

Rethinking Peer Review: Ways to Safeguard the Future of Science

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Insights

- Peer review is an integral process for ensuring the credibility and quality of a wide range of scientific products including journal articles and grant applications.
- This process is regarded as the gold standard for establishing trustworthiness of scientific products.
- Despite the widespread use of peer review, there is still no consensus on its definition and the process that should be used.
- Many limitations of peer review have been identified including bias and inconsistency in review.
- Several strategies have been suggested to improve the peer review process but there is limited evidence on the effectiveness of these strategies.
- Until there is consensus on how to revitalize peer review, extra effort and vigilance is required from the scientific community to uphold integrity in any work requiring peer review.

“Peer review is the process of subjecting research, or other scholarly work, to close examination by others in the same field as the study in question. These peers help determine whether or not the study should be published, if it needs to be revised, or if it should just be completely rejected.”

———— Mortimer (2018) (1) ————

“As an institutional norm governing scientific legitimacy, it [peer review] plays a central role in defining the hierarchical structure of higher education and academia [3]. Now, publication of peer-reviewed journal articles plays a pivotal role in research careers, conferring academic prestige and scholarly legitimacy upon research and individuals [4]. In spite of this crucial role it plays, peer review remains critically poorly understood in its function and efficacy, yet almost universally highly regarded.”

————— Tennant JP & Ross-Hellauer T (2020) (2) —————

Peer Review: An Imperfect Yet Indispensable Process

Peer review was introduced in the 18th century as a way to identify credible and high-quality research (3). Since then, there has been a lack of consensus on the definition or the exact operational process for peer review – with the exception of the general consensus that it refers to review by a third party not involved in the original work. Despite disagreements on what peer review actually entails, it continues to be used as the gold standard for quality control to assess if scientific products generate any value for society – whether it is a research grant, book chapter, or journal article. This can raise some significant ethical concerns, as not only is peer review a very time-consuming process, but with a lack of standardization in the process itself, the validity of the decisions made regarding scientific products based on peer review can be seriously questioned. Only recently, there have been some initiatives for the formal study of peer review, which have generated mixed evidence of its effectiveness. This begs some obvious questions – if peer review is not doing the scientific and the broader communities much good, why should we continue to use it? What are some alternatives we can consider to safeguard the future of science? These are some timely questions worth asking as we currently witness an unprecedented rate of scientific activity that requires peer review. The COVID-19 pandemic has seen a surplus of scientific products that have challenged the current peer review infrastructure due to sheer volume. Yet, when these products have been published without adequate peer review, significant limitations in evidence have been identified that led to quick retraction of these products ([Article 1](#), [Article 2](#)). Revitalizing the peer review process based on a set of common standards that value the credibility and quality of scientific products, as well as building capacity for alternative measures to critically appraise these products can help restore the integrity of science.

“Different practices for the evaluation of knowledge have been proposed and applied by the scientific community, including but not limited to single-blind review (where reviewers remain anonymous, but author identity is known to the reviewer); double-blind review (where the identities of both authors and reviewers are hidden); and open peer review where both authors and reviewers are aware of each other's identity. Journal editors also have an important role, both in the initial assessment of whether to send a manuscript for review and in terms of management and final decision-making on the basis of reviewer recommendations; the precise degree of editor- versus reviewer-based selection can vary greatly between different publications (McCook, 2006).”

———— Birukou et al (2011) (4) ————

“Peer review is thus like poetry, love, or justice. But it is something to do with a grant application or a paper being scrutinized by a third party—who is neither the author nor the person making a judgement on whether a grant should be given or a paper published. But who is a peer? Somebody doing exactly the same kind of research (in which case he or she is probably a direct competitor)? Somebody in the same discipline? Somebody who is an expert on methodology? And what is review? Somebody saying 'The paper looks all right to me', which is sadly what peer review sometimes seems to be. Or somebody pouring all over the paper, asking for raw data, repeating analyses, checking all the references, and making detailed suggestions for improvement? Such a review is vanishingly rare.”

———— Smith 2006 (5) ————

Current Approach to Peer Review

Even though peer review is a requirement of most granting agencies and publishing venues, there is no general agreement on who should be considered a peer appropriate to review scientific work. It is not unheard of for granting agencies to share grant applications with reviewers who may not have methodological or content expertise in the area of interest. Furthermore, some places use a more rigorous peer review process than others. Some journals may use the classic system, where the editor looks at the title of a paper and sends it to two reviewers s/he considers to have the expertise for a fair review (5). If both reviewers agree on publication, the paper gets accepted to the journal, whereas if both reviewers advise against publication, the paper gets rejected (5). If the two reviewers disagree on their decision for publication, the editor sends the paper to a third reviewer and makes a decision in accordance to this reviewer's recommendation (5). There are also journals where authors submitting a paper can suggest individuals who they would like to review their work. Moreover, some venues, such as book publishers, may use a single reviewer approach – where only one individual, often the editor, may decide whether a book chapter should be accepted for publication or not.

As far as the critical appraisal of research goes, a wide range of tools have been developed to help the scientific community take a comprehensive and structured approach to review scholarly work. These include the [Cochrane Risk of Bias Tool for Randomized Trials](#), Tool for [Risk Of Bias In Non-Randomized Studies - of Interventions \(ROBINS-I\)](#), [QUADAS-2](#) to assess the quality of primary diagnostic accuracy studies, and the [Quality in Prognostic Studies \(QUIPS\) tool](#). Yet, the majority of journals do not enforce the use of these tools when conducting peer review. Peer reviewers are free to provide feedback as they wish – with varying focus on the methods and content of the work under review. Ideally, peer review should reflect a balance between an objective and subjective process – where the objective feedback may focus on methodological strengths and limitations and the subjective feedback may focus on scope of the content presented. Since there are no common guidelines for conducting peer review, different individuals may critically appraise the same scientific product quite differently.

“Despite this ubiquity of the practice (or perhaps more properly, of a great diversity of practices coming under the same name), peer review has been little studied by scientists until the last decades. The results of these studies are perhaps surprising, being as they are often very equivocal about whether peer review really fulfills its supposed role as a gatekeeper for error correction and selection of quality work (Jefferson et al., 2007). A significant number of papers report that peer review is a process whose effectiveness “is a matter of faith rather than evidence” (Smith, 2006), that is “untested” and “uncertain” (Jefferson et al., 2002b), and that we know very little about its real effects because scientists are rarely given access to the relevant data.”

————— Birukou et al (2011) (4) —————

“This—perhaps inevitable—inconsistency can make peer review something of a lottery. You submit a study to a journal. It enters a system that is effectively a black box, and then a more or less sensible answer comes out at the other end. The black box is like the roulette wheel, and the prizes and the losses can be big. For an academic, publication in a major journal like Nature or Cell is to win the jackpot.”

——— Smith (2006) (5) ———

What Are the Challenges with Peer Review?

To begin, the effectiveness of peer review is difficult to assess because there is no common definition of the process. This is further complicated by the fact that there is no consensus on qualities of a good paper or good research proposal (5). Additionally, there is no common counterpart against which peer review can be tested (5). These present some significant roadblocks that prevent a methodologically sound and rigorous study of peer review. Nonetheless, few studies have examined the effectiveness of peer review, particularly the ability of this process to detect errors as well as measuring reviewers' ability to foresee the future impact of the work as measured by citation count (4). The results from these studies have been mixed. For example, Goodman et al. (1994) found that peer review was only able to identify small errors in papers, such as those in figures, statistics, and description of results (6). On the other hand, Godlee et al. (1998) found some reviewers did not find any errors despite deliberate introduction of errors in papers (7). This can be particularly concerning when fabricated data is guised as real data and peer review is not able to make the distinction. Indeed, publications on drug treatments for COVID-19 that were published by two high impact journals were retracted, only after readers raised concerns about fraudulent data (8). In terms of predicting citation count, studies show that peer review alone can not predict this metric of performance and other important factors also come into play such as editors' ratings (9). Exhibit 1 shows a summary of some of the most salient limitations of peer review.

Exhibit 1: Limitations of Peer Review (5, 8, 10)

Limitation	Description
Inhibition of innovation	Peer review is a slow and expensive process. It has a large 'opportunity cost' – the time spent reviewing could be spent doing original research.
Bias in review	There is mixed evidence regarding whether there is bias against certain authors in peer review. However, there is strong evidence that there is bias against women when it comes to the process of awarding grants. Furthermore, there is evidence of bias against authors from less prestigious institutions when it comes to papers submitted to journals. The peer review process has been also biased towards studies with negative findings – i.e., where it was found an intervention does not work.
Inconsistency in review	Reviewers can provide very different feedback on the same paper with varying quality.
Conflict of interest	Authors may recommend colleagues and friends as reviewers to receive positive feedback. Editors may have relationships with authors or industry which may influence editorial decisions. There is evidence of editors of high-impact journals receiving payments from industry which may impact final decision after review. Additionally, reviewers can steal ideas and present them as their own. They can also provide unjust and harsh reviews or slow down the publication of the ideas of their competitors.
Lack of preparation	There are no benchmark qualifications for peer review nor do reviewers receive any training. Additionally, journals usually do not provide reviewers with standard tools to assess study quality or validity.
Lack of diversity	Journals' or granting agencies' research priorities may not reflect diverse topics of research for diverse populations. There is evidence that editors and peer reviewers are more likely to accept papers from authors of the same gender and country as them, particularly when the editors and reviewers were all men (11).
Lack of compensation	Peer reviewers are not paid for their service. The credit they receive for their service is difficult to weigh or assess.
Large volume	There is an increasing volume of scientific products to review and not enough skilled reviewers available to critically appraise them.

“Despite the many flaws within the peer review system, throwing it out completely probably wouldn't be the best approach. At least, not until there are acceptable alternative methods that have been proven to work better. Instead, the focus should be put on improving what is already there and working to rid peer review of its flaws.”

———— Mortimer (2018) (1) ————

“Peerevaluation.org aims at becoming a place where scholars come to make sure that they are getting the best of online sharing: increased dissemination, visibility, accessibility, commentary, and discussion, fruitful collaborations and, finally, evidence of impact, influence and re-use.”

“The basic peerevaluation.org scenario – focusing on the dissemination and remote pre- or post- publication peer review and commentary – unfolds as follows: (a) you upload a PDF of your recent paper; (b) you export the PDF's abstract and link to your blog, your Mendeley account and a repository like CiteSeerX. (c) simultaneously it gets indexed by Google Scholar and Microsoft Academic Search; (d) wherever your file is, people can comment it, discuss it, recommend it, share it, have access to your articles statistics, social impact measures; (e) all these remote social interactions are simultaneously aggregated and displayed in your peerevaluation.org account, for you and others to consult.”

———— Birukou A et al (2011) (4) ————

Revitalizing Our Approach to Peer Review: Something Old, Something New

While recognizing that peer review has many flaws, the reality is that in principle, it serves an important role to safeguard the credibility and quality of scientific products. In this context, there have been several new ideas to improve the current peer review process, as well as alternative approaches to replace peer review as it stands now. However, there is very limited evidence to support the use of any of the new ideas to improve the peer review process. Blinding reviewers is difficult to achieve because there are often internal clues in a paper that reveal author identity – there is mixed evidence regarding the effectiveness of blinding reviewers to author identity (12-14). Schroter et al. (2004) found that training reviewers also makes little difference to improve the peer review process (15). Opening up the peer review process where the authors but not readers knew the identity of the reviewers, or publishing every document associated with peer review along with the names of everybody involved when a paper is published online, also did not improve the quality of the review (5). Given this background, approaches highlighted in Exhibit 2 have been suggested to overhaul the peer review process. Important to note, even without much empirical evidence to support their use in terms of improving the quality of the peer review process, there are advantages and disadvantages associated with these strategies that should be considered before their use.

Exhibit 2: Strategies to Revitalize the Approach to Peer Review (1, 2, 4, 8, 10)

Strategy	Description	Advantages	Disadvantages
Post manuscript online before submission	Make manuscript available online for public judgement before formal peer review.	Allows more people to review work and provide extra scrutiny before traditional peer review takes place. Limits biased decisions and allows anyone to provide feedback as a reviewer regardless of their gender, race, sexual orientation etc.	May reduce likelihood of paper receiving press and media attention once it is formally published.
Bidding for review	Prospective reviewers make bids to review submissions of manuscripts based on titles and abstracts.	Garners reviewers who are interested in reviewing the manuscript and possibly familiar with its subject matter.	Not all appropriate reviewers may be in the position to participate in bidding and some reviewers with conflict of interest may still win the bidding process.
Standardize review process	All journals implement the International Committee of Medical Journal Editors reporting standards and standard format for initial submission. Set benchmark timelines for submitting feedback from review.	Establishes consistency in the review process across journals, streamlines workflow, and minimizes time and cost drain for researchers.	N/A
Improve quality of review	Create standardized peer-review checklists to provide guidance to reviewers – these checklists can be specialized according to research methodology. Select reviewers according to journal editors' recommendations, not those provided by authors. Create a registry of skilled reviewers who can be contacted to review manuscripts based on their area of expertise. Use specialized software and technology to identify fraudulent data and plagiarism. Manage conflict of interest relevant for the peer review process.	Improves reproducibility of review. Reduces chances of biased review. Verifies credibility of research presented.	Expectations of peer review may vary between disciplines, subspecialties, and even journals, which may not facilitate standardization of this process.
Open source pre-print and post-publication reviews	Allow open review of manuscript by the broader scientific community at every stage of the publication process.	Allows critical appraisal of research in a timely manner.	Time and cost drain due to multiple and ongoing nature of review.

“Our final wish is that all actors within the scholarly communication ecosystem remain cognizant of the limitations of peer review, where we have evidence and where we do not, and use this to make improvements and innovations in peer review based upon a solid and rigorous scientific foundation. Without such a strategic focus on understanding peer review, in a serious and co-ordinated manner, scholarly legitimacy might decline in the future, and the authoritative status of scientific research in society might be at risk.”

———— Tennant & Ross-Hellauer (2020) (2) ————

Future of Peer Review: A Long Road to Perfection

Peer review is undoubtedly an indispensable process to safeguard scientific integrity. However, the credibility of the outcomes of this process are highly questioned when it is subject to many shortcomings. The current approach to peer review is a far cry from the initial purpose which integrated this process in the scientific discourse in the first place. It is encouraging that there are now calls to rejuvenate peer review with many recommendations of strategies for improvement. It will require some time to test the effectiveness of these strategies as well as ensure their widespread implementation. In the meantime, concerted effort and vigilance from the scientific community is needed to prioritize integrity in all their peer review work. This can begin with strong leadership at institutions where high quality scientific activities are encouraged and supported – which includes providing peers honest, meaningful, and robust feedback on their work. At an individual level, it is also important to be constantly mindful of the quality of peer review work one engages in. These are not perfect solutions for a complex problem – however, until there are some agreed upon common standards that are operationalized for peer review, it will be the responsibility of everyone in the scientific community to safeguard the quality of scholarly work.



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