Social influence and peer review

Why traditional peer review is no longer adapted, and how it should evolve

Daniel Fisher & Nikolaos Parisis

There is a nearly unanimous perception among molecular and cell biologists that publishing has become the most discouraging and frustrating part of research. The trepidation level peaks at each stage of the process: the editorial stage where rejection without review has become the norm; the review stage where reviewers frequently do not fully understand the work or its implications; and the revision stage, when authors shoulder the disproportionate effort to revise the paper per reviewers' demands. The problems with peer review are not limited to publishing though, and also affect funding or hiring decisions in academia each time a group of experts tries to predict the impact of a grant proposal or job applicant.

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A widespread assumption is that the current publication system mainly benefits scientists at the top who publish frequently in high-impact factor journals; yet many of these scientists are also dissatisfied with the current state of affairs. Ron Vale, winner of the 2012 Albert Lasker Prize in basic medical research, analysed the evolution of the amount of data needed and the time it takes to get a paper published in biomedical journals. He found that both have increased significantly during the past decades, to a point that it is harming the career prospects of young researchers and holding back scientific discovery [1]. Richard Smith,

former Editor-in-Chief of the *British Medical Journal*, blames the peer review system, describing it as “slow, expensive, profligate of academic time, highly subjective, something of a lottery, prone to bias, and easily abused” [2]. He proposed to abolish pre-publication peer review altogether, arguing that it is no longer necessary because the power of the Internet now allows instant publication of all results without requiring assessments of their novelty or impact on the field. Notably, however, the BMJ has not abolished peer review.

Indeed, the majority of publishers are unlikely to do away with peer review, because—despite the lack of empirical evidence that peer review is good at judging the quality of papers or research proposals—it has become synonymous with “quality”. The Management theorist Stuart MacDonald argues that this label is no longer associated with any process that makes science an objective truth teller, but instead is a valuable myth that underpins the foundations of the industries that depend on it [3]. These include not only the publishing and pharmaceutical industries, but also the higher education industry, which relies on peer review at multiple levels. Nonetheless, it is at the publication level where peer review has the largest impact because a paper in a high-profile—read high-impact factor—journal can make or break careers by impressing review committees for funding or hiring decisions further down the line.

The academic peer review system has various well-documented weaknesses. For example, it has no standard safeguards against abuse (journal policies vary widely on whether and how they “enforce” good reviewing); some reviewers simply do not conform to

accepted guidelines, the most fundamental of which is “treat all manuscripts in the same manner that you would want your own treated” [4]; and reviewer accountability is insufficient, despite authors' right to reply. Another issue is that, however well written the paper, a reviewer or editor cannot possibly understand it as well as its authors. It is simply impossible to convey all the information that a reviewer would need to understand and appreciate several years of work in a few thousand words. Instead, editors and reviewers are presented with a seamless progression from hypothesis to results that often bears no relation to the order of experiments or the reasons they were done in the first place. Direct dialogue between reviewers and authors would improve understanding and might reduce this problem, but might introduce another problem, as we shall see.

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More important still, even the best-intentioned reviewer is unable to reliably predict the future impact of a scientific paper—which is the main currency of most scientific journals—without a crystal ball. As Nils Bohr put it, prediction is very difficult, especially if it is about the future. The scientists who tried to analyse flavonoid biosynthesis in petunia—and the reviewers of their paper—could not foresee that their work would lead to the discovery of RNA

interference; nor could the microbiologists who studied bacterial innate immunity against phage infection predict that the CRISPR/Cas system would revolutionise molecular biology. The sociologist Duncan J Watts has documented how such unpredictability results from highly complex and interconnected systems in which small triggers can cascade into ever larger effects [5]. This finding echoes studies of peer review in academic publishing, which have shown that reviewers rarely agree more than would be expected by chance [6]. By way of example, the major discoveries made by Albert Einstein or Francis Crick and James Watson were not subjected to 21st-century standards of peer review. History is the ultimate arbiter in science, and has no need for pre-publication peer review.

Social influence, bias and herding are also important factors in the peer review process that further compound the problem of unpredictability in complex networks [7]. In an experimental study of unconscious bias, using an Internet-based protocol of quality ratings, Watts and colleagues

showed that increasing the strength of social influence strongly increased both the inequalities and the unpredictability of the ratings [8]. The implications for scientific peer review are clear: increasing the social influence at work on reviewers by revealing the identity and affiliations of the authors will inevitably distort reviewers' perceptions. Empirical analysis of peer review largely supports this view. There is a further potential shortcoming of peer review when reviewers confer with each other before submitting their reviews: powerful social influence between the reviewers may increase both the likelihood of unconscious bias and the unpredictability of the outcome. Most funding decisions are nowadays based on group peer review, which might explain scientists' perception that the outcomes are largely arbitrary.

Fortunately, at least some publishers have realised that there is something rotten in the state of peer review and have been experimenting with changes and alternative models so as to improve quality

and accuracy. Journals such as *PloS ONE*, *Scientific Reports*, *PeerJ* and *Biology Open* only review the accuracy and technical quality of the experiments and the conclusions drawn, but not novelty or potential impact on the field. This greatly reduces the influence of reviewers' opinions about the importance of a paper, which, as discussed above, are subjected to social influences and personal bias and not much better than second guessing anyway.

Other publishers have taken steps to make the whole review process more transparent. The EMBO Press journals [Editor's note: *EMBO reports* is published by EMBO Press] publish full-text reviews, editorial decision letters and author responses together with the accepted article. *eLife* has adopted a similar approach by publishing the editorial decision letter and author response. This, together with referee cross-commenting *after* the referees have submitted their reports, as practiced by EMBO Press and *eLife*, encourages reviews to be more objective and measured and deters abuse, though it does not alleviate the

influence of social factors as discussed above. Nevertheless, the most damaging reviews, the ones that result in unfair rejection of the paper, still remain invisible.

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Other journals have gone further: the editorial process in the Frontiers series of journals involves an open dialogue between reviewers, who are identified, and authors. Biology Direct goes even further: not only are authors and reviewers known to each other, but authors themselves select reviewers from the editorial board. This increased transparency and communication between authors and reviewers should drastically reduce unfair reviews or reviewers' undeclared conflicts of interests and thereby authors' perception of unfairness. However, rather than decreasing social influence, this practice actually increases it, and whether this will improve the peer review process itself is therefore another question.

One alternative to reduce social influence is double-blind peer review, where neither authors nor reviewers know each other. This is now becoming the norm in many fields, but is virtually unknown in the physical and biological sciences. An increasing number of journals, including EMBO Press and the *Nature* journals, now offer authors the option of anonymity. It is debatable whether this will lead to genuine improvement in the quality or fairness of reviews, or merely improve perceptions of fairness, since it is not mandatory. Well-known authors who trade on their reputation will be inclined to opt out of anonymity to retain their social influence, which contributes to their competitive advantage. A recent, more radical proposition is an “inverted” form of single-blind peer review: authors remain anonymous to both reviewers and editors, but know the identity of reviewers [9]. This direction of the social influence would be less likely to distort the review process. Moreover, the authors argue that as well as improving reviewer accountability, it would also benefit reviewers by making their

voluntary, often important contributions to the publications of others publicly visible.

Yet, all these ideas, changes and proposals, as helpful as they might be, are still merely tinkering with the system. A more radically alternative publishing model is not to submit to a journal directly but to publish on pre-publication servers, such as bioRxiv, and let the community do the reviewing. Community reviewing already exists: despite teething problems, commenting on already-published papers via platforms such as F1000, PubPeer, ResearchGate and PubMed Commons is rapidly increasing in terms of volume and impact. Ron Vale argues that this potential could be harnessed to speed up the communication of results and, ultimately, advance knowledge. In essence, this echoes Richard Smith's idea to post everything on the Internet and let the community judge its value—but Vale acknowledges a major obstacle: unlike in physics or mathematics, where pre-publication on arXiv is the norm, pre-publication is not recognised as a declaration of discovery in the biomedical sciences. Thus, “cheaters” may gain disproportionately by using the publicly available results of others to publish in peer-reviewed journals. To alleviate this risk for authors, bioRxiv and similar databases could be indexed on search engines such as PubMed or Google Scholar, which would allow editors and reviewers to find their results more easily. The problem of “cheaters” could also be addressed if scientists published formatted papers on pre-print servers alongside their submission to a traditional journal. This should dissuade others from copying the work because they would be likely to get scooped themselves by the peer-reviewed publication of the original discoverers.

Another potential problem is that if publication on pre-print servers were to be accepted as discovery, it might fuel paranoia about being scooped to the extent that hurriedly acquired and unreliable data would be dumped onto servers to stake a claim to discovery. Yet, one could argue that this is not much different to the current situation anyway, where “publish or perish” encourages hasty publishing and where many studies published in high-impact journals turn out to be irreproducible [10]. Perhaps knowing that results can be published without delay once they are solid and verified might encourage scientists to take their time and invest in longer-term

projects. In fact, many publishers now offer “scooping protection” and no longer reject an article under review on grounds of insufficient novelty if similar results are published elsewhere. More importantly, research evaluation bodies, grant funders and hiring/promotion committees should stop using unreliable proxies of journal impact factor and citations to evaluate productivity, and should instead look at the results, which would be immediately available.

Some observers have even suggested that modern communication methods have signalled the death knell of traditional peer-reviewed journals in much the same way that public telephone booths and video rental stores have disappeared. However, this is not very likely. As mentioned above, the science-based industries rely on peer review and bibliometrics, which is currently based on publication in peer-reviewed journals. Moreover, busy scientists still appreciate a reliable source of new, interesting and relevant results in their field, which is what journals generally deliver. For better or for worse, science will have to live with traditional peer-reviewed journals. These are, in any case, already evolving and adapting to the new opportunities of online communication. Pre-publication and post-publication peer review will evolve and eventually converge. A more plausible scenario than the disappearance of traditional peer-reviewed academic journals is their co-existence with pre-print servers together with post-publication review by the academic community. The traditional journals will need to develop more reliable modes of peer review, such as identifying reviewers, improving dialogue between all parties, and emphasising technical soundness and novelty rather than perceived importance.

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One future scenario would combine the best of both worlds: journals could agree to only accept submissions for review that have

already been deposited on a public archive. Although this is not compatible with author anonymity, it would eliminate the risks of pre-print publication while maintaining the benefits of both immediate communication of results and the usefulness of high-quality peer-reviewed journals. Alternatively, authors could be offered a choice: either submit anonymously to a journal, or submit work that has already been posted on a pre-publication server. Whatever the nature of the system that emerges, history will have the final word.

Acknowledgements

Experimental work in the team of Daniel Fisher is currently funded by the Ligue Nationale contre le Cancer, programme “Equipe labellisée”, grant EL2013. LNCC/DF. Thanks to Claire Lee, Ron Vale, Philippe Jay and Robert Hipskind for helpful discussions and comments on the manuscript.

Conflict of interest

Daniel Fisher is a voluntary Review Editor for *Frontiers in Cell and Developmental Biology*, for which he receives no financial remuneration.

References

1. Vale RD (2015) Accelerating scientific publication in biology. *Proc Natl Acad Sci USA* 112: 13439–13446
2. Smith R (2006) Peer review: a flawed process at the heart of science and journals. *J R Soc Med* 99: 178–182
3. Macdonald S (2015) Emperor's new clothes the reinvention of peer review as myth. *J Manag Inq* 24: 264–279
4. Benos DJ, Kirk KL, Hall JE (2003) How to review a paper. *Adv Physiol Educ* 27: 47–52
5. Watts DJ (2002) A simple model of global cascades on random networks. *Proc Natl Acad Sci USA* 99: 5766–5771
6. Kravitz RL, Franks P, Feldman MD, Gerrity M, Byrne C, Tierney WM (2010) Editorial peer reviewers' recommendations at a general medical journal: are they reliable and do editors care? *PLoS One* 5: e10072
7. Baddeley M (2015) Herding, social influences and behavioural bias in scientific research. *EMBO Rep* 16: 902–905
8. Salganik MJ, Dodds PS, Watts DJ (2006) Experimental study of inequality and unpredictability in an artificial cultural market. *Science* 311: 854–856
9. Shaw DM (2015) Blinded by the light: anonymization should be used in peer review to prevent bias, not protect referees. *EMBO Rep* 16: 894–897
10. Begley CG, Ellis LM (2012) Drug development: raise standards for preclinical cancer research. *Nature* 483: 531–533