Peer Review – Thriving or Ailing in the Twenty-First Century?

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The use of independent peer reviewers, to obtain advice from experts knowledgeable in a particular research area, is an intrinsic and essential part of the allocation of funds and the publication of results. For around 150 years, the vast majority of researchers have put their faith, and the future of their careers, in an anonymous peer review process which is a fundamental underpinning of high quality world science and, ultimately, of evidence-based medicine. But is peer review in good health or fit-for-purpose in the twenty-first century?

Of course like any process or convention, scientists often question the process of peer review, usually when they have just received a rejection of their latest grant proposal or carefully crafted paper! But an observer of British and American science in the last five years might be forgiven for thinking that, in the internet age, peer review as we know it has reached a difficult period of ill-health, even perhaps its declining years.

To use another metaphor, peer review appears increasingly under attack a dated, blunt and unsophisticated tool in the service to the scientific community. This short article aims to summarise where we are now, after about a year of quite intensive scrutiny of scientific peer review to try to diagnose its problems and offer a prognosis for its future.

Peer Review of Research Publications

Most scientists' and medics' first contact with peer review is through reading the research papers selected for publication in journals. It is this use of anonymous peer review which first came under serious challenge about five years ago, as the major journals started to feel the changes brought about by the rise of open-access internet publishing. In 2002, Richard Smith (no relation to the author), then editor of the British Medical Journal, wrote openly that peer review was "slow, expensive, profligate of academic time, highly subjective, prone to bias, easily abused, poor at detecting gross defects, and almost useless for detecting fraud." [1,2]

Richard Smith anticipated that the basic premise of peer review would remain, but that the internet would enable it to become much faster. He also predicted that peer review could become less of an anonymous "black box" process, and that a system of open online comments would be used. In 1999 the BMJ had begun to open its process of peer review, offering "signed" reviews and found that quality of judgement was not affected though some comments became more restrained. Richard Smith argued that there was huge scope for "re-engineering" the peer review process to make it perform better and more efficiently, even in areas such as detecting fraud or subjective bias. Indeed it seems that authors of papers have been keenest to see change, to bring about a more rapid and transparently fair system in an era of intense pressure and competition to publish. Editors and reviewers have been slower to institute change. The BMJ continued to experiment, focussing on ideas like training a body of peer reviewers instead of relying on a "learn by doing" culture. Other journals such as *Cardiovascular Research* made more radical changes or continuous improvement.

Between June and December 2006, came what was probably the most widely publicised peer review experiment, prompted in part by a perceived breakdown in trust between author, journal and the public evidenced by the papers in *Science* on human embryonic stem cells by Woo Suk Hwang and his colleagues. *Nature*, the world's most highly cited multidisciplinary science journal, undertook a trial of a particular type of open peer review. The editors reassured readers that peer review served the journal and community well for decades but it was time to consider a radical re-think. In this trial, authors whose submissions to *Nature* were sent for peer review were also offered the option to participate in an open peer review process in which their manuscripts were posted on the internet and comments were invited. Any scientist could post comments, provided they identified themselves. Once the usual confidential *Nature* peer review process was complete, the public 'open peer review' process was closed. Editors then read all comments on the manuscript and invited authors to respond. At the end of the process, as part of the trial, editors assessed the value of the public comments. Opting to take part did not affect the likelihood of eventual publication of the submitted work, and *Nature* ran a web debate on peer review at the same time, in which all readers could comment. In reporting on the results of the trial in December 2006 (Editorial in *Nature 444*) [3], *Nature* commented that despite general enthusiasm for the concept, open peer review was not widely popular, either among authors (only 5% opted to take part) or by scientists invited to comment. There did not seem to be any evidence that open peer review would be any more likely to detect serious fraud.

There are fundamental concerns about the feasibility of open reviews relating to how the information would be handled before actual publication. For instance, if each journal posted every submission it received, the internet would be flooded with new data, some of which the media would report, and perceptions of fraudulent science might actually increase. Also, if a journal ultimately rejected a paper, who else would accept it, if the information was already made public? How would the journals make money, which remains a basic question surrounding all forms of open-access publishing? The experiment was an interesting one, and there remain arguments for both closed and open reviews. In reporting its experiment, *Nature*'s editors noted that another form of peer review emerges *after* publication, when work is replicated — or not. To put that kind of discussion into the open, rather than confining it to conference gossip, *Nature* will offer a forum where users are able to comment on individual papers, with minimal editorial intervention. So, in journal peer review, we await the results of this "re-engineering" idea with interest.

Peer Review of Research Funding

The other major use of peer review in science is in the allocation of research funding. There is a clear contrast to draw with journal review, on the apparent health of peer review. In funding science, peer review is a mechanism in which all parties seem to place their trust, but also know it can always be improved.

Research Councils UK began a project in February 2006 to analyse the costs of the peer review process operated by the eight Research Councils funding British science, and to look for any potential for improving its efficiency whilst maintaining effectiveness. The study took as a starting premise the continued commitment of UK government to the principles of a project-based peer review system, and argued it to be a key feature of successful British science. A number of earlier studies such as the Advisory Board for the Research Councils' report of 1990, known as the *Boden* report [4], and a Royal Society report of 1995[5] concluded that peer review remained the most effective mechanism for taking funding decisions. However, good quality comes at a price. Both reports acknowledged the burden placed on peer review communities when success rates were low, and the huge hidden costs of running the process. There has always also been an undercurrent of disquiet about the peer review allocation of resources being rather "safe" and conservative, not wishing to take risks with tax-payers' or donors' money on ambitious projects when that money is tight.

To quantify this, the total cost to the UK of preparing and reviewing proposals and reports for Research Council funding was estimated, given current volumes, at £196 million per annum. Of this, the time of investigators, reviewers, and administrative staff in universities forms by far the largest part. Crucially, that time is contributed free of charge, but is effectively a huge time-cost to their employers, the universities. The costs incurred *directly* by the Research Councils themselves amounted to some £9.8 million.[6]

Of the 33,608 research grant and studentship proposals and reports peer reviewed by the Research Councils in the sample year, nearly 50% were full research proposals created through many hundreds of hours of work by teams of hopeful scientists. The costs of producing and processing these full proposals represented 84% of the £196 million. In the opinion of the majority of the researchers surveyed by RCUK, the UK compares favourably with other major countries on the overall efficiency of research funding but success rates are watched very carefully. The annual number of proposals to Research Councils has doubled since 1988/89, and increased by 20% in the last nine years. Average Research Council success rates fell from around 41 % in 1988/89 to around 28% in 2005/06, though indications are that they have become more efficient at handling the increased volume.[6]

The RCUK project's authors took the view that a success rate above 20% and below 50% represents an acceptable balance between the benefits of competition and the cost/effort to support the system. Many scientists would of course wish success rates to be higher than 50%, though it could be argued that success rates of over 80% can also lead to a serious loss of confidence in a peer review system as poor quality research could be funded. The overall Research Council success rate of 28% is within the acceptable range. However, in some research areas success rates are under greater strain (around, or below, 20% in some fields). Furthermore, if trends continue, the average success rate across all Councils could fall below 25% by 2012/13.[6]

The RCUK project report concludes that action should now be considered to avoid further deterioration in success rates and efficiency of the peer review system. In other words it proposes that a "re-engineering" of peer review for resource allocation could be tried. Three of the modeled options which are suggested would provide modest savings and would have limited impact on the way researchers and universities work. These are: i) increasing Research Council sifting/triage rates ii) tailoring peer review so that it better reflects project risk and complexity; and iii) introducing a new or modified final report process.

At the moment the Research Councils are considering these minor options. A fourth minor option, the use of specific disincentives for the small number of individuals who place a disproportionate burden on the system with large number of unsuccessful proposals, was also suggested for consideration but the Research Councils have tried this in the past and failed to make much impact with it.

The four options that offer greatest potential for savings are more complex to introduce and inherently contain greater potential risk to the overall effectiveness of the research system. These four major options are currently hanging like a threat over UK universities. They are:

- **Consolidation** - to increase the proportion of Research Council funding allocated to larger and/or longer grants;
- **Institutional-level Quotas** - to introduce quotas either for all institutions or for those with particularly poor success rates;
- **Controlling resubmissions** – to introduce processes that limit the recycling of proposals within the system; and
- **Outlines** - to deploy an outline-bid stage for responsive-mode grant schemes.

Keele was one of many universities consulted on these options and we have yet to see whether any radical changes will result. Keele has already introduced internal peer-review procedures [7] to ensure that only the best quality applications are submitted and it has no blame for clogging up the system with unfundable projects. But certainly the consolidation and quota options could have serious negative implications for smaller provincial universities such as Keele, with its expanding research base linked to the undergraduate Medical School, as such quotas are likely to concentrate funds in the larger institutions, and be based on relatively static, historical metrics of research activity, not recent growth or future potential.

The peer review processes employed by the UK Research Councils are also being "re-engineered" in other ways, to be sensitive to the different needs and cultures that exist within the academic community and also reflect the variety of mechanisms employed to support different types of research e.g. basic, strategic or applied research. The Councils are keen to simplify and standardise the processes involved in applying for research funding, but have also innovated and kept a separate identity. For example some have mirrored the idea of training a group of peer reviewers as being most efficient and focussed on the needs of the organisation, by setting up Peer Review Colleges of members selected by their communities. The Engineering & Physical Sciences Research Council has enhanced its peer review system significantly by maintaining anonymity of the reviewers but allowing grant applicants to see and comment fully on their submitted reports before the application is considered at a panel meeting.

One area that the Research Councils have not much considered up to now is the inherent problem that peer review systems tend to be conservative in assessing the quality of innovative research proposals; they stick with what they know and take few risks. A recent report[8] - reveals much discussion about how to ensure that pioneering research is not jeopardised by such conservatism. The report is of the proceedings of a conference organised by the European Science Foundation, the European Heads of Research Councils, and the Czech Science Foundation, held in October 2006. The conference brought together some 150 delegates from across Europe, the USA and Asia, including publishers as well as funding bodies and research institutions to take a clear look at all aspects of peer review and how it can be kept in good health in an age when many of the methods it uses are changing. The conclusion seems to have been that there is a need for "a strategic evaluation at a more conceptual level, not of a specific mechanism, but of the underlying principles and ideas", though it is unclear who might do this.

Conclusion

Peer review has never been as closely scrutinised as it has been in the last five years, yet it seems that in its two major uses in science, publicaiton and funding allocation, it is not facing an immediate demise. However, given the more radical options proposed by certain Journals or the RCUK Report, peer review needs to continue to deliver a trustworthy, efficient decision making process and it is in all our interests to continue to make it work. Indeed it could be argued that in provincial or smaller universities without the privileges of London or Oxbridge, trust in peer review with all its imperfections and re-engineered changes represents the best method for the fair allocation of resources and publication of our results.

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