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Assessing insularity in global science

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Abstract Most scientific research has some form of local geographical bias. This could be caused by researchers addressing a geographically localized issue, working within a nationally or regionally defined research network, or responding to research agendas that are influenced by national policy. These influences should be reflected in citation behavior, e.g., more citations than expected by chance of papers by scientists from institutions within the same country. Thus, assessing adjusted levels of national self-citation may give insights into the extent to which national research agendas and scientific cultures influence the behavior of scientists. Here we develop a simple metric of scientific insularism based on rates of national self citation corrected for total scientific output. Based on recent publications (1996–2010), higher than average levels of insularism are associated with geographically large rapidly developing nations (Brazil, Russia, India, and China—the so-called BRIC nations), and countries with strongly ideological political regimes (Iran). Moreover, there is a significant negative correlation between insularism and the average number of citations at the national level. Based on these data we argue that insularism (higher than average levels of national self-citation) may reflect scientific cultures whose priorities and focus are less tightly linked to global scientific norms and agendas. We argue that reducing such insularity is an overlooked challenge that requires policy changes at multiple levels of science education and governance.

Keywords Citations · National ranking · Knowledge production · Self-citation

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Introduction

The references cited within an article reflect, to a lesser or greater degree, the geographic focus of the work. For example, a scientist writing a paper on the accumulation of toxins in a marine catfish sampled from an estuary close to São Paulo in Brazil would be expected to cite other articles written about the same species, estuary, region, ecosystem, etc. Such localized work frequently has a global significance, drawing upon universal conceptual frameworks or testing hypotheses or conjectures that support an emerging area of research. The global context of an article will also be reflected in the cited references, many of which will derive from institutions beyond the national borders of the country where the research was conducted.

Certain factors may lead to different countries varying in the geographic specificity of their research and, by extension, the relative frequency of national self-citation (references deriving from institutions within the same country as the lead author's institution). For example, research within small countries such as Belgium or Ireland might be expected to be more 'international' than in geographically vast nations such as China or India, where the geographic focus of the work is frequently contained within the boundaries of the state. Moreover, developing nations might be anticipated to have higher rates of national self-citation because of an increased emphasis on highly applied scientific issues that respond to the perceived needs of national development.

There are also several cultural factors that could influence the rate of national self-citation through their impact on the citing behavior of native scientists. First, scientists may have a tendency to cite papers that have summaries or translations in their native language, or to which they have access to in their institutions library/online collection. Second, the rigorous definition of research agendas by the State may also have an influence on citation practices through creating large national research networks with extremely narrow research agendas. There would inevitably be a strong tendency to produce articles that cited papers from within these networks. Finally, scientists may cite a paper produced by a national institution in place of a more appropriate 'international' reference due to poor referencing practices (cf. guide to good referencing in Harzing 2002). Such practices might be exacerbated by overly didactic or nationalistic teaching practices in universities.

If relatively high rates of national self-citation reflect a nationally focused research agenda that produces articles primarily for national consumption, it follows that the articles produced by such countries may have limited international impact. In other words, a combination of highly localized research questions, a politicized research agenda, and a cultural tendency to preferentially cite nationally produced articles might result in large quantities of low impact papers.

In summary, a degree of scientific insularism driven by multiple and overlapping social phenomena is inevitable in all countries. However, too much insularity could decrease the contribution of a nation's scientists to global scientific agendas, reducing the overall rate of global scientific progress. Moreover, as many of the articles produced by an insular scientific culture are likely to be of only peripheral interest to the global scientific community, they are predicted to be poorly cited.

In this short note we assess pattern and consequences of insularity in global science through: (1) the creation of a simple metric of insularity based on national self-citation statistics, and (2) an assessment of the relationship between this metric and average citation rates for the 100 most scientifically productive nations.

Insularity metric

Our metric is based on SCImago's recent analysis of scientific articles that is available on the Scopus bibliographic database (1996–2010). SCImago (2010) analysis provides rates of country self-citation (the citing of papers produced by scientists at other institutions within the same country). However, this figure will vary according to the overall proportion of articles produced by that country. For example, if a country is responsible for 15 % of the global output of scientific articles then, *ceteris paribus*, we would expect by chance that 15 % of the articles they cite will derive from institutions within their country.[1] Thus, our insularity metric (Ins) is adjusted for the size of a country's scientific output:

$\text{Ins} = \text{CF} - \text{NO}$, where CF is the percentage of national self-citations, NO is the percentage share of the national output in the total database.

The calculation of this metric reveals that the leading self-citers (Table 1) are a curious mix of authoritarian regimes (Iran), ex-soviet bloc states (Serbia, Ukraine, and Poland) and the emerging economic powerhouses of Brazil, Russia, India, and China (the so-called BRIC nations). In contrast, the lowest self-citers (Table 2) of countries with more than 10,000 citable documents over the period 1996–2010 tend to be smaller countries, often with a high proportion of postgraduate programmes taught in English (e.g., Israel, Denmark, Singapore, and United Arab Emirates).

As predicted, there is a highly significant negative relationship ($r = -0.390$, $n = 100$, $p < 0.001$) between adjusted rates of self-citation and the average numbers of citations per article at the country level for the 100 most scientifically productive nations (Fig. 1).

Tacking extreme insularity

As mentioned, high rates of national self-citation probably reflect the institutional and political culture of a country. Thus, countries with a high Ins have arguably developed a science base that focuses on geographically local and/or highly applied questions. This does not mean that the research is necessarily of low quality or irrelevant, although it may sometimes have little connection to global scientific agendas. This latter aspect was recently highlighted by a leading Brazilian scientist who characterized the thinking of some of his fellow academics in the journal *Science* as "*The anteater is yours so don't worry about the gringos*" (Regalado 2010).

Scientific insularity may have also been facilitated by the proliferation of national journals willing to publish low-grade descriptive science (in English or in combination with the national language) and, potentially, by the common practice of citing papers by national scientists that are simply repeating the findings, opinions, and conclusions of papers in high impact international journals. A curious instance of the glocalization (sensu Swyngedouw 2004) of scientific knowledge: the transformation of globalized knowledge to make it more accessible for consumption by the local academic community. Recent increases in national journals facilitated by online publishing may therefore be a factor driving high rates of country level self-citation. This explanation is also consistent with the lowest citing countries (Table 2) which tend to be small and often explicitly orientated towards international research and are therefore unlikely to produce a significant number of national journals.

[1] In reality, countries will vary in their relative contribution to global scientific output over time. However, if citations are of relatively recent references the assumption is relatively robust.

Table 1 The 10 leading countries for national self-citation

Country	% Documents	% Self-citation	Adjusted rate (% self-citation − % documents)
China	8.61	51.03	44.41
Iran	0.54	41.20	40.66
Serbia	0.07	32.10	32.03
India	2.37	34.40	32.03
Brazil	1.49	32.50	31.01
Pakistan	0.17	30.52	30.35
Ukraine	0.41	28.80	28.39
Russian Federation	2.24	30.30	28.06
Turkey	1.03	28.15	27.12
Poland	1.22	27.19	25.98

% Documents = the proportion of citable scientific articles in relation to all those published between 1996 and 2010. % Self-citation = the proportion of citations of nationally produced scientific articles between 1996 and 2010

Table 2 The 10 lowest countries for national self-citation for countries that published more than 10,000 citable articles between 1996–2010

Country	% Documents	% Self-citation	Adjusted rate (% self-citation − % documents)
Indonesia	0.06	10.97	10.92
United Arab Emirates	0.06	12.14	12.09
Ireland	0.35	12.48	12.13
Switzerland	1.37	14.26	12.89
Austria	0.73	14.65	13.93
Saudi Arabia	0.16	14.19	14.03
Vietnam	0.05	14.24	14.19
Singapore	0.50	14.80	14.31
Israel	0.84	15.18	14.34
Denmark	0.73	15.15	14.43

% Documents = the proportion of citable scientific articles in relation to all those published between 1996 and 2010. % Self-citation = the proportion of citations of nationally produced scientific articles between 1996 and 2010

Restricted citing behavior may also be a product of insufficient training of post-graduate students and post-doctoral researchers, who may lack the skills required to appropriately frame their research in a global or conceptual context for high impact international journals. Such an interpretation is supported by a recent study demonstrated that younger scientists in Brazil have a very strong tendency to publish in national journals (Leite et al. 2011). More generally, it is possible that a culture of insularity is indirectly promoted at the government level, especially through the application of assessment systems that use out of date criteria for evaluating its researchers which fails to sufficiently distinguish between different levels of scientific output (e.g., high *vs*. low impact), or which do not adequately reward scientists who are able to publish in leading international journals. More extremely,

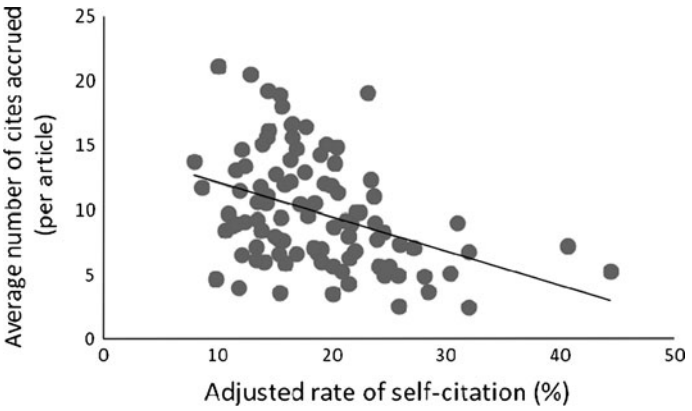

Fig. 1 Relationship between the rate of national self-citation adjusted for overall rate of scientific production and the average number of citations per article for scientific papers published between 1996 and 2010

a culture of insularity may also encourage an exodus of leading scientists to foreign institutions that better value their contribution and are able to provide the financial and intellectual support needed to address fundamental questions.

There are at least four ways in which excessive insularity in science can be countered: (1) Greater investment in capacity-raising in high level science communication. Many of the barriers to high level research production, such as the lack of skills in framing research questions of global significance, improved referencing and better English writing, could be rectified through workshops, mentoring schemes, etc. (2) Raising awareness within the countries where excessive insularity is an issue. (3) Reviewers for all journals need to encourage authors to use the best and most appropriate references (Harzing 2002; Todd et al. 2007) and avoid excessive self-citation (at author, institution, and country level). (4) Governments need to adjust their incentives and assessment systems to ensure that those scientists with the potential and ambition to compete globally are given the support they require.

Finally, it should be noted that the crude metric developed in this manuscript is an exceedingly blunt tool for monitoring and assessing such a complex social phenomenon as insularity in global science. More refined metrics that, for example, take into account the proportion of national journals or which are subject specific are required for an in depth analysis of this fascinating and potentially damaging social phenomenon.

References

Harzing, A.-W. (2002). Are our referencing errors undermining our scholarship and credibility? The case of expatriate failure rates. *Journal of Organizational Behavior, 23*(1), 127–148. doi:10.1002/job.125.

Leite, P., Mugnaini, R., & Leta, J. (2011). A new indicator for international visibility: exploring Brazilian scientific community. *Scientometrics, 88*(1), 311–319.

Regalado, A. (2010). Brazilian science: riding a gusher. *Science, 330*(6009), 1306–1312.

SCImago (2010) SCImago Journal & Country Rank. Resource document. Available: http://www.scimagojr.com. Assessed on 10 August 2011.

Swyngedouw, E. (2004). Globalisation or 'Glocalisation'? Networks, territories and rescaling. *Cambridge Review of International Affairs, 17*(1), 25–48.

Todd, P. A., Yeo, D. C. J., Li, D. Q., & Ladle, R. J. (2007). Citing practices in ecology: can we believe our own words? *Oikos, 116*(9), 1599–1601. doi:10.1111/j.2007.0030-1299.15992.x.