

## Mimicry in science?

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**Abstract** Since bibliometric indicators have obtained a general acceptance in science policy and attained applied relevance in research evaluation, feedback effects on scientists' behaviour resulting from the use of these indicators for science funding decisions have been reported. These adaptation strategies could be called mimicry in science. Scientists apply strategies that should enable them to comply to bibliometric accountability and to secure funds to their own research.

**Keywords** Research evaluation · Mimicry · Scientific progress

Bibliometric data are being used by leading and fast-growing countries in science for research evaluation purposes. In UK the allocation of public funds to the universities will be mainly carried out according to these data. “The Government has a firm presumption that after the 2008 RAE [Research Assessment Exercise] the system for assessing research quality and allocating ‘quality-related’ (QR) research funding to universities from the Department for Education and Skills will be mainly metrics-based” (UK Office of Science and Technology 2006). Due to this development “the death of peer review” in the allocation of research funds is being discussed (Gilbert 2006). The reason for the popularity of bibliometrics compared to peer review is seen in lower costs and criticism of the peer review system (Weingart 2005). In an ever more complex science system, bibliometric analysis should allow for evaluation of mass-data no longer understandable to the single reviewer (Butler 2004).

### Back coupling on scientists' behaviour

Since bibliometric indicators have obtained a general acceptance in science policy and attained applied relevance in research evaluation, feedback effects on scientists' behaviour

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resulting from the use of these indicators for science funding decisions have been reported (Evidence Ltd. 2007; Lawrence 2003). Similar to certain animals trying to escape their predators or seeking out prey (e.g. through assimilating their appearance to the environment), scientists apply strategies that should enable them to comply to bibliometric accountability (Rodríguez-Ruiz 2009) and to secure funds to their own research. In biology such adaptation strategies, that lead to an illusion triggered by a simulated but meaningful sign, are called mimicry (Patent 1978). Since science funding has become more and more determined by principles of ‘publish or perish,’ the following changes of publication behaviour have been reported in the literature (see here Lawrence 2003; Research Evaluation and Policy Project 2005): (1) To increase probability of acceptance of their papers by a journal, scientists tend to do research in accordance with the mainstream in their fields and avoid unusual research (e.g. risky, interdisciplinary or long-term); (2) To be able to come to publishable results more quickly, scientists pursue short-term rather than long-term research; (3) Scientists attempt to provide their paper to low-quality journals as long as these journals are indexed by literature data bases used for bibliometric analyses in research evaluation; (4) To boost the number of publications, scientists slice their findings as thin as salami and submit these to different journals even though findings could be presented in a single paper.

The study by Fraser and Martin (2009) was able to detect an increased use of biased words (e.g. pivotal, crucial, and essential) in scientific papers. This finding is to be construed as scientists trying to raise their chances of publication by using this ‘biased’ word choice. In extreme cases mimicry in science could lead to a state of anomie as described by Merton (1938). Merton (1938) studied deviant behaviour in society, “how some social structures *exert a definite pressure* upon certain persons in the society to engage in non-conformist rather than conformist conduct” (p. 672). If “winning the game” dominates over “winning through circumscribed modes of activity,” a violation of commonly held rules (norms) can occur (Martinson et al. 2006). If scientists are geared to indicator-based goals but their behaviour is not linked to acceptable modes of achieving these goals (rules of good scientific practice), the threat of scientific misconduct is present. Many times the pressure to publish has been seen to indicate as causing scientific misconduct. Chinese universities award “cash prizes, housing benefits or other perks on the basis of high-profile publications” (Qiu 2010) and at the same time are increasingly confronted with dubious science-publishing activities.

### **Increase in productivity as an effect of national research evaluation systems**

In the past few years ex post evaluation systems for allocating research funds have been implemented by other countries besides the UK (e.g. Australia and Finland) (see an overview in Macilwain 2010; Schneider 2009). Some studies have investigated which effects these systems had on scientists’ behaviour. In Australia (Butler 2003, 2004) a substantial increase in scientists’ annual publication output was observed after introducing ‘formula based funding’ (i.e. linkage between the number of publications and the allocation of funds). Though more were published in journals indexed in the Web of Science (WoS, Thomson Reuters, Philadelphia, PA, USA), but mostly in journals with a low journal impact factor (JIF). The JIF is the average number of times papers from the journal published in 2 years (e.g. 2005 and 2006) have been cited in the following year (e.g. 2007) (see Bornmann et al. 2007). Five interviewees of Gläser and Laudel (2007) reported that “they changed their publication strategy by publishing more, publishing alone, and

publishing in higher reputed (international) journals” (p. 142). Furthermore, interviewees advanced their research lines towards more applied and ‘hot’ topics. In Spain, scientists are offered a reward in terms of a pay raise by the National Commission for the Evaluation of Research Activity (CNEAI, Madrid) whenever they publish in a renowned journal (journals with a high JIF). Results of a study on the effect of this science policy measures show: “The consequences of this law have been first, a change in Spanish scientists’ publication habits; second, an increase in the number of Spanish source items in the ISI databases [the databases of Thomson Reuters]; and third, a levelling off of source items in Spanish bibliographic databases” (Jimenez-Contreras et al. 2002). Similar effects were observed in another study (Rey et al. 1998). For the UK RAE Moed (2008) found “three distinct bibliometric patterns, that can be interpreted in terms of scientists’ responses to the principal evaluation criteria applied in a RAE. When in the RAE 1992 total publications counts were requested, UK scientists substantially increased their article production. When a shift in evaluation criteria in the RAE 1996 was announced from ‘quantity’ to ‘quality,’ UK authors gradually increased their number of papers in journals with a relatively high citation impact. And during 1997–2000, institutions raised their number of active research staff by stimulating their staff members to collaborate more intensively, or at least to co-author more intensively, although their joint paper productivity did not” (p. 153).

### **Possibilities of increasing citation impact**

In contrast to publication numbers, citation counts are seen to be less susceptible to strategies by scientists. The study conducted by Bornmann and Daniel (2007) however shows the opposite. They examined to what extent the application of a publication strategy, including the duplication of findings of a research project (redundant publication) or splitting them up (salami slicing), respectively, and publishing them as a larger number of publications, leads to an increase of citations. Approximately 100 applicants for a research fellowship of the Boehringer Ingelheim Fonds (Heidesheim, Germany) notified Bornmann and Daniel (2007) about the papers they had published within the scope of the research project they had applied for funding. The research projects were comparable in that they all served to fulfil the requirements for a doctoral degree, addressed a topic in biomedical basic research, and were completed successfully. To exclude higher citation counts as a result of a higher quality of the research project, the project quality was controlled by ratings of reviewers in the statistical analysis. The citation analysis of the papers showed a substantial influence of the number of papers published out of one project on the sum of the citation counts: The more papers were published the more frequently the research results were cited in sum—independently of the quality of the research project (measured by reviewers’ ratings). A strategy aiming for an increase in the number of papers can therefore lead to an advantage regarding the citation impact of publications. One explanation for that phenomenon might be that few scientists read or see all the papers in their fields, so if authors write many (redundant) papers, the chances of some of them being seen (and later cited) increases.

### **Do behavioural changes contribute to scientific advancements in science?**

“Governments around the world have been demanding greater productivity from their scientists as the price for continued support” (Mervis 2007). By introducing the research

evaluation systems expectations concerning the scientists' productivity and improvement of the quality of the research are raised. Also, behavioural changes of scientists through this system are indeed anticipated and intended (Schneider 2009). Productivity usually is measured by the number of papers in peer-reviewed journals; impact and importance of research (as one aspect of quality) with these papers' citations (National Science Board 2010). Several studies described above have shown that such (desired) adaptation processes were actually observable within scientists. Whenever this is interpreted as mimicry in science (and this is often the case) it is misconceived as manipulation by the scientists without expecting a positive effect on the scientific progress. When—according to Evidence Ltd. (2007)—an indicator is relevant to funding decisions “it starts to lose the information content that originally qualified it to play such a role. There is room for manipulation, there may be emergent behavioural effects and the metrics only capture part of the research process and its benefits” (p. 35).

The adaptation behaviours can also be interpreted as having a positive effect on scientific progress. On the one hand scientists publishing in low-impact journals indexed by Thomson Reuters in WoS can be assessed as something negative. On the other hand only those journals that have a certain quality standard are indexed (Testa 2010). Low-impact journals generally have a lower quality standard than high-impact journals; their standard, though, is usually higher than the not indexed ones. On the one hand it can be seen as being questionable that scientists orientate their research towards the mainstream, on the other hand the mainstream will align with the most important research questions in a field. Is the pursuit of short-term impact really tied to reducing of the science progress in the long run (Laloë and Mosseri 2009)? In times of big science (de Solla Price 1965), isn't short-term impact the rule? To be able to answer these and similar questions concerning mimicry in science satisfyingly, the results of in-depth analysis on the relationship between an evaluation-based research system, adaptation of the publication and citation behaviour and scientific knowledge production are needed.

## References

- Bornmann, L., & Daniel, H.-D. (2007). Multiple publication on a single research study: Does it pay? The influence of number of research articles on total citation counts in biomedicine. *Journal of the American Society for Information Science and Technology*, 58(8), 1100–1107.
- Bornmann, L., Leydesdorff, L., & Marx, W. (2007). Citation environment of *Angewandte Chemie*. *CHIMIA*, 61(3), 104–109.
- Butler, L. (2003). Modifying publication practices in response to funding formulas. *Research Evaluation*, 12(1), 39–46.
- Butler, L. (2004). What happens when funding is linked to publication counts? In H. F. Moed, W. Glänzel, & U. Schmoch (Eds.), *Handbook of quantitative science and technology research. The use of publication and patent statistics in studies of S&T systems* (pp. 389–405). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- de Solla Price, D. J. (1965). *Little science, big science*. New York, NY, USA: Columbia University Press.
- Evidence Ltd. (2007). *The use of bibliometrics to measure research quality in UK higher education institutions*. London, UK: Universities UK.
- Fraser, V. J., & Martin, J. G. (2009). Marketing data: Has the rise of impact factor led to the fall of objective language in the scientific article? *Respiratory Research*, 10, 35.
- Gilbert, N. (2006). *The death of peer review*. Retrieved March 8, 2010, from <http://www.guardian.co.uk/education/2006/dec/12/researchassessmentexercise.research>.
- Gläser, J., & Laudel, G. (2007). Evaluation without evaluators. The impact of funding formulae on Australian university research. In R. Whitley & J. Gläser (Eds.), *The changing governance of the sciences* (pp. 127–151). Dordrecht, The Netherlands: Springer.

- Jimenez-Contreras, E., Delgado Lopez-Cozar, E., Ruiz-Perez, R., & Fernandez, V. M. (2002). Impact-factor rewards affect Spanish research. *Nature*, *417*(6892), 898.
- Laloë, F., & Mosseri, R. (2009). Bibliometric evaluation of individual researchers: Not even right... not even wrong!. *Europhysics News*, *40*(5), 26–29.
- Lawrence, P. A. (2003). The politics of publication. Authors, reviewers and editors must act to protect the quality of research. *Nature*, *422*(6929), 259–261.
- Macilwain, C. (2010). Wild goose chase. *Nature*, *463*(7279), 291.
- Martinson, B. C., Anderson, M. S., Crain, A. L., & de Vries, R. (2006). Scientists' perceptions of organizational justice and self-reported misbehaviors. *Journal of Empirical Research on Human Research Ethics*, *1*(1), 51–66.
- Merton, R. K. (1938). Social structure and anomie. *American Sociological Review*, *3*(5), 672–682.
- Mervis, J. (2007). U.S. output flattens, and NSF wonders why. *Science*, *317*(5838), 582.
- Moed, H. (2008). UK research assessment exercises: Informed judgments on research quality or quantity? *Scientometrics*, *74*(1), 153–161.
- National Science Board. (2010). *Science and engineering indicators 2010*, Arlington, VA, USA, National Science Foundation (NSB 10-01).
- Patent, D. H. (1978). *Animal and plant mimicry*. New York, NY, USA: Holiday House.
- Qiu, J. (2010). Publish or perish in China. The pressure to rack up publications in high-impact journals could encourage misconduct, some say. *Nature*, *463*, 142–143.
- Research Evaluation and Policy Project. (2005). *Quantitative indicators for research assessment—a literature review (REPP discussion paper 05/1)*. Canberra, Australia: Research Evaluation and Policy Project, Research School of Social Sciences, The Australian National University.
- Rey, J., Martin, M. J., Plaza, L., Ibanez, J. J., & Mendez, I. (1998). Changes on publishing behavior in response to research policy guidelines. The case of the Spanish Research Council in the field of agronomy. *Scientometrics*, *41*(1–2), 101–111.
- Rodríguez-Ruiz, Ó. (2009). The citation indexes and the quantification of knowledge. *Journal of Educational Administration*, *47*(2), 250–266.
- Schneider, J. W. (2009). An outline of the bibliometric indicator used for performance-based funding of research institutions in Norway. *European Political Science*, *8*(3), 364–378.
- Testa, J. (2010). *The Thomson Reuters journal selection process*. Retrieved February 19, 2010, from <http://isiwebofknowledge.com/benefits/essays/journalselection/>.
- UK Office of Science and Technology. (2006). *Science and innovation investment framework 2004–2014: Next steps*. London: UK Office of Science and Technology.
- Weingart, P. (2005). Impact of bibliometrics upon the science system: Inadvertent consequences? *Scientometrics*, *62*(1), 117–131.