems and to highlight the results of their inquiry" (ibid.).

As will be discussed in the following section, from the active notion with regard to the author of the text, there are more aspects to being cited than being eminent and being able to communicate ones result as Merton suggested.

Citations as performance

In the research that informs this paper the argument is based on the notion of *performativity* as visible in relation to the citation index. In this view, the contrasting perspectives on citations as reward and cited references as persuasion are both lacking the technical and practical notions of 'being cited' as an effect of bibliometrics having a reciprocal effect on research practice.

Here, I will not elaborate on the theoretical aspects of this perspective more than to say that it is influenced by the conception of 'performativity' (Pickering, 1995) in STS as a means to unpack the situation that researchers are faced with in light of the bibliometric practices of research evaluation.

From the *performativity of "being cited"* position one could ask: What research work do citations do? I would suggest that citations could be seen as constructed and as examples of epis-

temological networking. In this perspective the citation is viewed as an outcome of achievement or "performance" instead of as a representation. Thus, in this view, the citation index works as a performative arena. This highly heterogeneous setting consists of such disparate actors as publishers, authors, citers, publications and articles; indeed the whole "citation culture", to borrow and to extend a concept coined by Paul Wouters, professor of scientometrics at Leiden university (Wouters, 1999). In this specific setting, researchers *actively* position themselves in the citation game by choosing research problems to study and publish on as well as by choosing journal/field to publish in. Thus, the process of "being cited" is translated into the problem for researchers to be cite-able in the system of citation based metrics and in publishing in the most "prestigious channels" in the impact based system.

This process could be a more or less conscious activity from the part of the individual researcher, but arguably, it is becoming harder and harder to stand outside the citation culture today. Not only is research evaluated at a higher rate than ever before, but the highly standardized and automatized bibliographic tools that are used to register published research are getting more readily available, and almost all activities that researchers do with regards to producing material in some form has become the focus of quantification.

But frequency in citations is not the only thing that matters. In the following, I will sketch one way in which the heterogeneous role of citations is played out, namely as pictured from different disciplinary practices of citing. The aim of this section is not to review every conceivable way that authors within these fields cite previous research, but to show that different citing styles could encompass both quantitative differences and qualitative differences in citing practices. To make the argument clear, I would like to invoke some tentative suggestions about citing practices:

- In the *natural sciences*, citations mark *influence* (to a higher degree), where research build on earlier work, and research often proceeds by way of "puzzle-solving" within an established framework.
- In the *humanities*, citations rather mark *textual aspects*. Here, the cited literature does not only consist of sources, but is often the subject of research. References are thus cited in '*conversation with the cited texts*'
- In *social science*, citations mark *rhetoric*. Social scientists often have more than one designated audience: the research community and 'the outside public', including politicians and civil servants. This suggests that references are cited in an *argumentative way*.

Publication and citing practices in different disciplines.

In this section, three "typical" research journal articles from three broad scientific areas as described above have been chosen. In each text, some distinctive features about the article and how references are cited has been noted. The goal was not to create a fully comprehensive view of how references are cited in the literature in each discipline, but rather to show the quantitative and qualitative differences in citing practices between, but often also within disciplines, and sometimes even within different parts of the text at hand. This work has been influenced by earlier work on citation context analysis within research (e.g. Chubin & Moitra, 1975; Cozzens, 1985; Hellqvist [Hammarfelt], 2010; Moravcsik & Murugesan, 1975), but it is used here to identify qualitative differences in citing practices.

Methodology

The articles were chosen based on convenience through searches in the three journal citation databases in. The science article was chosen as the latest article with a Swedish author that was found in the subject area 'biochemistry'. The Humanities article was a recent article in theoretical philosophy and the social sciences article was chosen purposely as the most cited article by a Swedish professor in political science, who has voiced criticism against Swedish social scientists for being 'provincial' in terms of publishing their work on their native language and not being part of the international research community (Rothstein, 2012).

Analysis

The biochemistry article is a rather typical research article reporting on a laboratory experiment. In the article, the authors have tested a specific enzyme and its effect on calcium levels in proteins (Rosengren et al., 2012). It has a very specific title, with names and acronyms of compounds that interact with each other in the experiment. The article has six authors from two different departments. One could induce that the first author is the key author and that some are more likely to have been lab personnel or to have contributed in more specific ways. The last author is the corresponding author is also the professor at the lab. By just studying the article and the way it uses references we will gain an understanding of how references are used in this field.

When it comes to the way in which the authors cite their references, one could note that the frequency of citations in the background and the methodological section is quite high. Every sentence, or at least every other sentence, ends with at least one reference. One sentence in the background has six references, including at one self-reference to the research group.

If we turn to the methods section we not only find regular references, but also references to the companies that produce the compounds that were used in the study. The reasoning behind citing these companies is not clear but might be because these are patented compounds that only could be obtained by contacting the companies that produces them. Additionally, there are two instances of a certain kind of acknowledgement that is conveyed in the text. The authors kindly acknowledge that they have received strands of cell lines from rat and mouse from two named professors in the field.

The article from theoretical philosophy that was chosen was published in the journal *Analysis* by a well-known philosopher named David Chalmers from Australia (Chalmers, 2011). As noted above, this is a slightly idealized case, since examples were not chosen at random, but to achieve an effect. If we look at how the argument is built up it is done so without any cited references at all. In the introduction the author begins: *"It is widely believed that..."* [no reference]. He continues: *"It is even more widely believed..."* [no reference again]. Then the author creates a counter-argument to his 'widely believed' claims, turning to spelling out the premises of this argument [still no references]. If one scroll down, on page one there is a footnote explaining a technical dilemma, but no cited reference, page 2 is passed by [still no references]. At last, on page 3 there is a footnote and at the end of the page we find the first cited reference to an earlier text. The author notes that a specific aspect of his argument is a version of the cited author's problem. In a way, he uses this reference to establish a basis to stand on although the reference seems more to act as additional information in the text. On the next page, again we find some references that describes a debate between a number of authors, explaining their arguments and how they differ from each other (Chalmers, 2011). All in all, we find 11 cited references in this paper, ranging over the course of 50 years.

The last article chosen for study was an article by Bo Rothstein, a professor holding a chair in Political Science in Sweden. From the outset it is clear that it has a very personal style. It starts:

In November 1997, I was invited to Moscow to lecture about the Swedish civil service to academics, politicians and bureaucrats... (Rothstein, 1990)

This is not the a-personal tone most often found in the natural sciences, and the whole article has an argumentative stance towards its subject. For example, just by counting pronouns in the text it is found that it contains 27 "I", 7 "me" and two "my". It also contains 34 "we", which could be regarded as slightly less personal, 7 "us" and one 1 "our". Lastly, there are 17 "you", although none of them are directed directly at the reader, but are used more in a hypothetical way.

Regarding the cited references in the text, a mixture of the two previous ways of citing references could be elucidated. We can clearly see that the author is making an argument by cumulatively building on others' ideas, either by line of argument or by "borrowing" conclusions from others. But in the end of such a long argument there follows a *negative citation* where the author uses a string of cited references to note a long argument only to summarize the arguments by:

"The problems with all these explanations are well-known. (Rothstein, 1990, p. 489)

If the author just wanted to note his influences here, why would he cite all these people only to dismiss their work completely below? In the end, it could be noted that that Rothstein cites about 85 references in the text, which means that he pretty well even out the number of refer-

ences given and the number of citations that the article had received at the time of analysis (77 citations in mid 2012).

Discussion

To sum up, it was found that different kinds of research take different form and that references are used in widely different ways. A general aspect that was found in the biochemistry article was that the authors used the cited references as stepping stones to build their argument *cumulatively*; this could be viewed as *paradigmatic* research that, according to Thomas Kuhn, develops by *puzzle-solving* and by following the *exemplars* of others (Kuhn, 1970 [1962]). It was also shown that in the biochemistry article, on top of the general citations to published literature that is indexed in the citation database, there are two additional layers of acknowledgement at work at the same time that are not found indexed.

Aspects of citing behavior were also shown when it comes to different understandings of the role of research. Many social sciences (and indeed many interdisciplinary fields) have, at least in part, an outspoken interventionist aspect to it—and I would argue that this is seen also in how references are used in the political science article. This differs from the (natural) sciences that often claim autonomy from society outside the research community and might not even be wanted in the humanities, where the research focus ideally is on understanding and not necessarily in the alteration of its research objects. The roles of each kind of article could very tentatively be coupled with an ideal contribution of respective research as indicated in Table 1.

Table 1: Ideal contributions of research in three broad research areas.

<i>Kind</i>	<i>Ideal contribution</i>
Natural sciences	Explanation
Humanities	Understanding
Social sciences	Intervention

Conclusions

Based on these results, what could be said about the use of bibliometric data in a research policy context, used for evaluation at different levels in the research community? Is it enough to devise quantitative solutions or is there a need to also identify qualitative solutions? Here I make a case that in spite of all the advanced efforts of author fractionalization, comparisons between actual publication levels and the expected mean publication rate of comparable fields, the field-normalization of citations or eradication of self citations, all performed to make bibliometric data comparable between the sciences, there is still a need to solve the basic problem of references being cited based on different practices and for qualitatively different reasons within different research areas. From this perspective, the scientometric community needs to *also* focus on the individual question about performativity of the different actors within the “*citation culture*”.

By this, it is suggested that the notion of “*being cited*”—how well researchers make themselves cite-able in citation-based metrics is a most promising concept to develop further.

References

- Chalmers, D. (2011). Actuality and Knowability. *Analysis*, 71(3), 411-419.
- Chubin, D. E., & Moitra, S. D. (1975). Content Analysis of References: Adjunct or Alternative to Citation Counting? *Social Studies of Science*, 5(4), 423-441.
- Cole, S., & Cole, J. R. (1967). Scientific Output and Recognition: A Study in the Operation of the Reward System in Science. *American Sociological Review*, 32(3), 377-390.
- Cozzens, S. E. (1981). Taking the Measure of Science: A Review of Citation Theories. *Newsletter of the International Society for the Sociology of Knowledge*, 7(1 & 2), 16-21.
- Cozzens, S. E. (1985). Comparing the Sciences: Citation Context Analysis of Papers from Neuropharmacology and the Sociology of Science. *Social Studies of Science*, 15(1), 127-153.

- Cozzens, S. E. (1989). What do Citations Count? The Rhetoric-First Model. *Scientometrics*, 15(5), 437-447.
- Edge, D. (1979). Quantitative Measures of Communication in Science: A Critical Review. *History of Science*, 17, 102-134.
- Garfield, E. (1955). Citation Indexes for Science: A New Dimension in Documentation through Association of Ideas. *Science*, 122(3159), 108-111.
- Garfield, E. (1963). Citation Indexes in Sociological and Historical Research. *American Documentation*, 14, 289-291.
- Garfield, E. (1972). Citation analysis as a tool in journal evaluation. *Science*, 178, 471-479.
- Gilbert, G. N. (1977). Referencing as Persuasion. *Social Studies of Science*, 7(1), 113-122.
- Gilbert, G. N., & Woolgar, S. (1974). The Quantitative Study of Science: an Examination of the Literature. *Science Studies*, 4(3), 279-294.
- Gläser, J., & Laudel, G. (2007). The Social Construction of Bibliometric Evaluations. In R. Whitley & J. Gläser (Eds.), *The Changing Governance of the Sciences* (Vol. 26, pp. 101-123). Dordrecht: Springer Netherlands.
- Hellqvist [Hammarfelt], B. (2010). Referencing in the humanities and its implications for citation analysis. *Journal of the American Society for Information Science and Technology*, 61(2), 310-318. doi: 10.1002/asi.21256
- Kaplan, N. (1965). The Norms of Citation Behavior: Prolegomena to the Footnote. *American Documentation*, 16(3), 179-184.
- Kuhn, T. S. (1970 [1962]). *The structure of scientific revolutions* (2. ed.). Chicago: Univ. of Chicago press.
- Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, Massachusetts: Harvard University Press.
- MacRoberts, M. H., & MacRoberts, B. R. (1989). Problems of citation analysis: A critical review. *Journal of the American Society for Information Science*, 40(5), 342-349.
- Merton, R. K. (1968). The Matthew Effect in Science. *Science*, 159, 55-63.
- Merton, R. K. (1973 [1942]). The Normative Structure of Science *The sociology of science: theoretical and empirical investigations* (pp. 267-278). Chicago: The University of Chicago Press.
- Merton, R. K. (1988). The Matthew Effect in Science, II: Cumulative Advantage and the Symbolism of Intellectual Property. *Isis*, 79, 606-623.
- Moravcsik, M. J., & Murugesan, P. (1975). Some Results on the Function and Quality of Citations. *Social Studies of Science*, 5(1), 86-92.
- Nelhans, G. (2013). *Citeringens praktiker – Det vetenskapliga publicerandet som teori, metod och forskningspolitik [The practices of the citation: Scientific publication as theory, method, and research policy]* Diss. (Diss.), University of Gothenburg, Gothenburg. Retrieved from <http://hdl.handle.net/2077/33516>
- Pickering, A. (1995). *The Mangle of Practice: Time, Agency, and Science*. Lanham: Univ. of Chicago Press.
- Price, D. J. d. S. (1963). *Little science, big science*. New York: Columbia Univ. Press.
- Rosengren, V., Johansson, H., Lehtiö, J., Fransson, L., Sjöholm, A., & Ortsäter, H. (2012). Thapsigargin down-regulates protein levels of GRP78/BiP in INS-1E cells. *Journal of Cellular Chemistry*, 113, 1635-1644.
- Rothstein, B. (1990). Trust, Social Dilemmas and Collective Memories. *Journal of Theoretical Politics*, 12(4), 477-501. doi: 10.1177/0951692800012004007
- Rothstein, B. (2012, 2012-08-15). "Svensk samhällsforskning är alldeles för provinsiell" ["Swedish research in social sciences is far too provincial"]. *Dagens Nyheter*. Retrieved from <http://www.dn.se/debatt/svensk-samhallsforskning-ar-alldeles-for-provinsiell/>
- Wouters, P. (1999). *The Citation Culture* (S. S. Blume Ed.). Diss: Faculteit der Scheikunde, Universiteit van Amsterdam.