

PEER REVIEW – IS IT WORKING?

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PEER REVIEW: NO ALTERNATIVE TO EXPERT JUDGEMENT



Sir Mark Walport
Director, The Wellcome Trust

Peer review is an integral part of the scientific enterprise. Misconceptions around peer review abound, and it is seen in some quarters as an opaque and slightly mysterious process. But the concept behind it is really very straightforward – simply that of review by experts.

Peer review is important because science involves many tough choices. Research funders need to decide how to allocate limited public and charitable funds between the many competing grant proposals they receive. Scientific journals need to decide which research papers are worthy of publication and which are not. And commercial enterprises and investors need to decide which scientific innovations will have the greatest potential to reach application and generate returns.

Peer review ensures that these key decisions are informed by the views of experts in their field, based on a robust and independent appraisal of the underlying science. Whatever the limitations and challenges of peer review may be, the alternative – effectively, that such decisions do not involve the input of genuine experts – is surely far worse.

PEER REVIEW AT THE WELLCOME TRUST

As a global research charity dedicated to achieving extraordinary improvements in human and animal health, the Wellcome Trust is committed to ensuring that we use the funds we have to support the very best

researchers with the brightest ideas. We want to identify those researchers who, based on their track record and research vision, have the potential to make real breakthroughs in advancing knowledge and its application to improve health. We believe that it is practising scientists who are best placed to make such appraisals, based on their experience and expert judgement.

As such, peer review lies at the very heart of our decision making processes. Grant applications are assessed by independent committees made up of leading scientists from around the world. Their deliberations are informed by the comments of external referees who are experts in the subject areas covered by a particular grant application.

Careful selection of reviewers is absolutely key to the success of peer review. At the Wellcome Trust, we put considerable effort into ensuring that we get the right mix of reviewers for a particular grant application. Because the field of possible reviewers in some areas is quite small, we will often try to include some reviewers with a broader perspective in addition to those with specialist expertise in the specific area covered by the application. We also have robust conflict of interest policies to mitigate risks that reviewers will be subject to undue influences in their appraisals.

No one is under the illusion that peer review is a perfect

system. In particular, the quality of review will only ever be as good as those who undertake it. It depends crucially on their rigour, generosity, fairness, expertise and sound judgement. Several recent high-profile cases have illustrated that when peer review is done badly, the consequences can be highly damaging and can erode public trust in science. All of us in the scientific community have a key obligation to uphold the integrity of peer review, and to be open and transparent in communicating its importance and its limitations to the wider public.

THE COST OF PEER REVIEW

Perhaps the most pressing challenge associated with peer review is the burden it places on the academic research community. The Wellcome Trust alone makes between 15,000 and 17,000 approaches to potential referees each year, and on average around 45 per cent of these approaches will result in a review being submitted. We consider this to be a good hit rate. However, with the mounting volume of requests for reviews being generated by research funders and journals and the pressures that exist on researchers' time, there is a risk of increasing 'review fatigue'. This will result in falling response rates and could ultimately compromise the quality of reviews.

At present, peer review is a service that researchers usually

provide on an unpaid basis, and which many conduct in their own time – fitting it around their research and teaching duties, often in the evenings or at weekends. Most do not resent the time they invest, and view their contribution as crucial to the successful operation of the wider scientific enterprise of which they are part. In addition, peer review can provide genuine benefits for their professional development and helps them to keep abreast of advances at the cutting-edge of their field.

Nonetheless, the current situation does raise important questions. At present, it is funders and publishers who benefit from the use of peer review, but it is the researchers themselves and their employing institutions who bear almost all of the cost. Ultimately this situation will probably have to change. Peer review is a professional service, and it seems appropriate to recognise properly this activity as part of a researcher's role. At the Wellcome Trust, we are developing plans for a peer review college to cover our major funding programmes, which would reimburse referees for the reviews that they provide.

The longer-term sustainability of peer review will depend critically on a continued pipeline of quality reviewers. Developing the skills necessary to conduct reviews is a key part of a young scientist's development, and is already fostered through informal mechanisms in academic departments, such as journal clubs. Nevertheless, there is a strong case for ensuring that formal training is also available; this is something that we would encourage research institutions to develop as part of their training and professional development activities.

ADDRESSING THE CHALLENGES

While the system is definitely not at the point of collapse, there is a pressing need for both funders and publishers to explore actively innovative ways of reducing the burden of review, whilst upholding its quality.

As a funder we adopt a combination of different approaches to peer review, which we endeavour to apply in a judicial manner at the appropriate stages of the application process. In particular, the use of methods such as triage can help to reduce the number of requests to external reviewers, without compromising the rigour of the overall process.

An excellent example is our Investigator Awards. These Awards provide outstanding early-career and established senior scientists with long-term flexible funding to pursue their research visions. Preliminary applications for these awards are first triaged by subject-based expert review groups, and only those that are successful are sent to international referees for review. Candidates are then interviewed by an Interview Committee, again consisting of international external experts, who make a final decision, based on the outcome of the interview and the comments of the referees.

INNOVATION IN PUBLISHING

There is also considerable scope for innovation in the publishing sector to address some of the challenges associated with peer review. This has been enabled in part by the rapid growth of the open access publishing movement over the last decade, which ensures that the published outputs of research papers are freely available to all at the point of

use. A popular myth persists that open access equates to less rigorous peer review – but this is simply not the case, proper peer review is as integral to open access publishing as it is to traditional scientific publishing.

Indeed, open access publishers have been responsible for some of the most exciting innovations in this area. The model pioneered by *PLOS One* – where review focuses solely on whether the findings are justified by the results and methodology presented, rather than on assessment of the relative importance of the research – has both reduced the burden on reviewers and the time it takes to get a paper published. Open access publishers have also led the way in the development of more sophisticated metrics to measure the impact of individual research papers, taking us beyond the blunt tool that is the journal impact factor.

Recognising the opportunities for transformative change in this area, the Wellcome Trust has joined with the Howard Hughes Medical Institute and the Max Planck Society to establish *eLife* – a new top tier, open access e-journal. *eLife* will place scientists at the heart of the publication process, ensuring rapid, transparent and scientifically-based editorial decisions. It will adopt innovative approaches to accelerate peer review and to maximise the potential of online technologies to enhance access to scientific information.

In pursuing such opportunities, it will be important to recognise that different scientific disciplines have very different cultures and ways of working, and there will never be a one size fits all approach for peer review. For example, whilst pre-publication review works well in the high-

energy physics field, it would not be appropriate for the medical sciences – where the publication of results ahead of expert scrutiny can sometimes carry significant risks for public health.

DEBUNKING THE MYTHS

There are a number of myths which have permeated the debate on peer review. These merit challenge. First, there is a widespread view that peer review serves to promulgate conservatism and inhibits ideas that challenge established norms. While this may happen on occasion, it is our experience that the vast majority of reviewers we work with genuinely wish to embrace innovative, cutting-edge research and to take risks where the underlying science is sound.

It is also widely claimed that peer review disadvantages research that cuts across disciplinary boundaries. This does not necessarily reflect our experience in practice as a funder, which is that most reviewers are very receptive and wish to enable such research.

A FINAL WORD

It is our strong belief that peer review remains critical to the process of science. Whilst it is by no means a perfect system, the decisions we make in science have major implications and need to be based on the judgement of experts. There is simply no viable alternative.

Should we actively embrace innovation to address the challenges and burdens associated with peer review? Of course we should. Is peer review broken? Emphatically not.



PEER REVIEW AND THE PUBLIC INTEREST



Tracey Brown
Sense about Science

Peer review is not just the esoteric concern of scientific researchers. It is a system of independent scientific scrutiny that helps to safeguard the public interest in sound science, and as such we should pay it a lot of attention.

Sense About Science is a UK based charity to help people make sense of science and evidence. We work with over 5000 scientists and hundreds of organisations from science and civil society to respond to questions about scientific issues and to chase up misleading claims.

Our trust was born in 2002, one of many responses to the troubled relationships between science and society, troubles which had been elaborated in the House of Lords Science and Technology Committee's report of 2000.

It was a baptism of fire. The newspaper front pages raged with headlines and horror stories about cloning, stem cell research, genetic modification, mobile phone radiation, the Measles Mumps and Rubella vaccine and nuclear waste disposal. Many stories were being generated by claims, often apparently conflicting, about what was shown by scientific research. Contradictory accounts of evidence were not just the product of the news media. They often arose in statements from advocacy groups, policy

makers, advertisers and from the rapidly multiplying public relations activities of institutions. At the same time, the Internet had given new life to single issue campaigners, product promotion and self-styled gurus offering theories about the causes and cures for disease, many of which were purporting to be based on cutting edge scientific research and techniques, such as stem cell implantation.

This was the landscape in which we had to intervene to encourage people – policy makers, media, organisations and the public at large – to consider scientific evidence. One of the first things that stood out was how little attention was being paid to the quality or status of research findings, and in particular to whether they had been subjected to any kind of peer review.

Peer review seemed to be a well kept secret of the research community. In no other area of life do people systematically volunteer their life's work to be critically evaluated by others in their field. Can you imagine a Government Minister's press releases being submitted for approval to MPs before publication?

Our Working Group on Peer Review, established in 2004 and chaired by Professor Sir Brian

Heap FRS, concluded that it was a process little understood by many who interacted with the findings of research. For them, and the public at large, insights into how research had been evaluated were valuable. The Working Group resolved that greater effort was needed by research institutions, journals, publishers and others to share the workings of these processes.

However, many in the scientific community were sceptical about the public's interest in peer review. This might in part have been the result of defensiveness about those times when the system broke down – incidents which accounted for what little publicity there was about the peer review process at that time. Concerns about bias, frustrating experiences, bad behaviour by reviewers or authors, eclipsed consideration of a system that delivered 1.3 million papers a year and that was used to select research for funding and to develop critical evaluation post-publication. There were also reservations about putting information about the system into the hands of the public, for fear that it would be misunderstood. For example, 'it's peer reviewed' might be taken to mean 'it's true'.

When we published the resulting public guide to peer

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review, *I Don't Know What to Believe*, I am afraid that we took these comments rather too much on board. The guide explains how research findings are reviewed for validity, significance and originality. It also gives a brief summary of how editors select reviewers and discusses the importance of ensuring that papers refer to previous work and provide information so that others in the field can see how the research was conducted. We printed just 10,000 copies.

It was to our surprise that the publication of the guide immediately generated public discussion, ranging from national radio and papers to the specialist publications serving voluntary bodies and public information services. Peer review seemed to be newsworthy. The guide began flying out of the door and the electronic link to it appeared across the Web.

Here we are today, some 500,000 copies and 10 reprints later, looking at a much improved situation. The guide is

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used by many people and organisations who respond to the public's questions about research claims, such as patient helpline operators who handle calls about the validity of stories in the news about the causes of Alzheimer's disease, for example. Our peer review work is now backed by library services, publishers and editors. Information about whether findings have been peer reviewed is sought by journalists, and details of the scientific publication are regularly included in institutions' press releases and

in news reports, though it has to be said, not yet regularly enough.

In policy too the picture is better. Back in the early 2000s, there had been a rapid growth in Government's use of consultations, especially on contentious policy issues. This appeared to have been accompanied by a rather literal weighing of research claims in Whitehall. So we saw situations where two consultation submissions giving opposite views about research were counted thus: one for, one against. Never mind that one might summarise and evaluate the entire peer-reviewed, published body of research and the other be based on the press release of an unpublished survey by a campaign group.

Now there is a greater awareness of the need to ask questions about the status of research being fed into policy making. Information about peer review is included in training for senior civil servants. Revised guidelines about the

Government's use of scientific advice include more explicit reference to the extent to which results have been reviewed and, where appropriate, repeated. Our campaigning mantra has been, and continues to be, that the status of findings is as *important* as the findings themselves.

Contrary to the fears of some researchers, the public seem quite able to understand that peer review is an indicator of scrutiny rather than the final word. Perhaps that should not be surprising. When we buy a

microwave it has a kitemark. We know this means that it has passed some safety and operating standards. We also know that the microwave won't work forever and, in fact, that the kite mark doesn't guarantee it won't break down the day we get it home. But we know that the kitemark is important all the same.

The importance of the status of findings shows up in the kinds of questions that the public ask us about research. When we analysed our call logs, we found that many enquiries were very similar: should we worry about these findings? Is it a scare story or real science? What do scientists actually know? Is it a proper study? How can I tell? What do other scientists say about it?

Having helped to promote a focus on questions about the ways that research is scrutinised, at Sense About Science we became concerned a few years ago about growing talk of 'a crisis in peer review'. This crisis talk seemed to refer variously to the global expansion of scholarly research, to particular incidents of flawed papers making it into print (the Wakefield paper on MMR and autism in the *Lancet* for example), to reaction to the UEA email exchange about trying to stop publication of some climate research, and to the mounting pressures on researchers to get grants and publish papers, leaving little time to review papers. Was the global peer review system about to collapse under this weight? Did the relatively small number of problems in how papers were handled threaten to become a much bigger number?

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In 2009 we conducted a survey of authors and reviewers about these issues, using the template of a Publishing Research Consortium survey 2007, and adding questions about the role of the peer review system and how well it was understood. We asked about the time spent reviewing papers and motivations for reviewing. The Peer Review Survey 2009 turned out to be the largest ever global survey of authors and reviewers. The preliminary findings were published in the journal *Serials*; the full data are online at our website and the final paper on these will be published this spring.

The biggest surprise was that overall satisfaction with peer review was very high. Only 9% of authors and reviewers said that they were dissatisfied with the system. There was some confusion among respondents about the purpose of the system. While, as expected, "improves the quality of the paper" ranked high in both what the system does and what it *should* do, a surprising number thought that peer review does and should be able to detect plagiarism and fraud. This might tell us that the peer review system is seen by researchers as bound up with other things that journals do, such as running software to help pick up plagiarism. While improvements to peer review were strongly supported, talk of crisis was clearly much exaggerated.

Motivations to review were altruistic. Reasons such as "playing my part as a member of the academic community" and being able to improve a



paper ranked much higher (90% and 85%) than gaining personal recognition or enhancing one's career (34% and 46%). Sir Mark Walport has discussed the question of paying reviewers. We should tread very carefully here, where there is a risk of undermining these values by putting a price on them.

I want to tackle a few things that people often conclude when we discuss the challenges of peer review. Some argue that we need alternatives to peer review. But why should we leap from individual failures in the

system to dismiss the bigger principles at stake? We don't do that in other systems which fall short of their principles. Lawyers will regale you about court delays and inadmissible evidence. But we don't say we need an alternative to justice. We ask how the system can deliver it better.

Let's be clear too about the 'alternatives'. There is just one. Something must select what we pay attention to from the sea of research out there. If it is not a system that aims for independence and objectivity, then it will

be researchers with the clubbiest contacts and institutions with well-funded public relations. You can dress this up in talk of online technologies and social media networks, but it remains what it was in the time of the Medicis – patronage.

Peer review is more than just having to settle for 'the best we've got'. It is the best. It might struggle with the weaknesses of human judgement, but that is because it has all the strengths of human judgement. It's a flexible system, which can reflect

movement within a field in a way that no tick-box approval system can. It has the ability to spot something good and bring it to the attention of researchers and research users more quickly. If it falls short, it is because our aspirations to objectivity are high. For the public and for the research community, we should keep them that way and improve the system.

PEER REVIEW – IS IT WORKING?

PEER REVIEW IN A CHANGING AND DISRUPTED PUBLISHING LANDSCAPE



Dr Irene Hames
Editorial Advisor and Consultant

Peer review is often the subject of intense debate, and never more so than now when we are at a critical juncture in scholarly publishing. A number of interlinked areas, including peer review, are impacting one another and will affect how research output is going to be communicated, accessed and evaluated in the future. The time is ripe for innovation and it is likely that new models and new players will enter the arena.

Peer review in journal scholarly publishing (known as 'editorial' peer review, to distinguish it from funding review) is, quite simply, "the process by which research output is subjected to scrutiny and critical assessment by individuals who are experts in those areas"¹. It traditionally

takes place before publication, ie a 'filter, then publish' approach, but there have been suggestions that everything should be published and only then evaluated, ie 'publish, then filter'. Many, however, are concerned that this approach would not only release incorrect material, which in some disciplines could be harmful or misleading, but readers, particularly non-specialists, would find it difficult to know what to trust. Indeed, one of the conclusions of the 2011 House of Commons Science and Technology Committee inquiry into peer review was that "Peer review in scholarly publishing, in one form or another, is crucial to the reputation and reliability of scientific research"².

It is important to stress that

quality of peer review is independent of journal business model. It does not matter whether it is subscription based, open access with author-side payment, or has a hybrid arrangement with elements of both. Sweeping statements shouldn't be made by any group to denigrate another (as has sometimes happened against open-access journals); there are good and bad examples of peer review in all the models. Criticisms of peer review itself have, however, been around for a very long time – that it is slow, expensive, unreliable, idiosyncratic, conservative, and open to abuse and bias. These are certainly potential problem areas, ones that most researchers have experienced in their careers. Peer review isn't

infallible. It can and does go wrong, just as any other human activity. The peer-review process looks deceptively simple, for example when described in a flow chart. In reality it's complex and sophisticated, and at its best and in the right hands a powerful tool. The role of the Editor is absolutely critical. A common misconception is that it is reviewers who 'accept' or 'reject' manuscripts. They don't. They assess, advise and make recommendations, and it is Editors who makes the decision whether or not to publish. Good and skilful Editors are ones who exercise sound and fair critical judgement, acting as more than just vote counters, deciding whether reviewers' criticisms and requests are justified, whether additional work is or is not needed. They help create and maintain a sound scholarly

*primary role of communicating scientific discovery to one of demonstrating academic activity."*³

This is even more applicable today, with greatly increased submissions to journals making publication highly competitive. Competition is also becoming keener because of the increasing numbers (and quality) of submissions from newly emerging scientific nations such as China and India. Editorial and reviewing loads are becoming heavier, and this has led to speculation that "the peer review system is breaking down and will soon be in crisis"⁴. There is currently some geographical imbalance in submission and reviewing activity which may be partly responsible for this, with researchers in the USA, for example, carrying a higher

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record. Bad and inept Editors bring the system into disrepute. Good peer review helps improve not only manuscripts, but often the science behind them.

Researchers are being put under increasing pressure to publish in high Impact Factor journals. Despite the criticisms levelled at the use of journal Impact Factor as a proxy measure of research and researcher quality, it still plays an important role in the careers and funding prospects of researchers. Over 20 years ago, Stephen Lock, *BMJ* Editor 1975-1991, voiced the concern:

"... And underlying these worries was yet another: that scientific articles have been hijacked away from their

reviewing burden, producing about 20% of papers globally but conducting about 32% of the reviews, and those in China producing 12-15% of the papers but doing only 4-5% of the reviews⁵. The situation is likely to become better balanced as researchers from the emerging nations become more established, gain international reputations, and name-disambiguation schemes currently being developed make it easier to identify people correctly.

The scale of the total reviewing effort needed is enormous – about 1.5 million articles are published globally in around 26,000 peer-reviewed journals each year. This equates to at least 3 million reviews, probably many more, because

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articles that are rejected from one journal go on in most cases to be submitted to other journals in turn until accepted somewhere. This 'wastage' of reviews is of concern to many, and has led to various 'cascading' initiatives – both within publishers (eg Nature Publishing Group, BioMed Central, Institute of Physics Publishing, Royal Society of Chemistry) and between them (eg Neuroscience Peer Review Consortium) – where rejected manuscripts and their reviews can, if authors choose, be passed on to other journals for consideration. Reviewing is a reciprocal 'give and take' activity, as authors and reviewers are mostly the same community. So reviewers get valuable feedback on their manuscripts when they are authors. Increasingly it is felt that there should also be more formalised recognition of reviewing, and training available for early-career researchers.

Two events – one a few years ago, one just a few months ago – have resulted in seismic shifts in the scholarly publishing landscape, and the traditional publishing industry now faces the threat of disruption. These shifts have, however, also brought opportunities to move forward with the scientific research community and provide new value-added services.

In December 2006, a new open-access journal, *PLoS ONE*, was launched in which the two

functions of peer review – assessment of rigour and selection for interest and novelty – were for the first time separated. The journal's review process would concentrate only on assessment of scientific and ethical soundness and not make any judgement on novelty, interest or potential impact. That would be left for the post-publication phase. *PLoS ONE* has grown extremely rapidly and is now often referred to as the largest journal in the world. In terms of annual output it is: in 2011 it published around 14,000 articles, representing about 1.5% of the total world scientific output. The journal is a true 'game changer', partly because it has proved itself to have a sustainable business model. Indeed, many publishers have rushed to launch similar repository-type or 'mega' journals. With this model, researchers no longer have to go from journal to journal to get research published, thus avoiding delays in getting sound work out and available to others to use and build on and allowing them to concentrate on their research rather than chasing publication. Many, understandably, like this, and *PLoS ONE's* respectable Impact Factor (4.411) has led to a steep rise in submissions.

The second seismic event began on 16 December 2011. On that day, the Research Works Act (RWA) bill (HR 3699) was introduced into the US House of

... The blogosphere and Twitterverse are becoming increasingly important. . .



Representatives. The RWA would, if passed, effectively reverse the NIH (National Institutes of Health) Public Access Policy of 2008, which requires NIH-funded researchers to deposit all final peer-reviewed manuscripts resulting from that funding in PubMed Central (NIH's National Library of Medicine free archive of biomedical and life sciences journal literature) and to be publicly accessible no later than 12 months after publication. It would also prohibit any further open-access mandates for federally funded research. Support of the bill by the Association of American Publishers (although a number of member publishers dissociated themselves from this) and the actions of certain publishers acted as a trigger, releasing latent unrest amongst the academic community. An acrimonious battle has since broken out and is being played out in the blogosphere. There has been a 'call to arms', which is having a direct effect on peer review – researchers are being asked to refuse to review, submit and carry out editorial duties for certain commercial publishers as a protest against support of the RWA and other measures to restrict free exchange of information, the prices of journal subscriptions, the level of some publisher profits, and reluctance to move to open access as the basis of research publishing. For example, The Cost of Knowledge web site <http://thecostofknowledge.com/> was started at the end of January (originally for mathematicians, but it now encompasses various sciences,

medicine and social sciences) and at the beginning of March has nearly 8000 signatures. Template letters for review refusal are circulating on the internet, along with negative, sometimes vicious, comments about publishers. A major problem seems to be a lack of understanding and engagement by the two sides. Publishers cannot afford to ignore what is being said. All partners in the funding and communication of science need to get together to find ways to move forward for the benefit of science. On 27 February, the controversial RWA was very suddenly abandoned. The unrest in the research community, however, continues.

Peer review doesn't stop at publication. Many feel that this is actually when real peer review starts, as researchers begin to scrutinise, repeat and build on published work and the self-correcting nature of science starts. Post-publication review and evaluation can take a number of forms and the internet and technological advances have brought increasing opportunities for experimentation and innovation. There are a number of challenges, including how to get people to participate (the level of engagement is in many cases very low), how to aggregate opinions, evaluations, blog posts and other contributions in a meaningful way, and knowing who to trust. A number of projects are already under way, but there is again plenty of space for innovators to create new services. With the increasing number of journals adopting the *PLoS ONE* model, there is a real need for

evaluation, sorting and analysis of all the work being published. The blogosphere and Twitterverse are becoming increasingly important in this respect, especially as adoption of social tools by researchers grows, allowing scientific interaction outside of journal articles. They also provide the means to alert communities rapidly about problems with published work, for example as happened with a paper published in the journal *Science* in December 2010⁶. When researchers reported that they'd found a bacterium that could grow on arsenic and incorporate arsenate in place of phosphate into its DNA, experts in the field started to post criticisms of the methodology and interpretation online within a day or two. The story came to be known by its Twitter hashtag, #arseniclife⁷. The online community knew about the problems with the paper straight after publication, readers of the journal article wouldn't have known about them until a number of commentaries on the article appeared 6 months after its publication.

So, is peer review working? Yes, but it's facing many challenges. As the publishing landscape evolves, so will the diversity of peer-review models. It's possible that new organisations will be set up to offer peer-review services. A recent example is *Peerage of Science* (<http://www.peerageofscience.org/>), a Finnish company founded, owned and governed by scientists. There is the potential for considerable disruption in the scholarly publishing sector. To maintain a

central position, publishers will need both to convince researchers of the value they bring and to innovate in ways that will help them be more productive, providing the tools they need to do this. Research funder-publisher partnerships will also be critical, and publishers need to be prepared for funders to require the work they fund to be publicly available. Publishers have to ask themselves the brutal questions: Can researchers survive without publishers? Can publishers survive without researchers?

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