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o'Peer: open peer review

J H Brewer

Professor Emeritus, Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada V6T 1Z1

E-mail: jess@phas.ubc.ca

Abstract. I have built a "demonstration" website at http://oPeer.org to illustrate how peer review and publication might be improved relative to the current model, which was designed and implemented in an era when scientific communication was either face-to-face or relied upon human delivery of ink marks on dead trees.

1. Introduction

Please excuse my indulgence in a little long-range perspective:

A million years ago, it was difficult for one person to know what another person thought; language was invented to solve that problem. Many millennia ago, it was difficult for one person to know what another person had said; writing was invented to solve that problem. Many centuries ago, it was difficult for one person to know what another person had written; the printing press was invented to solve that problem. Many years ago, it was difficult for one person to discover what other people had written on a particular subject; journals were invented to solve that problem. More recently, the limitations imposed by forest conservation and library shelf space have also been circumvented by the seemingly infinite capacity of electronic storage: arXiv[1] has plenty of room for everything ever written, and the Internet provides convenient access to it all.

Today there is no difficulty in discovering what any number of people have written about any subject; the difficulty is in discovering which of those writings are worth reading. Because one determined individual can only hope to read an infinitesimal fraction of the papers published in his or her area of specialization, there is a desperate need for good judgement in filtering the wheat from the chaff.

Journals employing peer review are currently the best solution to this latest difficulty. However, the ratio of submissions to publications in the most selective journals is so enormous that the selection process demands a great deal of summary judgement: Editors can only afford to request reviews from a small number of referees for a given paper, and many papers are not even reviewed except by the Editors.

The Internet has spawned myriad *open access* journals (OAJ), published at the authors' expense rather than the readers', which address the authors' problem of getting their results published but not the reader's problem of picking what to read. To their credit, some OAJ strive to maintain high standards; but they are like King Canute trying to hold back the tide: if they must turn a profit to continue and the authors are their only source of funds, the temptation to publish indiscriminately will remain as persistent as entropy itself. The ground state of an OAJ is a useless vanity press.


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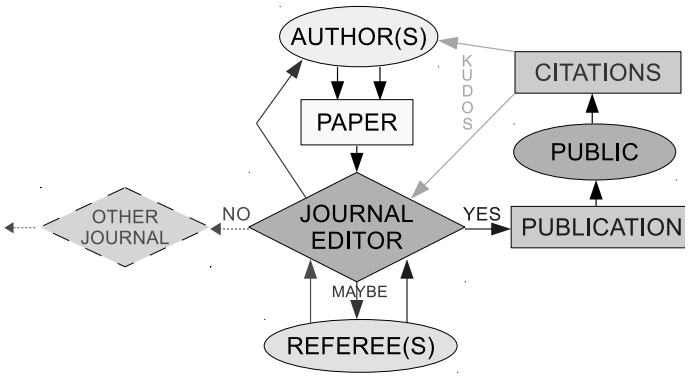


Figure 1. Cartoon of conventional publication procedure.



Figure 2. Conceptual diagram of open peer review procedure.

Meanwhile, ubiquitous data analysis has facilitated continuous monitoring of all journal publications, combining the number of publications, the prestige of the journals and the numbers of citations by other authors in other papers into a well-known "impact factor" for every journal and every author, which in many cases determines the profits of the journal as well as the career progress of the author. Under these pressures, the peer review process may not be able to maintain its presumed objectivity. Good work may go unpublished and flawed but fashionable work may become recommended reading.

2. "Like" is not enough!

Another problem with the current system is that it actually is susceptible to the form of corruption imagined by all "cranks" whose papers are rejected: the "Old Boys' Network" of Editors and their cronies who serve as Referees, excluding all new ideas and protecting their territory. This caricature is patently unfair and usually undeserved, but a sort of chemical potential does exist that drives networks of Editors and Referees in that general direction.

Editors have an extensive database of Referees, either in their heads or on their computers. These databases must be very well protected, as they contain not only sensitive personal information but also intelligence essential to the journal's success. And yet the least interesting information about each Referee is their personal identity. A list of unique serial numbers (such as ORCID[2]) would serve just as well, provided that all potential Referees were registered.

A more democratic model is widely employed by entities as diverse as Slashdot[3], YouTube[4] Facebook[5], ResearchGate[6], Google[7] and essentially all "social networks" that allow posting of material of any kind. This method involves simple indications of preference ("likes") by semi-anonymous viewers. It is, perhaps, useful for measuring appeal to a broad contemporary audience, but it is clearly useless to an intellectually elitist discipline like Physics. We don't care how much non-Physicists "like" a paper; we want to know the opinions of people whose judgement we respect, usually because they have established their own credibility in the same field and are known to exercise their judgement fairly in the interest of better science. That is, we want to know the opinions of the Referees a good Editor would choose from that extensive database of various attributes — which brings us back to peer reviewed journals.

3. What Can Be Done?

To paraphrase Winston Churchill, "Democracy is the worst possible form of government, except for all the rest."

Let's try to imagine a system of *Open Peer Review* (herein given the cute name "*o'Peer*"[8]) which encourages universal participation in the process of evaluation and yet weights the opinions of *cognoscenti* more than those of the ignorant. Obviously this entails either stealing the precious information in the journal Editors' databases or generating the equivalent information independently. I prefer the latter. How can this be done?

Allow me to assume that all possible authors and reviewers with any potential interest in *o'Peer* are registered in the *o'Peer* database in a secure and capacious computer facility. The $i^{\rm th}$ registrant has a *Credibility* index $\vec{C}_i$ (actually an array with many components) determined and updated by the algorithms described below.

The database also contains *papers* submitted by the registrants. The location, status and *Quality* $\vec{q}_\mu$ of the $\mu^{\rm th}$ paper are stored in the database and $\vec{q}_\mu$ (also a multi-component array) is updated by similar (in fact, the same) algorithms as $\vec{C}_i$.

3.1. The Components of $\vec{C}_i$ and $\vec{q}_\mu$

The choice of characteristics maintained in the *o'Peer* database is subject to revision and will certainly engender intense debate if Open Peer Review ever really catches on. Fortunately it is easy to add extra columns to the database if they are deemed useful. In fact, users can decide for themselves which attributes they consider most important in any given search of the database. My initial guess is

$$\vec{C}_i = \{L_i, W_i, O_i, A_i, E_i, T_i, I_i\} \qquad \text{and} \qquad \vec{q_\mu} = \{\ell_\mu, w_\mu, o_\mu, a_\mu, e_\mu, t_\mu, i_\mu\} \tag{1}$$

where, for registrant i, L_i is judgement of appropriate manuscript *length*, W_i is judgement of good *writing*, O_i is judgement of *originality*, A_i is judgement of *creativity* (*art*), E_i is judgement of *execution*, T_i is judgement of *correctness* of the work and I_i is judgement of its *importance*. For paper μ, the analogous lower case components of the q_μ array have the same meanings as the upper case ones above, minus the phrase "judgement of". For simplicity, in the following I will use C_i and q_μ to denote arbitrary components of $\vec{C}_i$ and $\vec{q}_\mu$; all components are treated the same way.

3.2. The Algorithms

When a new paper is submitted, it becomes open for review by everyone but its own author(s). (To ensure this, it is obviously necessary for *all* the authors of any paper submitted to *o'Peer* to be registered in the database.) When reviewer j evaluates paper μ, s/he may submit a written Review along with the evaluation Q_μ^j (on a percentage scale from 0 to 100, the latter meaning, "It doesn't get any better than this!"). Said Review will be added to the database as another paper in the reviewer's name (identity can be hidden or revealed at the reviewer's discretion, but the computer always knows who wrote what) and can be in turn evaluated by others. In fact, registrants with no submitted papers of their own are *required* to submit a written Review of paper μ in order for their evaluation to be counted.

The *Quality* of the paper is then updated as follows:

$$q_\mu = \frac{\sum_j Q_\mu^j C_j}{\sum_j C_j} \tag{2}$$

where the sums $\sum_j Q_\mu^j C_j$ and $\sum_j C_j$ accumulate as various reviewers offer their opinions. Thus q_μ is the running "Credibility-weighted average" quality of the paper.

Meanwhile, the *Credibility* of the author(s) of the paper is updated in the same way from the same evaluations:

$$C_i = \frac{\sum_j Q_\mu^j C_j}{\sum_j C_j} \tag{3}$$

The only difference is that the latter sums accumulate *for every paper μ of which registrant i is an author*. Assuming there are N_i such papers, we can rewrite the above equation as

$$C_i = \frac{1}{N_i} \sum_{\nu} q_\nu \tag{4}$$

where the summation runs over only the N_i papers of which registrant i is an author.

Again for simplicity I will pretend that the paper has only a single author. I anticipate some discussion of whether every author of a multi-author paper should receive the same "credit" for its quality, (as is the convention now in most cases), or if the credit should be apportioned fractionally, perhaps with extra credit going to the submitting author. I doubt that this would be a good idea, so for now I would prefer to give every author the same Credibility update. Unfortunately this presents practical difficulties, as discussed below.

4. Problems

One obvious problem is that only those authors who are *registered* in the *o'Peer* database can receive bouquets or brickbats for the papers with their names on them. It will therefore be necessary to begin initially with a system that credits *only the submitting author*. Hopefully the other authors will find this inequitable enough that they will register themselves to obtain their share. This still introduces an "update" burden on the system, but it is manageable using Eq. (4) *as long as all the authors of each paper are correctly and uniquely identified*. The best way to ensure this is to eventually require the submitting author to check the database and identify all the authors by their unique index. This same problem exists in all citation databases now, and some promising measures have been taken to ensure reliable identification of authors; one example is ORCID[2], which could provide the necessary uniqueness if all *o'Peer* users were willing to register themselves with ORCID.

Another dilemma is how much credibility to assign to a *new o'Peer* user: if one starts with *zero* credibility, the motivation to review other authors' work is absent until one has one's own papers or reviews evaluated, and even then it grows rather slowly. If all started with 100% credibility, *o'Peer* would be no different from various "like"-collection sites. Since credibility can increase or decrease depending on subsequent work, I plan to start with 50% on all new accounts. (This may be the high point of some careers.)

Clearly there may be a temptation to "play the system" by teaming up with other authors to give superb reviews to one another's work, and/or to systematically "pan" that of third parties. This problem is not unique to *o'Peer*, of course. With computers handling all the evaluations, it should not be difficult to detect such cheating using "metadata" analysis techniques. It would be nice to see a few unprincipled referees get caught and exposed.

What about copyrights? One of the purposes of *journals* is to make money for the publishers and (on *extremely* rare occasions) for the authors. More often the authors pay the journals to publish their work, knowing that this will bring them greater esteem and better jobs with higher salaries; for most scholars, *Intellectual Property* (IP) is something you pay publishers to take from you. The goal of most researchers is to get their work into the public domain. *o'Peer* starts and ends there. It remains perfectly reasonable to write monographs and textbooks which are sold by publishers who share their profits with the authors; such works can be evaluated within *o'Peer*, but they need not be. Similarly with patents and other forms of IP.

5. Conclusions and Speculations

Since I was unaware of such a facility, I bought the domain name `oPeer.org` and built a "demo" version "*o'Peer Physics*" which is now open for business[8]. Obviously several developments are required if this is to have any impact: first, enough people have to register to form a critical mass

of reviewers; second, enough papers have to be submitted to form a critical mass of material; and third, registrants have to treat it as seriously as they now do their responsibility of refereeing journal papers. While this may seem unlikely, I take heart from the fact that journals do find enough qualified people to perform this essential service without any remuneration other than the satisfaction of keeping their colleagues honest (and having their opinions listened to).

So far there is only *o'Peer Physics*. Since every discipline has a different "culture" and different criteria for "excellence", the database architecture for *o'Peer Chemistry*, *o'Peer Biology*, *o'Peer Medicine*, *o'Peer Literature*, *o'Peer Art* and *o'Peer Music* should be quite different, as should the procedures for peer evaluation. It may even be that YouTube's "like" option already adequately satisfies the need for democratic evaluation of videos, although one might hope for something better.

Unlike most "open access journals", I have no plans to charge authors *or* readers for use of *o'Peer Physics* — if the cost of maintaining this "hobby site" becomes burdensome I will seek funding from appropriate sources.

The most improbable outcome is that *o'Peer* should "catch on" and still remain under my management, such as it is. It is much more likely that the concept, once demonstrated to work, would be adopted by entities far more capable of refining and exploiting it, such as ResearchGate[6] or Google[7]. That would be fine with me, as long as they don't screw it up!

I dream of a future in which all the products of human endeavor are critically but fairly evaluated because the credibility of reviewers is subject to equally just and public evaluation.

Acknowledgments

I acknowledge that "proper scientific papers" are supposed to be written in third person passive voice. That's just stupid. Motive, attitude and intent are integral parts of any analysis, and hiding them is the same as suppressing data.

I am well aware that URLs are not considered legitimate references. Get over it. They are *different kinds* of references — ones that are explicitly impermanent and have an implicit expiry date.

I also acknowledge that there is an extensive literature on this and related topics of which I am largely unaware. Therefore I am no scholar of open peer review; I'm just a guy with an idea.

Finally, I admit that I have not even thoroughly read all of those listed below: [9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25]. So sue me. Said list is offered (like most Reference lists) only to show that such literature does exist and is receiving serious consideration by real experts in the management of scholarly material.

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