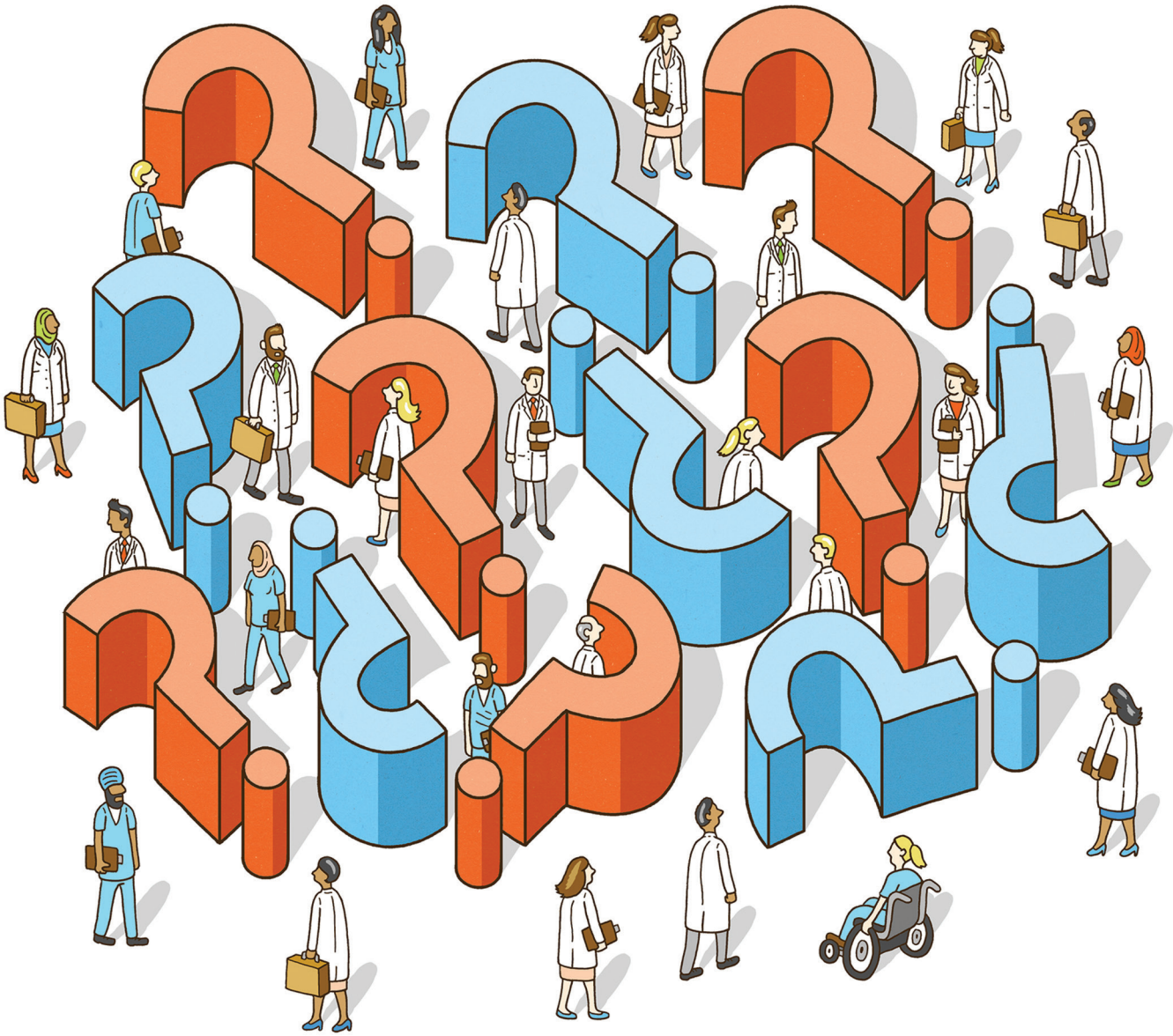
Quality, trust & peer review:

researchers' perspectives 10 years on



ELSEVIER

SENSE about SCIENCE

A study by Elsevier and Sense about Science published September 2019.

Contents

Introduction and key findings

Since the middle of the 20th century, peer review has proved the lifeblood of scholarly communication, supplying a gold standard for evaluating, authenticating and improving research articles. In 2009, Elsevier and Sense about Science joined forces for one of the largest ever international researcher surveys on the topic of peer review*.

During that survey, we asked researchers for their thoughts on various aspects of the process; for example, what it should do, how it was performing, and how it could be improved. The insights we published became an influential reference document for publishers and policy makers alike.

A decade on…

Over the past 10 years, much has changed. Technological advances are transforming not only how research – and peer review – is conducted, but the article formats and channels used to communicate those findings.

For both the public and researchers, these changes bring advantages, including greater access to published research, more transparency around how research is conducted, and faster delivery of results. But they also bring challenges – with so much information now available, and so many channels to choose from, sifting material and evaluating sources becomes more complex. Cross checking facts has become increasingly important, but it takes time, and short-cuts to minimize those efforts may narrow options. And it's not always clear whether what is reported by a third party has been peer reviewed; for example, a preprint, piece of code, or a media story. There's also opportunity for misrepresentation and/or exaggeration of findings to creep in at all stages of the communication process.[1] Understandably, this has sparked discussions around research quality and trust in science.

Mapping the changes – the 2019 study

So, we decided to partner again on a new survey to understand how researcher attitudes have changed. More than 3,000 researchers responded from a wide array of disciplines, career stages and locations. We repeated some of the questions asked in 2009, but importantly expanded our scope to capture feedback on trustworthiness, what constitutes peer review, and which metrics best signal quality and aid evaluation. We also wanted to understand how researchers view public confidence in research. In addition to the survey, we interviewed a number of researchers to explore the issues raised. You'll find more details on the study methodology on page 31.

Peer review – the process

In the case of scholarly journals, editors typically send an authors submitted manuscript for evaluation by experts in the same field, who are generally asked to consider the **quality**, **originality**, and **importance** of the research in the manuscript. Following evaluation, the reviewers either recommend accepting it for publication – with small or extensive revisions – or rejecting it. The decision to publish lies with the editor.

In recent years, online platforms, digital technologies, and a rising volume of content have sparked new peer review criteria and formats, many of which we explore in this report.

Key findings – what we discovered

- Since our 2009 study, **researcher satisfaction with peer review has increased**. Researchers don't want to replace the process; they just want to improve it.
- With the number of information channels rising and the volume of research outputs increasing too, researchers are concerned about quality. **Cross checks are becoming the norm**, creating inefficiencies in the research ecosystem.
- For many, finding a way to shift the focus from **quantity** of research outputs to **quality** will be key to increasing trust.
- Along with improvements to guidelines and training, **reviewers want to be recognized** for the work they do, particularly by their employers.
- **Few researchers believe the public understand the concept of peer review**. For many, the solution to increasing understanding of research findings lies in providing context and easy-to-understand explanations.

* https://senseaboutscience.org/activities/peer-review-survey-2009/

Our hope is that the key findings we've identified during the course of this study will provide a starting point for much-needed conversations in the community around how we can address these points. In **Conclusion and next steps** on page 29, we propose four key discussion areas and highlight those we believe are most urgent. We also look at what Elsevier and Sense about Science are doing to address some of these issues. Our goal is that by examining trust, we can work together on constructing a path that will carry us through the next 10 years.

Peer review today – what do researchers think?

Satisfaction with the system is high

Key finding: *Since our 2009 study,* ***researcher satisfaction with peer review has increased****. Researchers don't want to replace the process; they just want to improve it.*

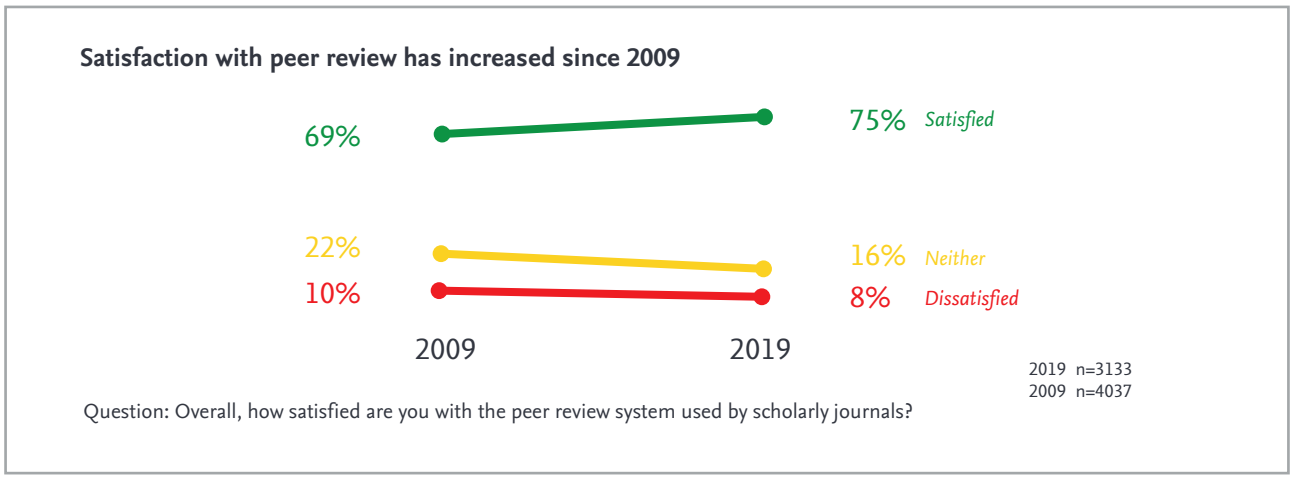


Figure 1: Researcher satisfaction rates with the peer review system – 2009 and 2019 figures.

Respondents to our 2019 survey were generally happy with the current evaluation system – in fact, satisfaction with peer review has increased since the survey we conducted in 2009, from **69 percent to 75 percent** (see figure 1).

"I think the process is beneficial for your blind spots. When it's your own research you think you've done an amazing job."

Dr. Amarachukwu Anyogu, Lecturer in Microbiology, University of Westminster, UK, researcher interviewee

Peer review: both successful and necessary

Almost all the researchers we surveyed in 2009 and 2019 (**91 percent** and **90 percent**, respectively) felt that peer review improves the quality of research published.

And respondents to both surveys strongly agreed that without peer review there would be no control in scientific communication (**84 percent and 85 percent**, respectively).

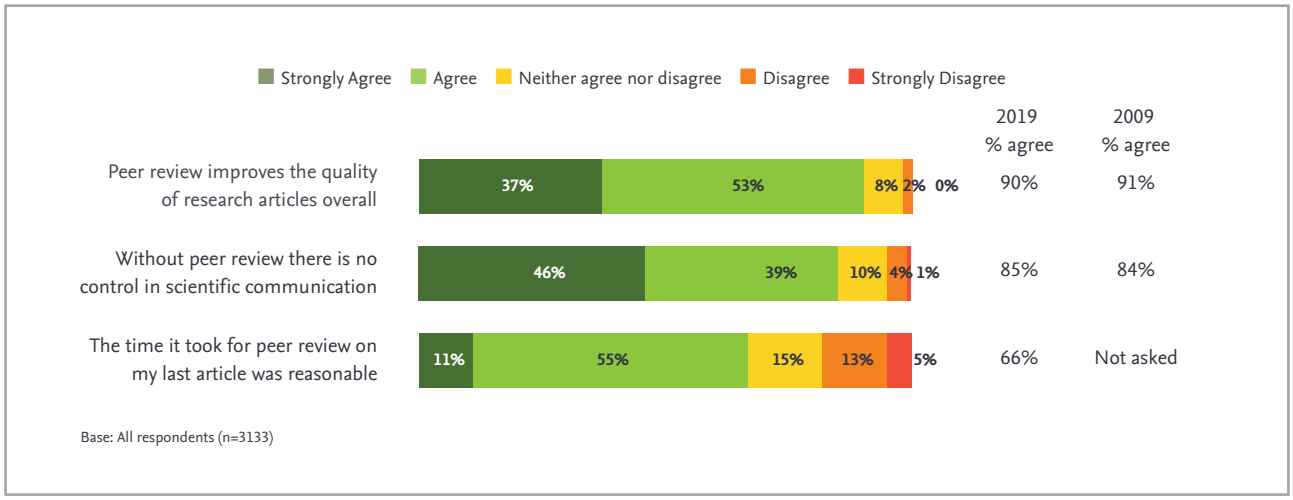


Figure 2: Researchers' views on how peer review is performing – 2009 and 2019 figures.

Researchers continue to view content with a critical eye

Key findings: *With the number of information channels rising and the volume of research outputs increasing too, researchers are concerned about quality.* ***Cross checks are becoming the norm, creating inefficiencies in the research ecosystem.***

For many, finding a way to shift the focus from ***quantity*** *of research outputs to* ***quality*** *will be key to increasing trust.*

How trustworthy do researchers find research outputs?

Trust in the research outputs they access is crucial for researchers, and those research outputs can take many forms, from data sets, code, videos, theses and preprints, to academic blogs, scholarly articles, or even media reports on findings. But while satisfaction with the effectiveness of peer review was high among survey respondents, confidence in the reliability and trustworthiness of research outputs had yet to hit a similar level. **62 percent** of respondents found the majority of research trustworthy, but over a third – **37 percent** – admitted they had doubts over the quality of at least some research outputs they had encountered in the week prior to the survey – including those they thought had been peer reviewed. Although, a number went on to note that questioning findings is a key requirement of their role.

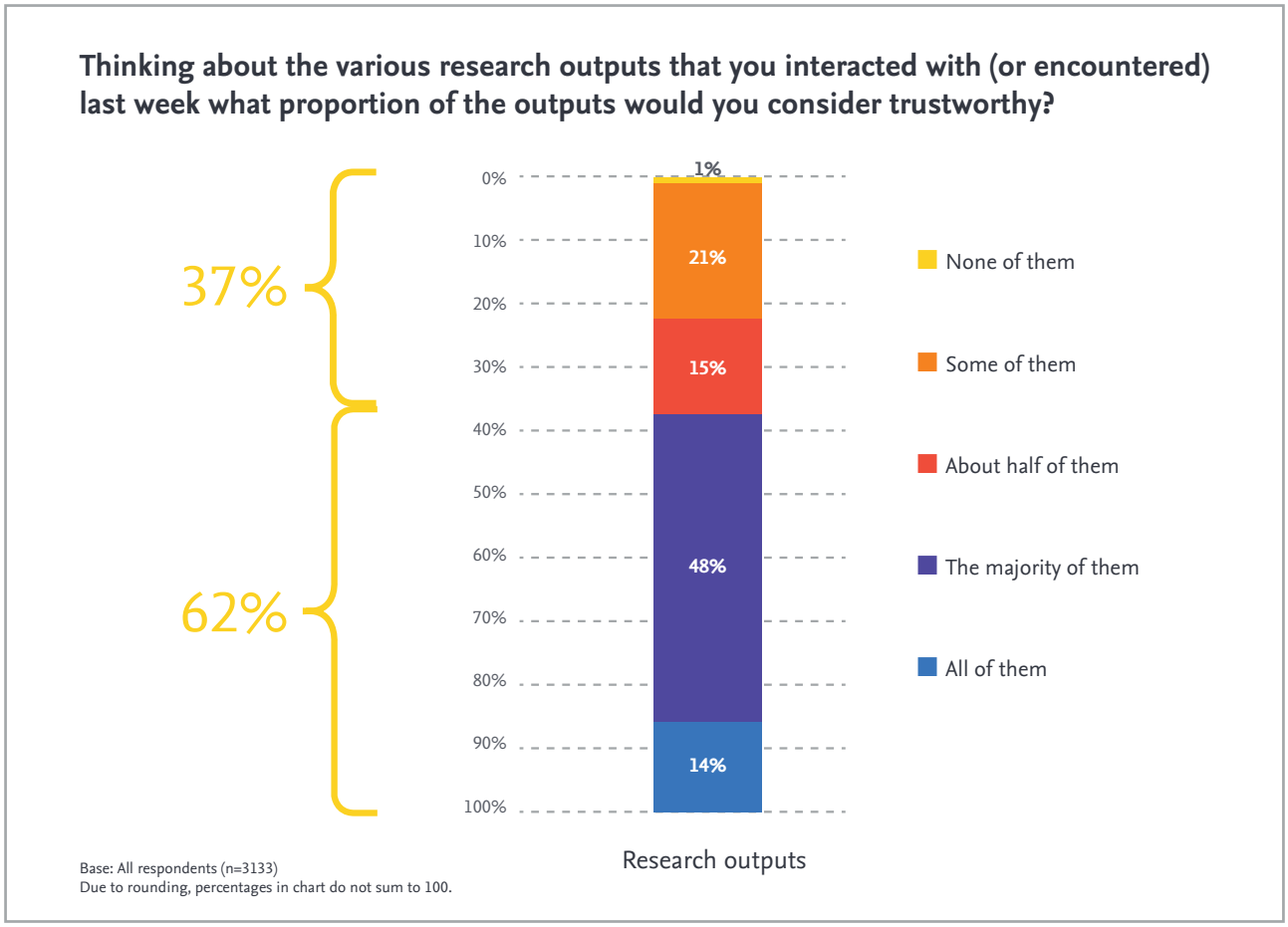


Figure 3: Researchers' views on the trustworthiness of recently accessed content.

"Researchers should doubt everything."
Social Scientist, Taiwan, aged 36-55, respondent to researcher survey

Responses varied by specialty (see figure 4), with Computer Scientists, who unlike other domains have a strong tradition of sharing information at conferences, showing the lowest level of confidence overall (**11 percent** trusted all content and **40 percent** the majority of content). Mathematicians were the most likely to trust all outputs they read (**20 percent**), probably because they are often checking a proof, which is easier to assess than the data interpretation common to many other disciplines.

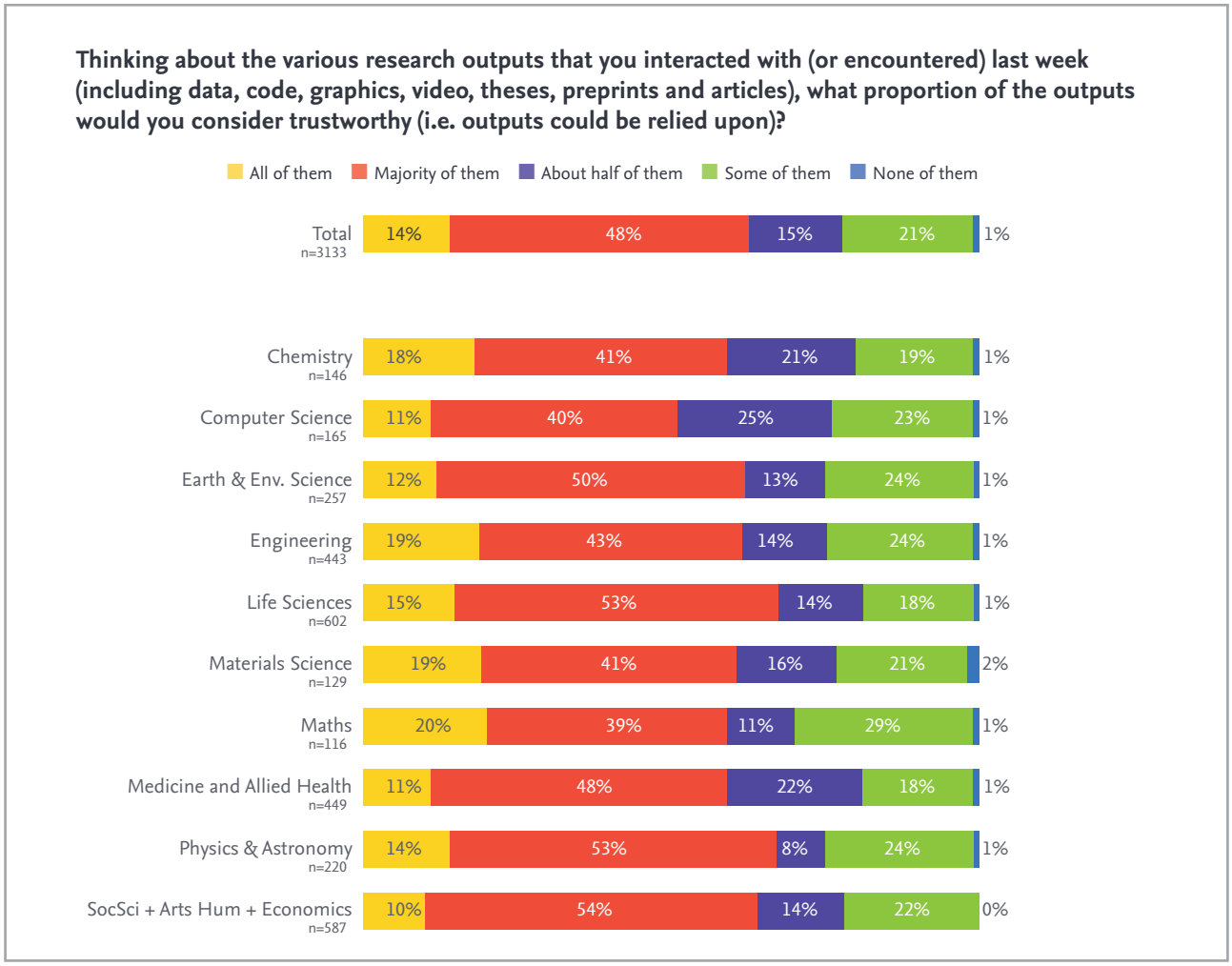


Figure 4: Researchers' views on the trustworthiness of recently accessed content (by specialty).

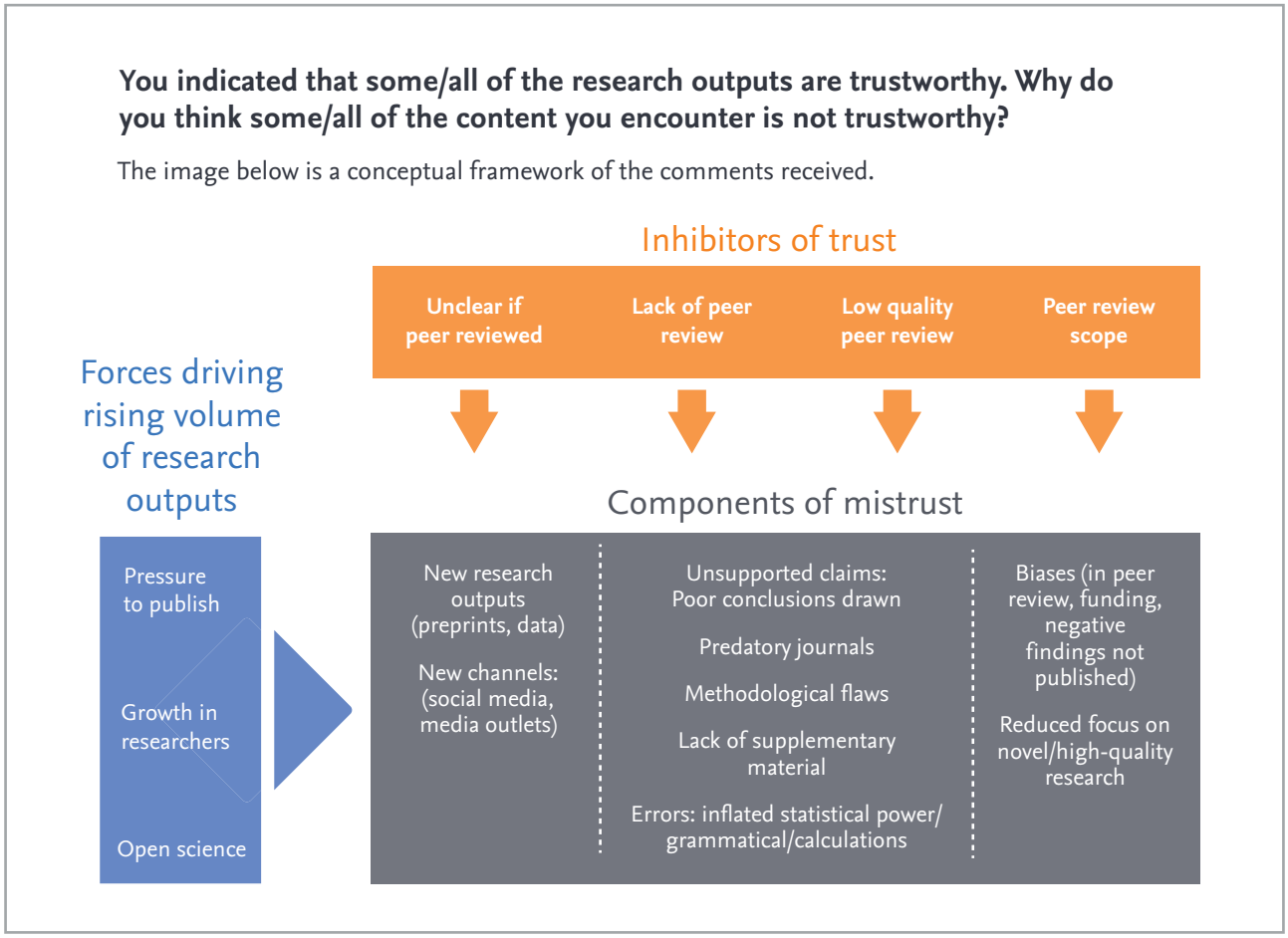


Figure 5: The reasons researchers gave for doubting some/all of the content they had recently encountered.

Reasons for mistrust

When we asked respondents why they thought some research outputs were untrustworthy, we received nearly 2,000 responses. A review of these comments, along with the in-depth interviews, enabled us to identify a number of themes (see figure 5). We've included a range of their quotes in this section to illustrate the most common points raised.

Pressure to publish

Our respondents indicated that the **"publish or perish"** spiral is playing a key role: the idea that researchers must regularly publish papers to secure grant funding and career progression. And according to Northwestern University's Dean of Libraries, Sarah Pritchard: "The notion that a person needs to have lots and lots of 'objects' credited to them to get tenure is not going to change. It's going to continue to be what counts when making the judgment call, 'is this person ready to get tenure?'"[2]

For our study respondents, these pressures are negatively impacting the quality of researchers' studies and, ultimately, their papers.

"The university/research system forces researcher to publish a ridiculous amount of articles… researchers do not have time to properly test and validate the results. Trying to reproduce the results highlighted in the paper is often impossible, because there are missing details or errors."

Researcher in Electrical / Electronic Engineering, Italy, aged 36 to 55, respondent to researcher survey

The number of articles published each year has shown steady growth for more than two centuries; around 3.5 percent per annum.[3] But a 2014 study using Scopus data found that the number of published articles increased from 1.3 million in 2003 to 2.4 million in 2013 – this indicates that the rate of growth has increased to approximately 6.3 percent (CAGR).[4] This is being driven,

in part, by the growth in the number of researchers globally – a trend that is expected to continue.

"There are too many articles and news for scientific related research. For example, I browse about 200 scientific papers per day. I can't believe all of them."

Chemistry researcher, China, aged 36 to 55, respondent to researcher survey

To break this pattern, there is an opportunity for the community to develop – and, importantly, be willing to adopt – new ways of measuring the effectiveness of researchers and institutions. Jean-Claude Burgelman, Open Science Unit Head of the European Commission, would like to see the traditional reliance on volume and impact replaced by a more holistic approach: "If you accept that the whole workflow becomes open, you can put metrics on every part of it, from destination to impact. Then you get a dashboard of what you do as a scientist. That will become very interesting for funding and promoting purposes."[2]

The high volume of content being generated is, in turn, putting pressure on a limited pool of volunteer reviewers who are struggling to meet demand.[5]

"The reviewers simply do not have time to check everything in a paper. So, when I use a paper, I either check everything quickly myself, even if it is spot-wise, or rely on the advice of colleagues I trust who tell me that they believe the results in that particular paper."

Mathematician, Switzerland, aged over 55, respondent to researcher survey

This pressure on reviewers is borne out by the findings of a 2018 report on peer review by Publons. It found evidence of increasing "reviewer fatigue", with a rise from 1.9 to 2.4 in the number of invitations required to secure one peer review report.[6] As the 2018 STM Report notes: "In this context, the need…to provide [reviewers] with good incentives, support and training, becomes ever more important."[3] We explore the steps researchers would like to see introduced in **Maintaining quality and improving trust – for researchers.**

Writing in 2018, authors Altbach and de Wit called for the community to turn its back on the drive to publish, outlining the benefits such a move would bring: "Reducing the number of academic articles and books would permit the peer review system to function more effectively, would reduce or eliminate the predatory journals and publishers that have emerged recently, and would, perhaps most importantly, remove massive stress from academics who worry about publication rather than teaching and service."[7]

Many of our survey participants and interviewees also felt that it was time for the focus to shift from quantity of published content to quality.

"The concept of high rejection rates should be seen as a good thing."

Sergio Della Sala, Professor of Human Cognitive Neuroscience, researcher interviewee

Low quality peer review and the emergence of predatory journals

The need for researchers to publish, and publish regularly, has created an opportunity for "**predatory journals**" to emerge. According to Shamseer et al, these titles "actively solicit manuscripts and charge publication fees without providing robust peer review and editorial services".[8] As Rick Anderson, Associate Dean at the University of Utah in the US, notes, they "don't care about the significance or even the validity of findings, just about selling a fake publishing credential to authors".[2]

"Predatory journals have created mass confusion in the scientific community."

Researcher in Medicine and Allied Health, US, aged over 55, respondent to researcher survey

Predatory journals were a cause of concern for many of the researcher survey participants and interviewees, with one describing them as the "dark side of open access". STM, the global trade association for academic and professional publishers, also views the rise in these predatory titles as "worrying", largely because they impact the high levels of trust "vital to ensuring that the publication and sharing of research results helps to advance research, the global pool of knowledge and the careers of researchers and investigators."[9] There is already strong will in the community to work together to crack down on these journals, but, with the regularity with which new titles appear, solving the problem will take close cross-industry collaboration and, for some,

increased transparency around peer review (see **Move toward open peer review**).

Other researchers are concerned about the quality of peer review in general, and the lack of clarity around the peer review process; for example, who is involved and whether they are sufficiently qualified.

"... many researchers publish (peer reviewed) content with questionable publishers where the review process is often not clearly communicated. Often, these works do not fulfil the minimum criteria for good research, be it, understandable English language, proper formatting, and some meaningful findings."

Researcher in Computer Sciences / IT, Austria, aged 26 to 35, respondent to researcher survey

New channels and research outputs

Traditionally, a researcher's key "go to" source of information about an experiment or study was the final research article, published in a peer-reviewed scholarly journal.

This is shifting, with new article and journal forms and new platforms emerging to cater for a changing research community's needs.

Some of new channels that researchers are turning to are non-scholarly, with blogs, websites, and social media all playing an increasingly important role in the dissemination of research. Part of this is driven by the growing call on researchers to communicate all their research outputs, not just to one another but the public too, which we explore in **Increase and improve communication around science**. But the question for many researchers is just how much faith they should place in the content they access there, particularly as some of these channels are operated by organizations that have no relationship with the content and little or no responsibility to get it right.

"I keep a prudent scepticism when it comes to websites that provide summarized contents or do science popularization. I've found that scientific journalists cannot always be trusted to transmit science correctly."

Researcher in Biological Sciences, Argentina, aged 36 to 55, respondent to researcher survey

Several of our researcher interviewees sounded a note of caution about using media coverage as marker for trust.

"Some research is more interesting not because it has been conducted better. Some famous research has been shown to be not very good research."

Dr. Amarachukwu Anyogu, Lecturer in Microbiology, University of Westminster, UK, researcher interviewee

For others, while peer reviewed content remains their favored source for reading about developments in their own field, news coverage offers a useful way to assess research in other subject areas.

Preprint servers such as arXiv, bioRxiv and SSRN have also been rising in popularity. These servers host research papers that have yet to be peer reviewed or published in a journal. Some communities have been vocal in their support for preprints, welcoming the fact that they enable public (and fast) registration of results. Others believe their value lies in the fact that people can share ideas at an earlier stage, helping them to test what does – and doesn't – work. Several major funders have already introduced policies to support the sharing of results on preprint servers. But while these channels add to the transparency of research, some researchers are unsure how much faith they can place in the content they read there.

"At the preprint level, it takes (more) time to examine if it is trustworthy."

Physicist, Japan, aged over 55, respondent to researcher survey

For example, this year saw Victor Dubowitz, Editor-in-Chief of the journal *Neuromuscular Disorders*, publish a strongly-worded editorial questioning the wisdom of sharing research that has yet to be validated by peer review.[10] The Editor-in-Chief of *JAMA*, Dr. Howard Bauchner, MD, was also moved to write an editorial about his reservations over what he termed "the rush to publication".[11]

"I read a lot of papers on arXiv that are helpful and interesting, but I don't fully trust all of the results unless I read the paper in depth to verify myself, or until it is published in a peer-reviewed journal or conference proceedings. Other work may not be in my field, so I would consult with an expert in that area before fully trusting the research."

Researcher in Computer Sciences / IT, US, aged under 36, respondent to researcher survey

Reduced focus on novel or high quality research

Among the new scholarly communication channels emerging are some offering a new flavor of peer review. For these platforms, it's not about whether the submission adds new knowledge to a field; the most important criteria is that the science is sound. This trend was largely triggered by the emergence of PLOS ONE as the first **megajournal** in 2006. It pioneered publication of a manuscript following an initial check for validity of the research. The article's true merit is established following publication, typically via the posting of reader comments. Since then, other publishers have adopted the model, launching titles that are multidisciplinary, (usually) gold open access, and much broader in scope and size than traditional journals.

"... some articles that are rejected by one journal 'do the rounds' until they do get published, even though they are sub-standard. So just because it's published doesn't mean it's any good, especially with the explosion in the number of open access journals recently."

Researcher in Medicine and Allied Health, Australia, aged over 55, respondent to researcher survey

In 2013, **F1000** took this model a step further with the launch of the open access F1000Research platform for life scientists, promising rapid publication (within seven days of submission). Peer review takes place post-publication and "peer review reports are published – alongside the reviewers' full names and affiliations – as soon as they're submitted, and remain attached to the article if it is indexed with sites such as PubMed and Scopus."[12] Several funders, organizations and a scholarly publisher have subsequently partnered with F1000 to launch similar platforms.

For some, these new channels bring benefits to the community, offering a home for the negative results, replication studies and other forms of research that often never get published – despite the role they can play in combating reproducibility issues and increasing transparency.

"Negative findings are usually under-reported."

Head of Department / Senior Management, Medicine and Allied Health, Greece, aged 46 to 55, respondent to researcher survey

The speed of publication offered by F1000Research and others ensures rapid sharing of results, which many see as key to tackling the global challenges society is currently facing.

For others, the high acceptance rates are only adding to the already rising volume of published research, while, for many, the decision to focus on sound science is resulting in too much low-impact research being published. Some of our researcher interviewees also expressed concerns about the reliance of megajournals on the posting of reader comments, with many saying they were too busy to take part in informal post-publication commenting themselves. Several also noted that this form of correction bypasses journal errata and corrigenda, the traditional and traceable way to amend scholarly articles.

However, there was a view among some interviewees that a shift of the publication bar is an inevitable and necessary step in the research process.

"We shouldn't be accepting that poor quality research gets published. But we should expect low impact research. Incremental research. It's how science works."

Professor Ginny Barbour, Queensland University of Technology, Brisbane, Australia, and Director of the Australasian Open Access Strategy Group, researcher interviewee

The rise of data, other materials and research integrity challenges

Open science has won support at all levels, with governments, funders, higher education institutions and researchers all working toward making science more available and transparent. Increasingly, research grants have open science conditions attached; for example, requiring that researchers share their data and other supplementary material. And, as we explore in **Introduce quality controls for data and supplementary material**, more than **70 percent** of survey respondents agreed that where this information is shared, it should be peer reviewed.

This shift is being driven, in part, by concerns around research **efficiency and reproducibility**. These are both seen as important strands of the wider research integrity story, which requires researchers to work in a way "which allows others to have trust and confidence in the methods used and the findings that result from this".[13]

"I only believe [in] reproducible data and code."

Researcher in Engineering and Technology, China, aged 36 to 55, respondent to researcher survey

Reproducibility, or ensuring that a researcher can duplicate a study's results using the same procedures,[14] is considered vital to verify findings and drive fields forward. But, in recent years, there has been talk of a "reproducibility crisis" with debate around just how much published research actually satisfies that reproducibility definition. For example, 70 percent of respondents to a 2016 *Nature* survey reported that they had failed to reproduce another scientist's experiment – and more than 50 percent said they had failed to reproduce one of their own experiments.[15] The results of a 2018 Elsevier survey suggest that the situation may not be as bad as feared, or is improving… of the respondents who had attempted to reproduce a study in the previous year, 37 percent were successful, 57 percent were partially successful and only 6 percent were unsuccessful.[2]

In **Provide clear signals to help assess research**, we explore the idea of introducing indicators to combat some of these issues.

Open science and the drive for reproducibility have also fuelled the **atomization of the article**. Increasingly, it's not only the final research article that's published, but shorter articles highlighting each stage of that study; for example, individual publications for data, method, software, code and hardware. As a result, the *rise in researcher numbers* is being accompanied by a corresponding *rise in the number of publications per researcher.*[16] New open access journals and platforms have launched to cater for these outputs, often providing valuable descriptions and metadata so the work can be more easily found and reused by others.

While some welcome this development, others are more wary, concerned that this breakdown of content may have unforeseen results.

"Another reason for mistrust is the hyper production of articles, where authors reproduce one research into multiple articles ….Sometimes research is part of a larger and complex subject…taking that small part from the context may have influence by itself on the final results."

Researcher in Engineering and Technology, Serbia, aged under 36, respondent to researcher survey

Unethical researcher behavior, errors and bias

As we've seen, there are many reasons our interviewees and respondents view published research outputs with a critical eye. For some, **bias**, conscious or not, is a source of concern. Several felt the problem lies within the system itself.

"Only a significant research finding gets published so may introduce bias."

Researcher in Medicine and Allied Health, India, aged under 36, respondent to researcher survey

While, for others, the issue lies with the researchers writing and reviewing the content.

"Authors, even good and well-intentioned ones, bring strong biases towards their preferred position in the field and peer review tends to rely on comment from people from within the same field so confirmation error and lack of well-informed challenge from peer reviewers is likely."

Psychologist, UK, aged 46 to 55, respondent to researcher survey

For some, political correctness is also leading to bias, either influencing the conclusions drawn or the decision to publish them.

"… try questioning "diversity" or "climate change" and see what happens to a manuscript. It will vanish and never be published no matter how valid its data may be. Some topics are "forbidden" and this makes some content suspect. Not an issue in many fields but in some it is a real problem."

Researcher in Biological Sciences, US, aged over 65, respondent to researcher survey

For others, conflict of interest was an issue, with concerns over research findings funded by industry, ministries or government agencies.

Some study participants also identified **unethical behavior** as a factor influencing publication quality. In recent years, a few high-profile cases of authors taking shortcuts, resulting in unintended consequences, or fabricating results (notably the falsification of data by Hwang Woo-suk),[17] have attracted media attention. But, for our researcher interviewees, the publicity these cases receive, may magnify the problem.

"There is a focus on fraud, but the vast majority of the problem is not doing really bad things. It's doing low quality research."

Professor Ginny Barbour, Queensland University of Technology, Brisbane, Australia, and Director of the Australasian Open Access Strategy Group, researcher interviewee

Researchers cross the ethical boundaries as reviewers too – there have been reports of researchers exploiting "loopholes in the peer review system to submit bogus reviews."[3]

Many of the researchers we spoke with were also realistic about the potential for **mistakes** to be made at every stage of the research and publication cycles. Some felt this was a direct result of the drive to publish we explore in **Pressure to publish**, others pointed the finger at lack of experience (on behalf of the author and/or reviewer), researcher culture, or simply "human error". Some felt that a certain level of inaccuracy was inevitable.

"Just statistically speaking, some work I view is going to be false (with benefit of the doubt to the author, unintentionally)."

Researcher in Biochemistry, Genetics, and Molecular Biology, UK, aged 26 to 35, respondent to researcher survey

The research community is already working to address many of these concerns; for example, tightening controls on reviewer invitations and increasing the use of tools to identify errors and unethical practices. Many of these steps have been made possible by recent advances in technology. Although, for some, these developments have the potential to create a new wave of biases and errors, as we explore in **AI in peer review – where should we draw the line?**

It is not just about content…

Researchers often consider the author or institution behind a study when deciding whether to read on. Online profile pages, which provide details of a researcher's prior research, *h*-index, citations etc. can be a helpful source of information, but these profiles are often hosted on non-scholarly sites. **75 percent** of respondents to our survey thought the majority of the profiles they had recently encountered were reliable; much higher than the percentage who found research outputs trustworthy. However, **a quarter** admitted they doubted the quality of at least some of the profiles they had read in the week prior to the survey (see figure 6).

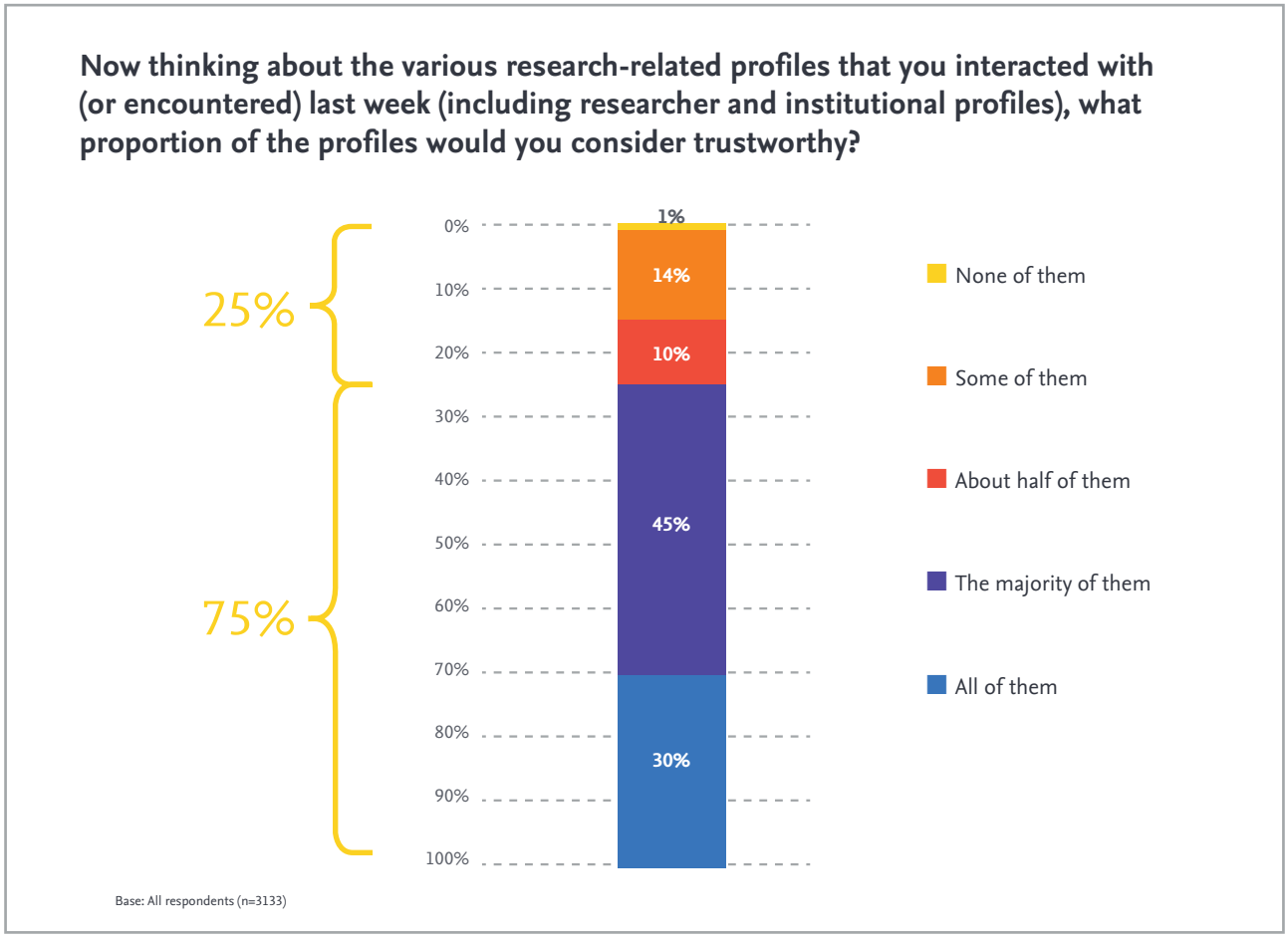


Figure 6: Researchers' views on the trustworthiness of recently accessed researcher profiles.

Survey participants identified a number of reasons they treated profiles with caution; for example, exaggeration, self-promotion and falsification were key concerns.

"Research profiles are becoming more important than research itself. Therefore, researchers tend to create huge, impressive but 'empty' profiles."

Researcher in Immunology and Microbiology, Spain, aged 46 to 55, respondent to researcher survey

Some touched on the fact that profiles may be out of date or inaccurate.

"Many are updated infrequently. Others appear to be updated semi-automatically and contain errors."

Researcher in Biological Sciences, US, aged 36 to 45, respondent to researcher survey

While others felt there wasn't enough information available to place the researcher in a community context.

"If I am contacted by someone with a profile disconnected from everybody, I do not trust it."

Researcher in Engineering and Technology, Switzerland, aged 26 to 35, respondent to researcher survey

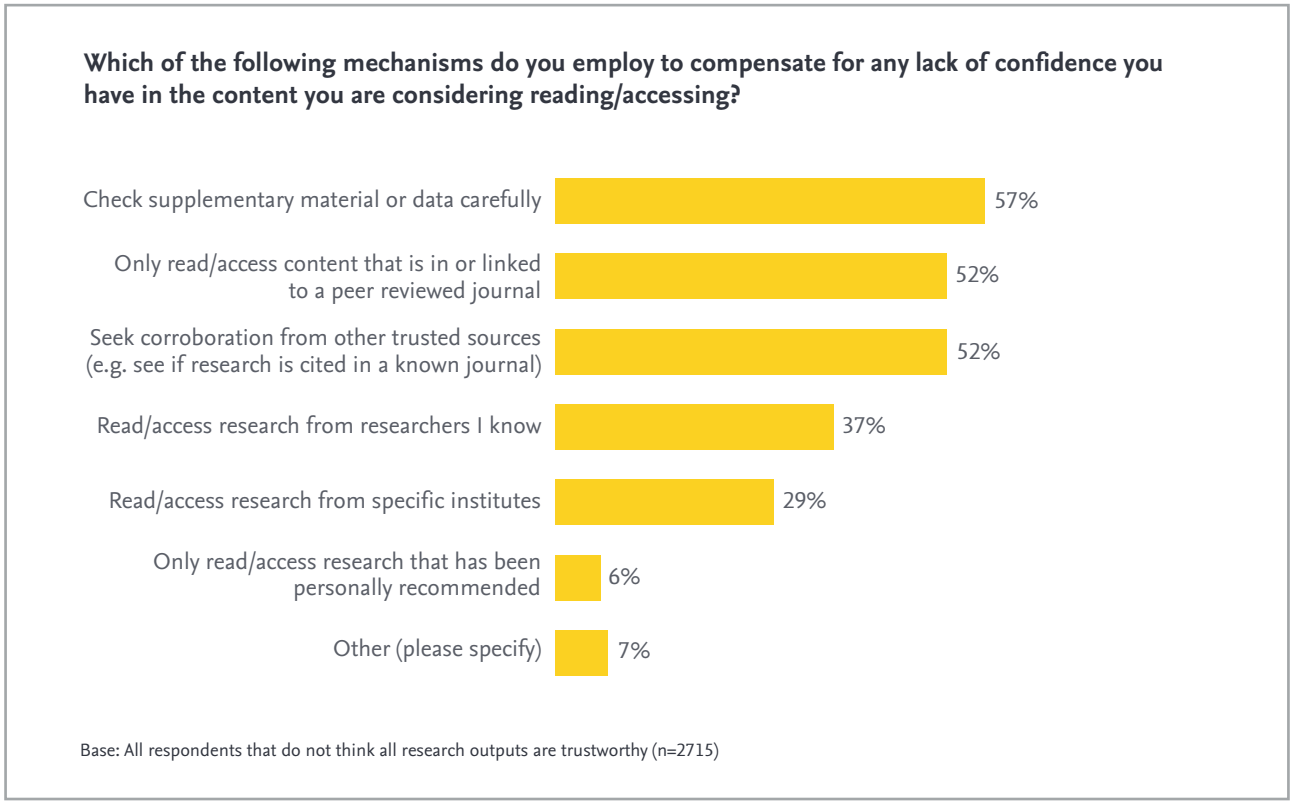


Figure 7: Actions researchers take to confirm the trustworthiness of published content.

How researchers assess research outputs

To combat their doubts over research outputs, researchers have developed alternative methods to evaluate content (see figure 7).

One of the most popular steps they take is to carefully check supplementary material (**57 percent**) – but that eats up precious time. And, along with approaches such as only reading research by researchers they know (**37 percent**) or that stems from a specific institute (**29 percent**), these coping mechanisms are in danger of limiting their field of vision.

What constitutes peer review and the role of the editor

What steps do researchers consider are necessary to qualify evaluation as peer review? For most of our survey respondents **(87 percent**), it was the assessment of research by at least two researchers, with or without input from a member of the editorial team (generally the most common form). Sometimes, two or more members of the editorial board will evaluate an article, but only **27 percent** of respondents believed this counted as peer review and the percentage dropped to **12 percent** when it was just one member of the editorial team (see figure 8).

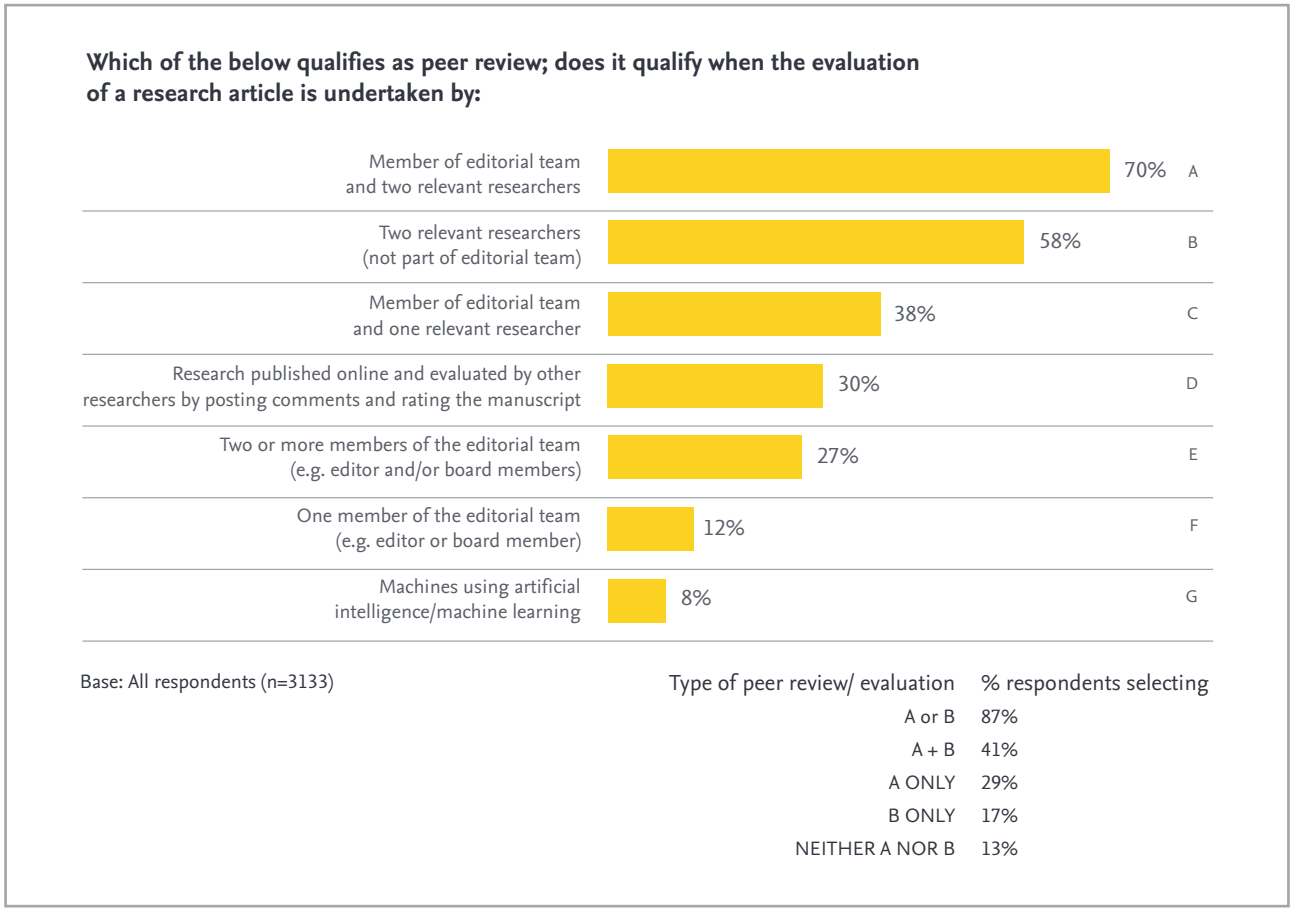


Figure 8: Researchers' views on what constitutes peer review.

This poses an interesting question for journal editors and publishers about how peer review and the decision-making process is perceived. Interestingly, several of the researchers we interviewed for this study felt there was a misconception in the community about the role of the editor in peer review. In particular, they were concerned that researchers viewed the process as a "voting system", i.e., that if two reviews were contradictory, the editor should commission a third, rather than weighing up the responses and making a judgement call themselves.

Writing for *Scholarly Kitchen*, Kent Anderson noted: "New editors are often surprised by the amount of sway their position provides, both over the editorial process and within the field."[18] He made the point that, in every journal, there is still a need for "filtering, selection, refinement, and finalization",[18] a role the editor fulfils.

Challenges and opportunities

In the previous section, we explored a number of the developments driving change in how research is accessed and evaluated, from new types of outputs to new channels to share them. But there are other factors at play...

Growing trends

Interdisciplinary and multidisciplinary science

Collaboration between researchers is increasing and one of the factors driving that growth is **interdisciplinary and multidisciplinary science**. Since the mid-1980s, research papers have increasingly cited work outside their own disciplines. And this crossing of subject borders is only growing in importance as global challenges, such as climate change, become ever more pressing. To solve problems on this scale will require researchers from many fields to join forces, sharing their knowledge and expertise on topics as wide ranging as energy storage, water management, refugee issues, and crop production. Some predict we will reach the stage where "the notion of discrete fields of study will become obsolete" and "phenomena must be examined holistically".[19]

Increasingly, governments and funding bodies require researchers to demonstrate an interdisciplinary approach in their research; in particular, a focus on mission-driven projects that bring economic or societal benefits.

For researchers, this need to embrace publications outstide their usual field means they may not have the knowledge to identify which ones to trust. And with interdisciplinary research still a relatively new addition to the published literature, the challenge for the community is to ensure the guidelines – and expertise – are in place to review these broad-scope projects, alongside suitable channels to publish them.

Move toward open peer review

As we've seen in **The rise of data, other materials and research integrity challenges**, there's a move toward open science in the research community and **open peer review** is viewed as another chapter in that story. Traditionally, peer review has seen limited information shared between the editor, reviewer and author, and even fewer details shared with the wider community.

Open peer view takes a different approach, introducing greater transparency to the process. It can take a number of forms:

- Varying levels of transparency around the pre-publication review
- Publishing reviewer names and/or the full peer review reports (with DOIs)
- Post-publication review (supplementary to, or instead of the pre-publication process)
- Collaborative peer review, where reviewers and editors conduct the review process in partnership

Open peer review advocates believe its benefits go far beyond increasing transparency and accountability. They believe it will make it more difficult for the dubious titles we explore in **Low quality peer review and the emergence of predatory journals** to operate. They also see it as an opportunity to provide reviewers with the greater visibility they desire and deserve (see **Improve support and recognition for reviewers**).

Although open peer review is not new, the number of journals experimenting with it has increased in recent years. And a 2016 report (conducted by Elsevier and others) found that there has been a marked increase in the likelihood of an author submitting to a journal where the reviewer's name will appear next to the article (in 2011, 45 percent were in favor; by 2015, this had risen to 52 percent).[20]

However, open peer review has yet to gain much traction, perhaps because, for some, there are still questions around the value it brings. As with any form of increased transparency, there are risks and concerns. A 2017 *Nature* editorial noted that some researchers and editors fear referee identification encourages positively biased or softened peer review.[21] While others fear that junior researchers, in particular, may be reluctant to have their names associated with negative reviews, or to be seen to criticize senior colleagues.[3]

As we explore in **Reduced focus on novel or high quality research**, carrying out evaluation of a paper after it's been published can speed up the sharing of results. But, according to STM, the "key problem with post-publication peer review is the relatively small number of papers that attract any comment or rating. Busy researchers have few incentives to engage, and there is a tendency to focus on controversial papers which attract negative comments."[3]

Global tensions

There are other tensions in the system. China has been performing 8.8 percent of reviews, while delivering 23.8 percent of published articles. Other emerging nations and regions together provide only 19.1 percent of reviews.[3] There is an opportunity here for the community to ensure that the reviewing burden is more evenly distributed. Previous work shows it is not due to a lack of desire to review on behalf of researchers in China,[20] as we explore in **Redistribute the reviewing burden**.

AI in peer review – where should we draw the line?

Whether performed before or after publication, and whether names are shared or hidden, the peer review system has changed little since its widespread adoption in the 20th century. But some believe that the rapid developments we are witnessing in artificial intelligence (AI), machine learning and natural language processing (NLP) are about to change all that.

Within the peer review process, AI technology is already being used to help alleviate one of editors' biggest headaches – identifying new reviewers – with algorithms able to assess the suitability of researchers much faster and more efficiently than humans can. It's also helping to fight plagiarism, identify bad reporting and statistics, and detect data fabrication,[22] as well as analyze and summarize manuscripts.[23]

All these tools are designed to support peer review, delivering information or recommendations that editors and reviewers can use in their decision making and, importantly, to speed up the review process.

However, for some, the logical next step is to remove humans from that process and fully automate peer review. Supporters of automated evaluation claim the benefits would be two-fold: machines would dramatically reduce the time required for reviews and remove human bias. [22]

However, only **8 percent** of respondents to our survey felt that artificial intelligence or machine learning would qualify as peer review.

Critics of automated peer review claim that computer algorithms have the potential to be fooled, or are inherently biased by the programmer and/or historical data (the effects of which can then be compounded). This could lead to AI influencing how submissions are written, with researchers careful to create texts similar to those accepted in the past. Others question whether algorithms can truly replace human input; for example, the vision someone might contribute to shape a field. In particular, they are concerned that novel discoveries might be lost with "AI reviewers" unable to recognize their innovativeness. This is something that emerged strongly in Elsevier's recent report *Research futures: Drivers and scenarios for the next decade.*[2]

The jury is still out on the desirability of AI peer review, and it is likely to be many years before the technology is sophisticated enough to take on that responsibility. For some, the question now is how we embrace the opportunities technology offers to manage the rising volume of submissions and alleviate the burden on reviewers, while retaining the benefits of human judgement. As we can see in figure 12 on page 22, only **17 percent** of our survey respondents are in favor of software being used to triage manuscripts prior to formal peer review.

Maintaining quality and improving trust – for researchers

Key finding: *Along with improvements to guidelines and training,* ***reviewers want to be recognized*** *for the work they do, particularly by their employers.*

Although researchers value peer review today more than ever, they know there is room for improvement.

The trends we are seeing raise a number of questions for the community. And researchers have their own ideas about where the system's foundations can be strengthened, and steps taken to deliver the trusted research outputs they need.

Introduce quality controls for data and supplementary material

The growing focus on open science and reproducibility means that more data and supporting material are now being shared – either within research articles or as separate outputs.

76 percent of the respondents to our survey felt that where elements such as data and supplementary material

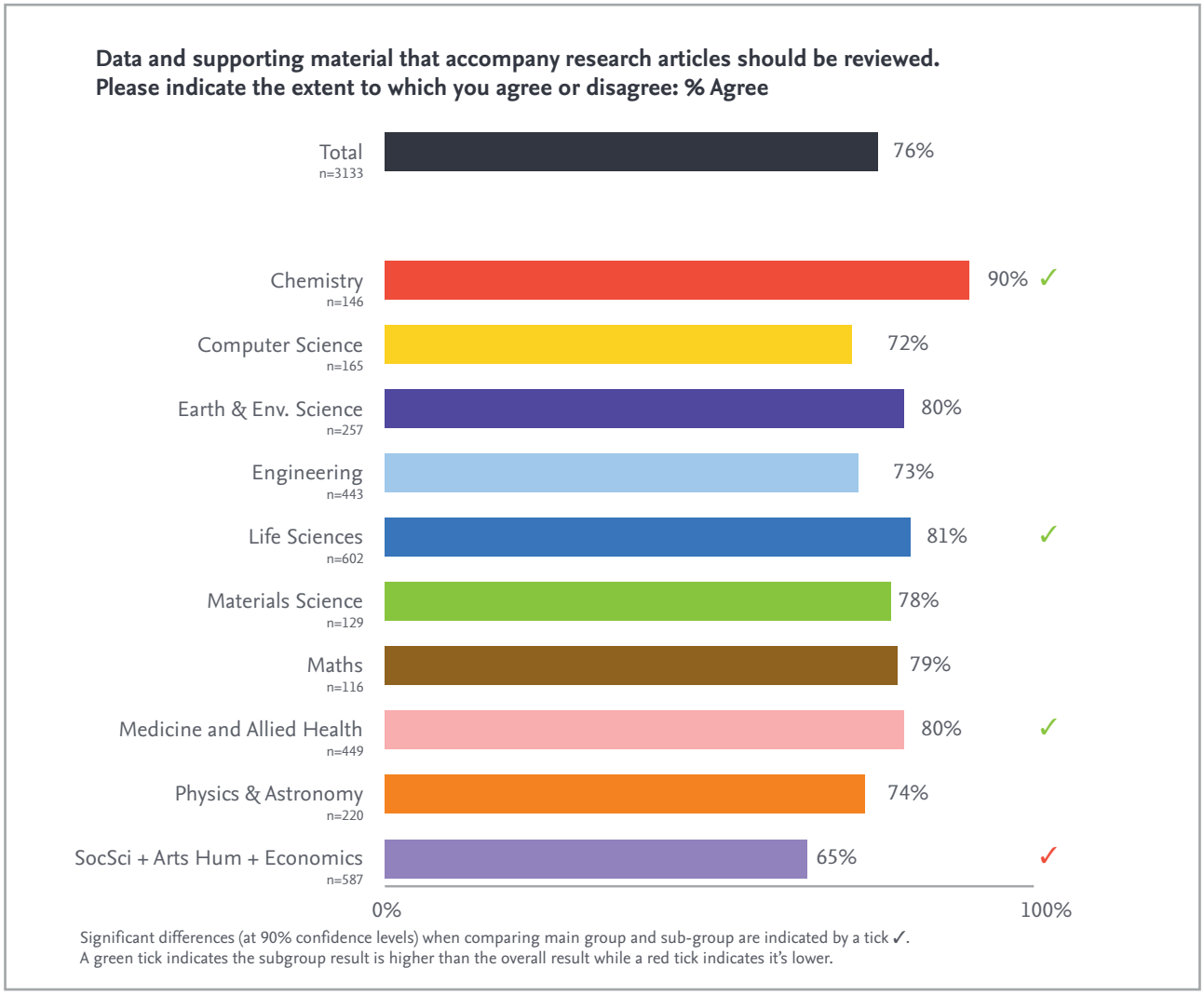


Figure 9: Researchers' views on whether data and other supporting material should be reviewed (by specialty).

were shared within the article, they should be evaluated in some way. If we look at the responses by specialty (figure 9), perhaps unsurprisingly, data-rich specialities such as Chemistry (**90 percent**), Life Sciences (**81 percent**) and Medicine and Allied Health (**80 percent)** believed it was important these elements were evaluated. While in specialities where data often plays a more subsidiary role, the appetite was weaker; for example, in Social Sciences, the Arts and Humanities, and Economics (**65 percent**).

Overall, just **6 percent** believed that data and supplementary material should not be reviewed. Based on our researcher interviews, this could be because some feel they simply don't have time, while others may feel that further investigation is only necessary if the paper itself raises a red flag.

The question is whether we have the right measures and guidelines in place to effectively review software, code or data. There are currently no agreed global quality or transparency standards for data. Furthermore, data sets can often be large and complicated, requiring in-depth understanding of their structure to determine their validity and completeness. In addition, the software or raw code used for modelling often require a knowledge beyond the expertise of the average reviewer. And where do we draw the line? As Northwestern University's Sarah Pritchard points out, "scholarly research also includes humanistic research that is a lot of diverse information. Non-book material, non-text, and non-paper material (film, audio, images, fabric, 3D objects...)".[2] Another challenge is creating time for researchers to review these extra materials. It could be that artificial intelligence will need to play a much greater role in the absence of "human" resources.

Provide clear signals to help assess research

As we've seen in **How researchers assess research outputs,** in a bid to allay their doubts over the trustworthiness of research outputs, researchers have developed alternative ways to evaluate content.

We asked our survey respondents to confirm which additional information, or signals, they thought readers (including those outside the community) would find most helpful when assessing research outputs (see figure 10).

Citations proved the most popular option (**88 percent**). An indicator to show whether someone else had tried to reproduce the research (and whether they had succeeded) also garnered strong support (**82 percent**), particularly among Chemists and Life Scientists (**90 percent**).

Interestingly, the most helpful tool they identified – citation count – is not usually available until some time after an article has been published, yet it is at the point of publication that many platforms flag a research output to potential readers. And the next three options they identified (reproducibility indicator, post-publication commenting and a peer review label) are only available intermittently. This creates an opportunity for the community to bridge the clear gap between what researchers want, and what is currently on offer.

A number of our researcher interviewees greeted the idea of a reproducibility metric with some caution, largely because of the low number of studies currently published in which the author has tried to replicate a previous study. For others in the community, agreeing a definition of reproducibility may prove a roadblock, with question marks around whether it should include concepts such as repeatable, replicable and reusable

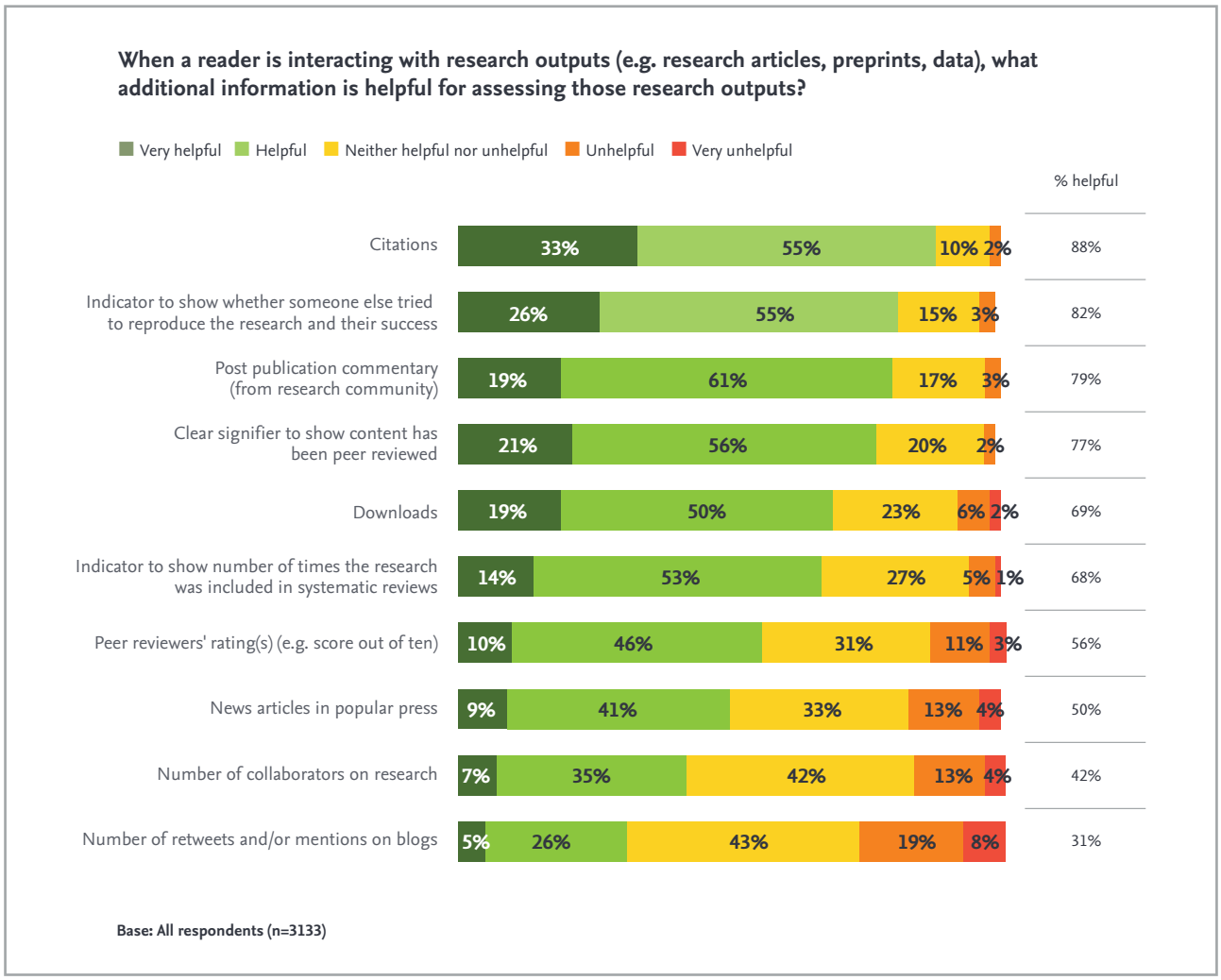


Figure 10: Researchers' views on additional information sources required to assess research outputs.

research. There is also debate around its relevance for some disciplines.[24]

Post-publication commentary also received support (**79 percent**), despite studies[3] – and our interviewees – suggesting that researchers were unlikely to find time to comment. Perhaps unsurprisingly, a high **77 percent** were in favor of ensuring peer reviewed publications were clearly marked up as such. Although, for some of our study participants, this was not for the benefit of researchers, but those outside the academic community.

"[As a researcher] you know from the database you are using to find the paper, that it has been peer reviewed."

Dr. Amarachukwu Anyogu, Lecturer in Microbiology, University of Westminster, UK, researcher interviewee

Increase transparency and control in delivery of content

When it comes to the tools and platforms researchers use to source scholarly content, many of our survey respondents felt that more information and, importantly, greater control, were key to finding trusted material.

78 percent agreed that being able to adjust or choose search algorithms and parameters was important. While **71 percent** wanted to see explanations about why an article had been recommended to them or returned in search results (see figure 11).

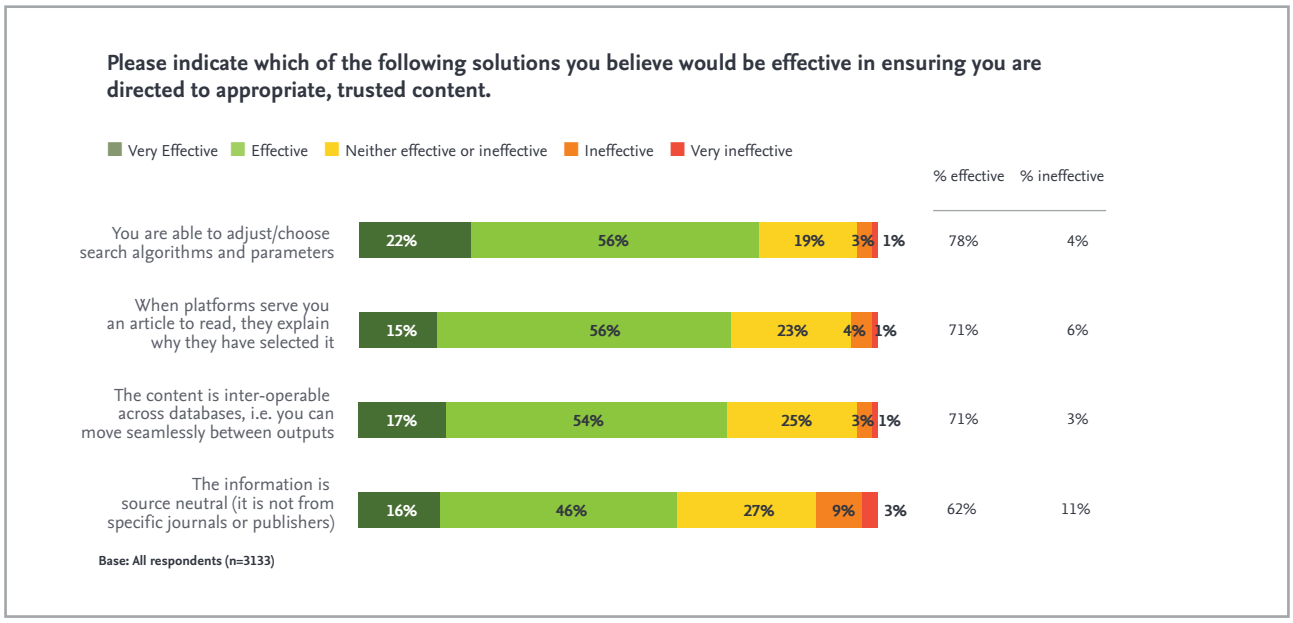


Figure 11: Researchers' views on how the delivery of trusted content could be improved.

Improve support and recognition for reviewers

Two thirds of our respondents (**66 percent**) felt reviewers would benefit from clearer guidance on reviewing criteria (see figure 12).

If we break down the results by specialty, clear guidance for reviewers proved important, whatever the discipline. But views varied on the need for formal training – interest was high in Medicine and Allied Health compared to the global average (**50 percent**), but generally lower than the average in the Physical Sciences, particularly Chemistry (**29 percent**) and Physics and Astronomy (**28 percent**), and in Mathematics (**17 percent**). For a full subject breakdown, please refer to the full survey results on Mendeley Data*.

Researchers regularly refer to the lack of proper peer review recognition as a weakness of the system; for example, it's a concern repeatedly raised at the Sense about Science peer review workshops held throughout the UK.[25]

Recognition can take many forms. In general, for respondents to our 2019 survey, employer recognition of the time they spent reviewing proved the most pressing need (**45 percent**), particularly in the Social Sciences, the Arts and Humanities, and Economics (**56 percent**). However, if we look at those figures by country, we see strong variations (see figure 13). China and Korea were the least likely to want employers to recognize the time spent reviewing (**23 percent** and **21 percent**, respectively) while the UK was the most likely (**72 percent**).

Other forms of recognition that respondents favored included accreditation (**34 percent**), and acknowledgement; for example, reviewer names published in the article (**28 percent**). Only **28 percent** wanted to see financial rewards for reviewers (**38 percent** in Computer Science) – this marks a substantial shift in views from 2009, when **41 percent** supported payment for reviewing.

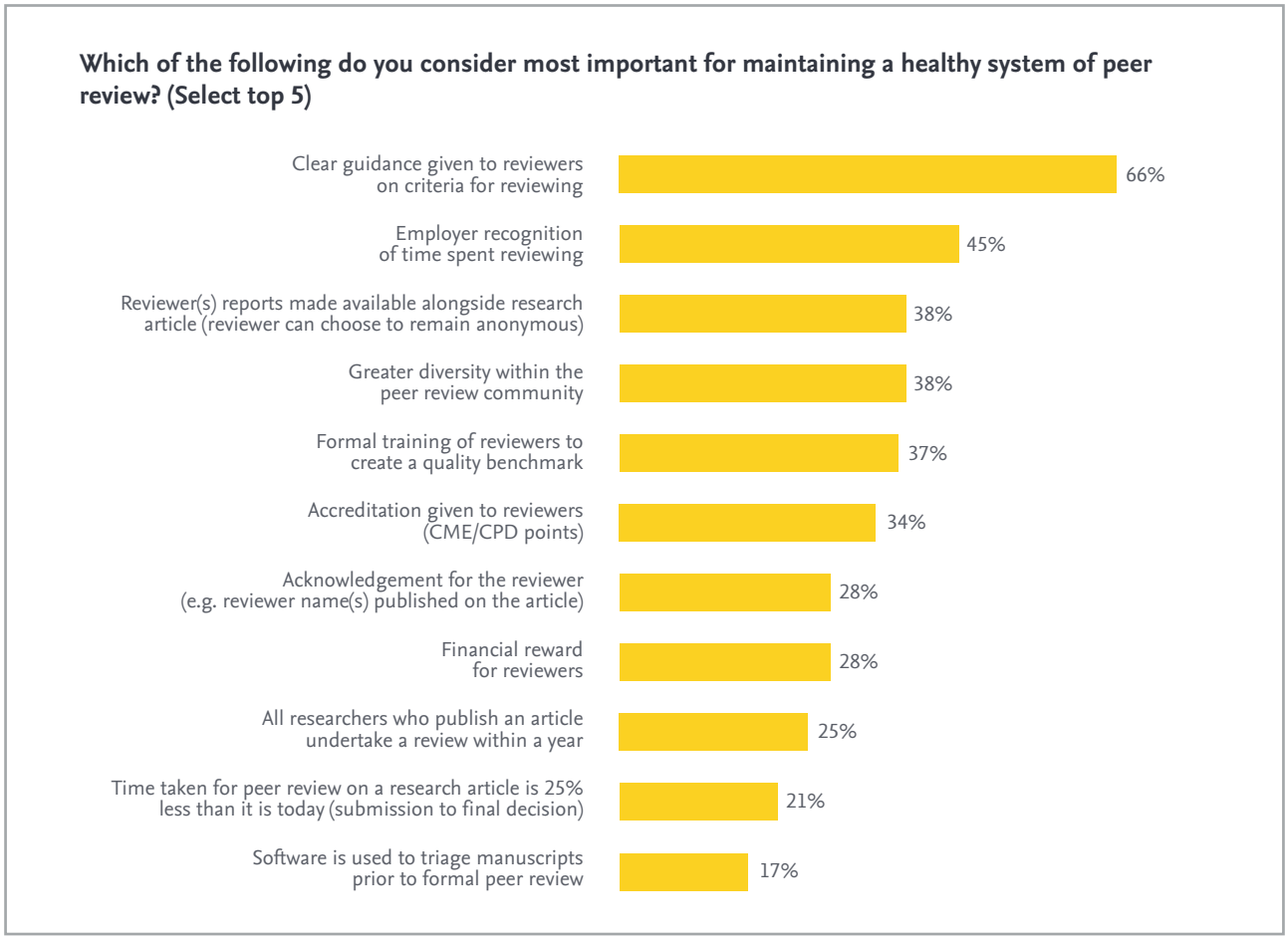


Figure 12: The steps researchers consider are important for maintaining a healthy peer review system.

*https://data.mendeley.com/datasets/wkd3jmm7mf/1

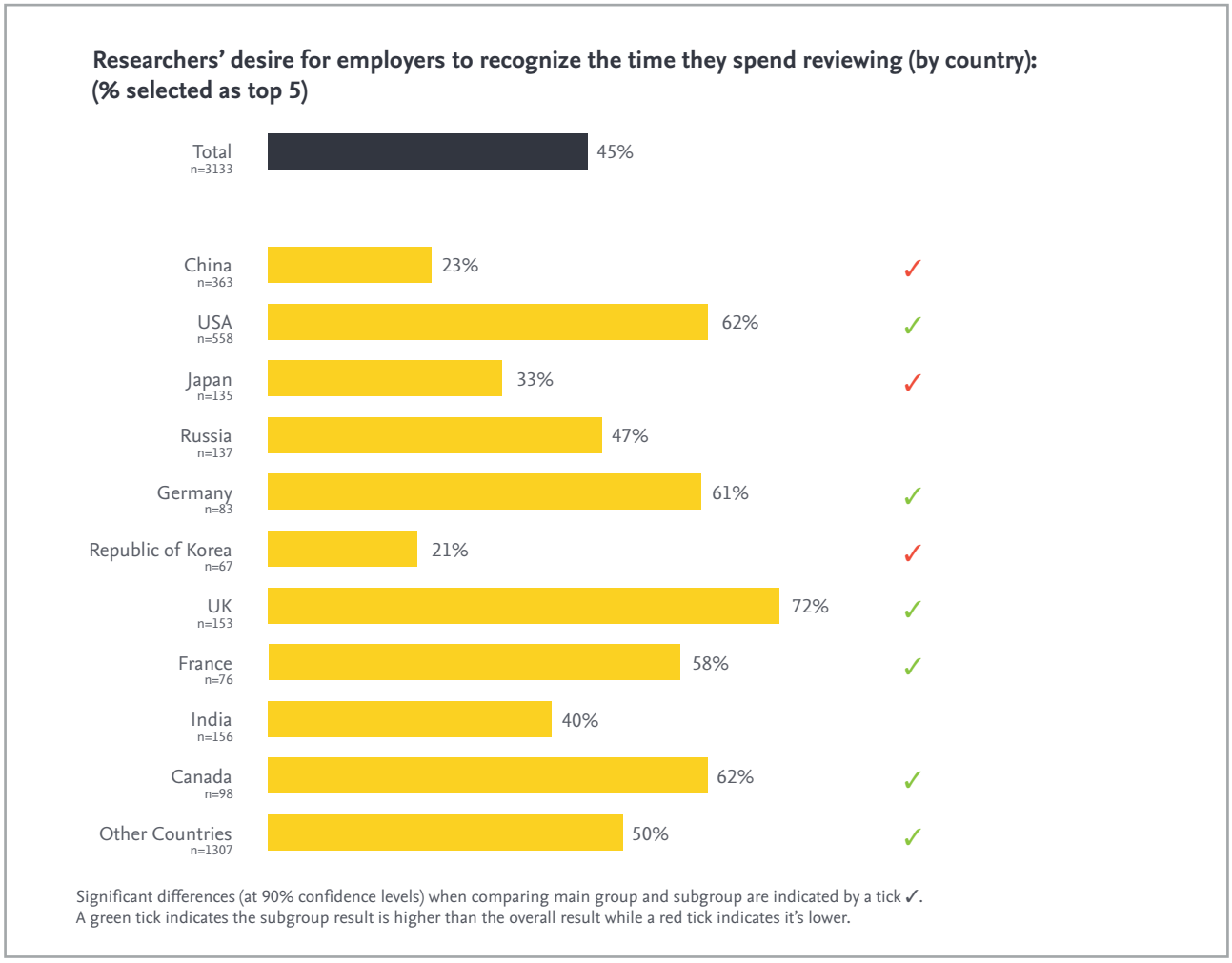


Figure 13: Researchers' desire for employers to recognize the time they spend reviewing (by country).

When it comes to recognition, many journals publish annual thank you lists, naming the reviewers who have supported them throughout the year. And initiatives such as Publons and Elsevier's Reviewer Recognition Platform help researchers demonstrate their reviewer contributions with indicators around the quantity and quality of peer review performed. However, for many reviewers, these steps simply don't go far enough. There is an opportunity for the community to remodel the existing incentive and evaluation systems so that researchers' reviewing activities become a core component. While, for some, this may involve incorporating the elements highlighted in figure 12, for others, the development of reviewer metrics will prove vital – however, to date, there has been no widespread agreement on what form these indicators might take.

Redistribute the reviewing burden

As we touch on in **Global tensions**, the burden of peer review is currently unevenly distributed. US researchers conduct disproportionately more than their global share of reviews, relative to the share of papers they publish. While China (and, to a lesser extent, India, Korea and Japan) review proportionately fewer papers than they publish. This is not because of an unwillingness to review when asked – studies suggest Chinese authors are the most likely to accept an invitation to review.[20] The solution lies in finding ways to leverage the willingness of researchers in emerging nations. Publishers need to ensure their editorial boards are representative of the wider research community they support. Editorial members in emerging geographies will be much better networked in their fields and will be able to identify appropriately qualified reviewers – often an issue for editors based outside those countries.

Maintaining quality and improving trust – for society

Key finding: ***Few researchers believe the public understand the concept of peer review.*** *For many, the solution to increasing understanding of research findings lies in providing context and easy-to-understand explanations.*

The pathways that researchers and the public walk are very different, but what they want is the same – to know that the research outputs they are interacting with are trusted.

And they share many of the same stumbling blocks; for example, sifting through a rising number of research outputs and formats while navigating an ever growing variety of communication channels.

While, for researchers, access to peer reviewed outputs via respected scholarly platforms goes a long way toward helping them filter content and establish its quality, for the public, the situation is far more complex, particularly as "citizens and scientists often see science-related issues through different sets of eyes".[26] As we've seen in **Provide clear signals to help assess research**, researchers have ideas about steps they and others can take to assess content. In this section, we explore some of the other methods they've identified to help the public identify and evaluate trusted sources.

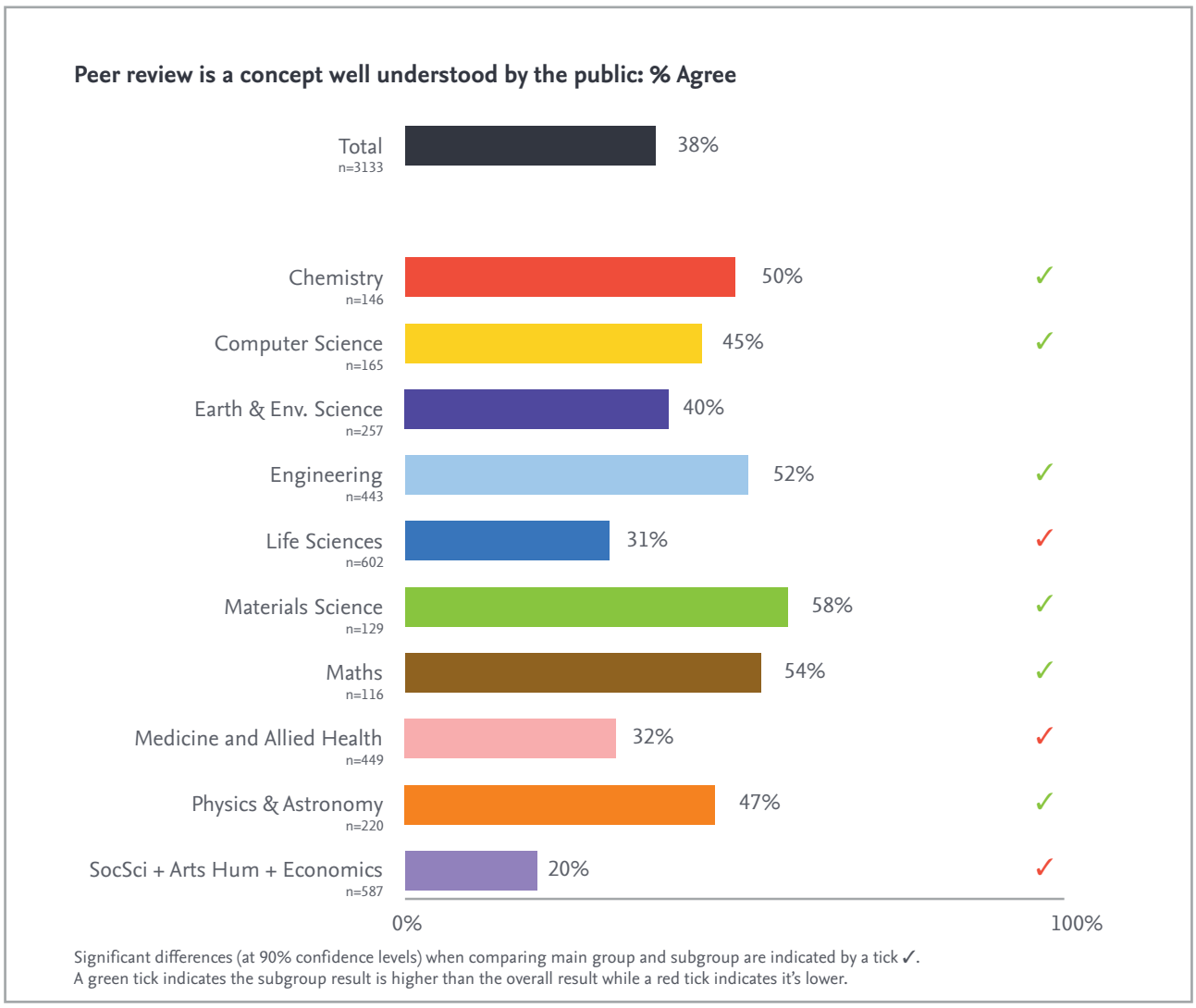


Figure 14: Researchers' views on public understanding of peer review (by specialty).

Understand the barriers facing the public

For many outside the research community, access to scientific knowledge is via competing (often non-scholarly) platforms and overwhelming numbers of mass media outlets. As we explore in **New channels and research outputs**, information is increasingly delivered by channels that have no relationship with the research community, and little or no incentive to get it right. As a result, the public has to work harder to locate trusted sources.

And the question is how they then establish the credibility of that content. For researchers, peer review lets them know that a publication has been evaluated by others in the field. But only **38 percent** of our survey respondents felt that peer review is a concept the public understands.

Interestingly, respondents' belief in public understanding of peer review varied strongly by specialty – Material Scientists were most likely to think they were familiar with the term (**58 percent**), compared to only **20 percent** of researchers working in Social Sciences, the Arts and Humanities, and Economics (see figure 14 on previous page).

There were also distinct regional differences. Researchers in APAC and Eastern Europe were more confident that members of the public understood the term (**54 percent**) while, in North America, that confidence level dipped to a low **14 percent** (see figure 15).

Another challenge for people outside the research ecosystem can be determining which of the many (often contradictory) claims out there they should believe, particularly in the wake of several high-profile cases in which the legitimacy of scientific findings has been called into question. For example, the discreditation of research showing a link between the MMR vaccine and autism[27] and senior political figures in the US disputing evidence of climate change.[28] Kent Anderson, CEO of the Redlink & Redlink Network, believes we are living in a "fragmented information space. It occurs at the highest levels and stems from people in the UK and US who have no business speaking about science, but the bar is so low that anybody can throw around words and convince people. There is too much scientific information, there's no good away to separate the good from the bad right now and that's really harmful."[2]

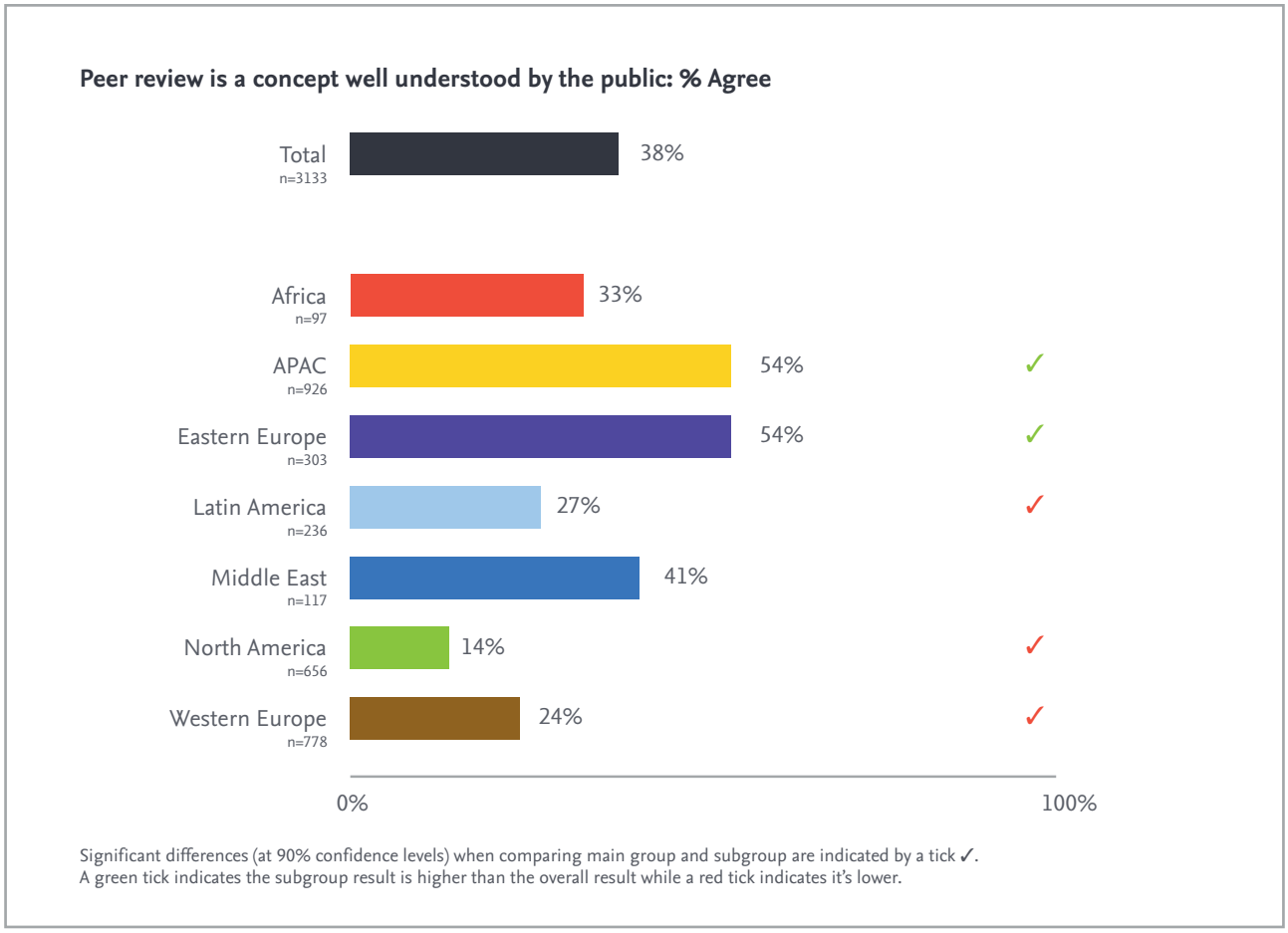


Figure 15: Researchers' views on public understanding of peer review (by region).

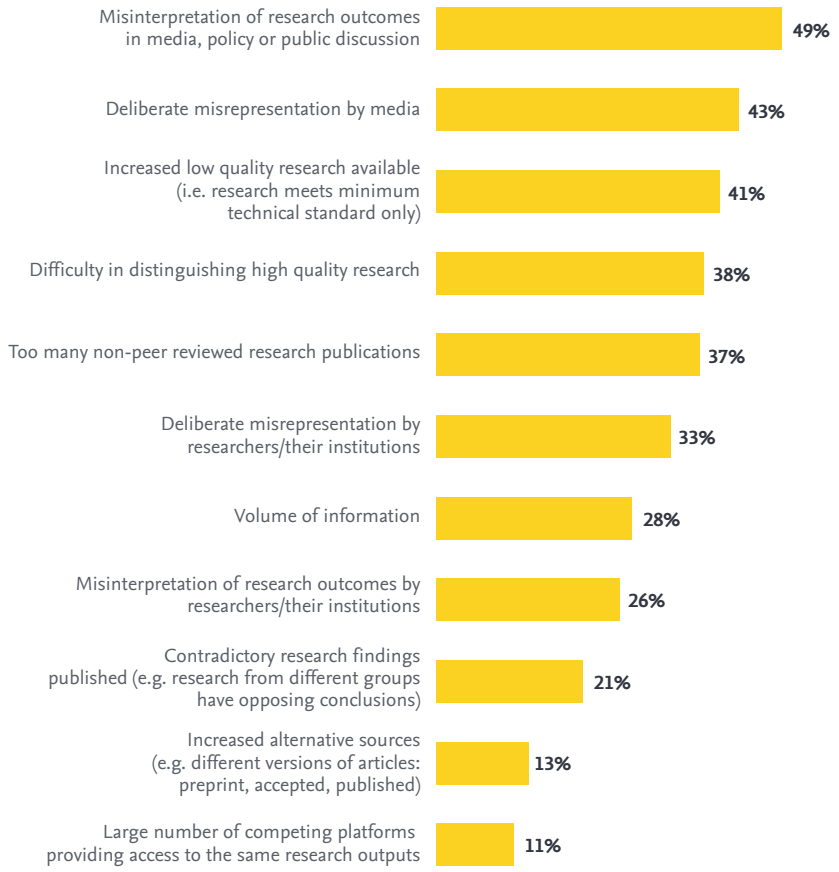
"I am friends with some antivax/anti-GMO people on Facebook who share a lot of junk pseudoscience articles. Content that was not peer reviewed, is opinion-based, and the evidence upon which the conclusions are based is either completely opaque, anecdotal, or based on misinterpreted data."

Researcher in Social Sciences, US, aged under 36, respondent to researcher survey

Despite these challenges, public faith in research remains high. A study by Gallup conducted on behalf of funder the Wellcome Trust, found that "worldwide, the majority of people (54%) have 'medium' trust in scientists, while almost one in five people have a 'high' level of trust, and only one in seven have 'low' trust in scientists".[29]

We asked researchers what they believed were the largest barriers to public trust in research (see figure 16). For nearly half (**49 percent**) of our survey respondents, the biggest problem was misinterpretation of findings in the media, policies or public discussion. Interestingly, in the case of the media, **43 percent** believed that the misrepresentation was deliberate. Another **33 percent** felt it was researchers and institutions who were actively choosing to misrepresent their findings (although, **26 percent** thought it was more likely that they were simply misinterpreting them, while most of our researcher interviewees blamed a desire to exaggerate).

Thinking about public confidence in research evidence, how much, if at all, do you believe any of the following are a problem? (% indicated it is a large problem)



Base: All respondents (n=3133)
Respondent was asked to choose from four options to quantify the scale of the problem: large, medium, small, not a problem at all.
For convenience we have only shown the % of responses that indicated it was a large problem. See full results for a breakout of this question on Mendeley Data at https://data.mendeley.com/datasets/wkd3jmm7mf/1

Figure 16: Researchers' views on factors affecting public confidence in research.

For some we spoke with, blame can't be laid at the door of institutions when it is the researchers themselves who sign off the press releases. Another felt that misinterpretation in the media was being driven, in part, by press releases on single studies, which may fail to give the fuller picture.

"[It's] important to consider that research results from single experiments (or a few experiments) may not, in fact, be the 'truth'. This may be different than 'trustworthiness', which I think is hard to determine."

Researcher in Pharmacology, Toxicology and Pharmaceutics, US, aged over 55, respondent to researcher survey

For others, the issue is that those reporting on the findings, don't always have the scientific knowledge to interpret them.

"…newspapers and magazines are under pressure from platforms so they can't afford to have expensive journalists who have specialist expertise."

Researcher interviewee

For **41 percent** of our survey respondents, public trust is being impacted by the increased availability of low quality research that meets minimum technical standards.

Interestingly, less than a quarter (**21 percent**) of our respondents believed the publication of contradictory research was a cause for concern, yet this is often an issue that causes consternation amongst the public,[30] observers and policy makers.

Increase and improve communication around science

Researchers understand that science is often based on probability, and not all research is equal. And they know that outcomes can be contradictory: each piece of new information adds to the jigsaw and may result in the revision of an existing theory or the establishment of a new one.

"How you measure things is sometimes as important as what you measure."

Dr. Amarachukwu Anyogu, Lecturer in Microbiology, University of Westminster, UK, researcher interviewee

For those not active in the research community, this may not be so obvious. As a result, for many, an important first step toward increasing public understanding of (and confidence in) research is to draw back the curtain on research and reveal how it works. According to communications expert John Besley of Michigan State University in the US: "We have to think about this as sharing what we're learning—we should share it respectfully, we should share it with humility, and we should include all that we do as the scientific community to ensure that what we're sharing is valid.....People genuinely want us to be open about those things."[31]

For some, **citizen science** is proving a valuable way to engage the public in research and shine a light on the scientific process. Also known as crowd science, civic science or networked science, citizen science covers any scientific research conducted by amateur scientists, as well as indirect activities such as crowd funding. Researchers such as Kullenberg and Kasperowski see citizen science as a way of "democratizing science, aiding concerned communities in creating data to influence policy and as a way of promoting political decision processes involving environment and health".[32]

For governments, funders and policy makers, the definition of research impact has been gradually broadening. Increasingly, measuring the effect of research on other studies is no longer enough. Many funders now require applicants to demonstrate how the research proposed will benefit society, and communicate the results in a way that the public can understand. In addition, a number require that the results are made freely available in some form.

Just last year, UK funder the Wellcome Trust, confirmed its commitment to reaching beyond the academic community with the launch of a Public Engagement Research and Evidence team. According to team lead, Carla Ross, they want to explore what encourages and deters researchers who want to engage with the public. "… it doesn't feel like the culture, structures and incentives are sufficiently aligned to enable researchers to practise public engagement regularly. Addressing this is imperative if we want to see public engagement done sustainably, at scale and with substantial benefit to society."[33] Another strand of their work will focus on building evidence to show that public engagement is good for both science and society.[33]

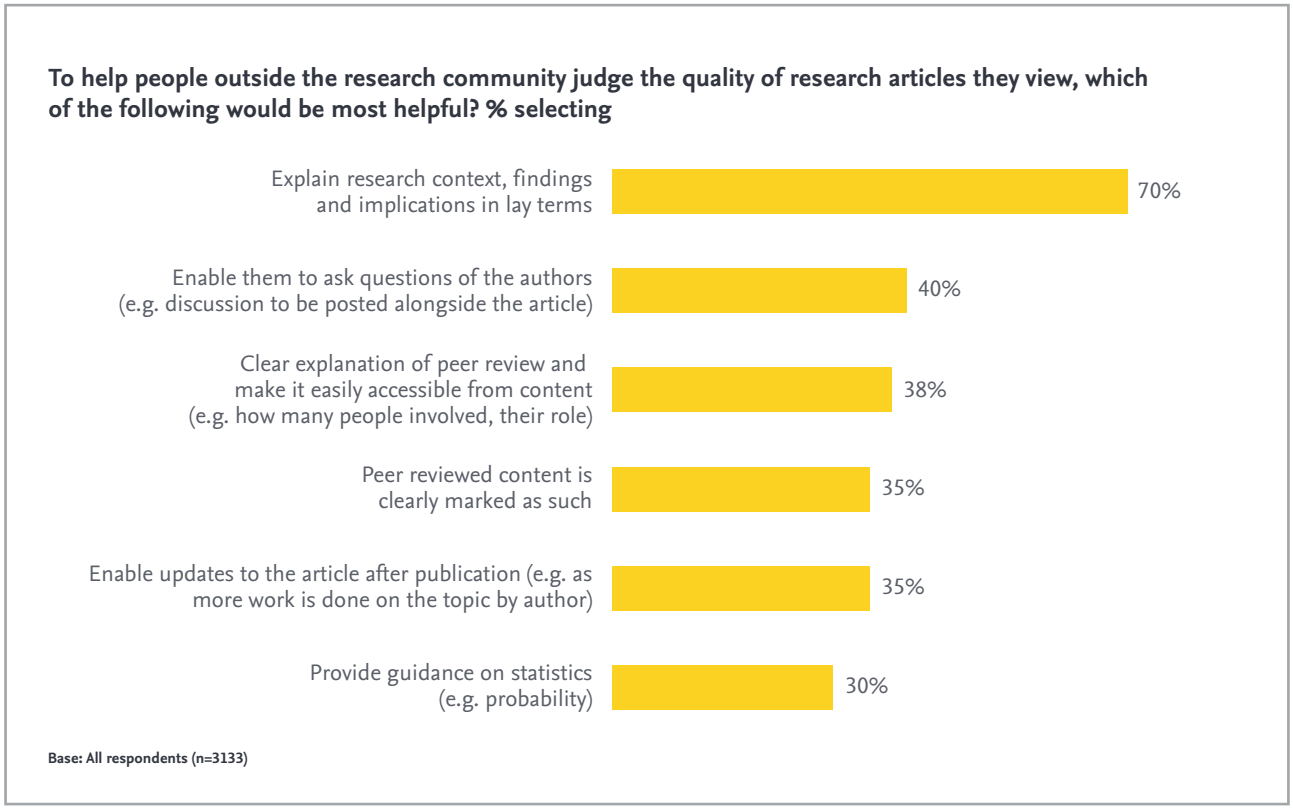


Figure 17: The measures researchers feel are necessary to improve public confidence in research outputs.

A large proportion of our survey respondents (**70 percent**) agreed that one of the most valuable ways we can help the public judge the quality of the articles they view is to clearly explain the findings and their implications – ideally in layman's terms (see figure 17). And that explanation should include context to help readers understand whether the results confirm existing knowledge or mark a change in thinking. Support for this option was particularly high among researchers working in Social Sciences, the Arts and Humanities, and Economics (**81 percent**). Among Mathematicians and Material Scientists, the appetite was lower (**59 percent** and **58 percent**, respectively). There were also variations regionally, with researchers in North America and Western Europe strongly in favor (**83 percent** and **80 percent**, respectively) and those in APAC less so (**60 percent**). For further details, please refer to the full survey results on Mendeley Data*.

Other measures our respondents identified were empowering readers outside the research community to ask questions of the authors (**40 percent**), explaining peer review (**38 percent**), enabling articles to be continuously updated (**35 percent**), and clearly marking research as being peer reviewed (**35 percent**).

The opportunity for the research community now is to increase understanding of the role of peer review among those outside academia, and ensure the benefits of the system that researchers enjoy, are enjoyed by the public too. In this study, researchers have identified the steps they take to verify the trustworthiness of content (see **How researchers assess research outputs**). Can we find a way to translate these approaches into a signal system that is easily understood by the public? There is also a need to build understanding among policy makers and members of the public as to how science works, so that people are aware contradictions are part and parcel of a healthy research ecosystem. Science communication is a skill and it takes time to create lay information and put it in context: supporting researchers, their institutions and others in the community as they work toward that goal will also be a crucial element of increasing public engagement and understanding.

*https://data.mendeley.com/datasets/wkd3jmm7mf/1

Conclusion and next steps

The overwhelming take home message from this study is that 10 years on from the 2009 survey, researchers still have confidence in the peer review system and believe it works. That's the good news.

But what we also found is that there are shortfalls in the process and increasing strain on the system. The drive to publish, combined with the increasing number of researchers, is having unexpected consequences. We've seen the rise of technically-sound journals and the growth of predatory journals over the last 10 years; this is putting peer review under pressure. Furthermore, the research and communication workflow is changing and the volume of research-related materials available (preprints, data, code, models, etc.) is increasing. All these factors together mean that researchers are unsure which research outputs to trust, which is placing new demands on them. They have developed coping strategies to navigate to trusted content. These shifts are creating an opportunity for all the various stakeholders in the research ecosystem. If we act now, we can not only preserve the current strengths of peer review, but also enhance them and ease the burden on readers.

And researchers have already identified many of the steps we must take.

We need to ensure researchers receive clear guidance on how to conduct peer review and recognition for reviewing. We need to leverage technologies to manage the ever-increasing volume of research articles and improve the speed of review. We need to think about whether peer review should be extended beyond the research article – if it is, this is perhaps one of the biggest resource challenges for the system, which might only be solved by drawing on technology to support the extra work. And, if we don't use technology, what are the implications? As a community, we need to move away from the current focus on the quantity of articles a researcher publishes and make quality the priority. As a consequence, we need to reconsider the evaluation system so it is not just about publishing but disseminating (data, code, models, articles), engaging with the public and embracing openness. This will involve everyone at all levels of the ecosystem contributing to, and agreeing on new measures of impact.

It's also going to be important to open up how science works to improve public trust. This means we need unambiguous signals that will give the reader confidence in the content. We need to find ways to share more of the benefits of the evaluation system we have with society; for example, help those outside the community understand why there might be contradictory findings and read science coverage with the critical eye of a researcher. And we need to ensure information is delivered to them in a way they can easily understand.

In short, we need to work together to secure the future of the evaluation system.

What should be done next?

Elsevier and Sense about Science are exploring ways to tackle these questions, but these are challenges that must engage the attention of the whole research community. We have identified a number of keys areas that should be explored. And we have suggested a timeframe for those conversations.

…urgent

- With the variety and number of information channels rising alongside the volume of published content, researchers are concerned about quality. As a result, they spend time verifying information. Respondents expressed a desire for **the provision of better signals, cross checks and more context, e.g. information about previous research**; even if it is a signal to indicate when a research output hasn't been peer reviewed or assessed in some way. What is the potential to provide this? What are the most appropriate signals?
- Researchers already struggle to find time to review. A need for better training, information, and more career-based recognition has been raised by researchers in this and other studies. Finding a way to remove the current inconsistencies in reviewer instructions is paramount. There is now discussion around which research outputs should be included in peer review (for example, data, code, models). Importantly, these discussions include **how we should *signify* the different types of review that a paper has been through**.

...pressing, but less urgent

- **Technology has the potential to resolve some of the peer review challenges** raised by respondents. But how can we ensure that we benefit from technology, e.g. use it to manage the rising volume of submissions and alleviate the burden on reviewers, without losing the benefits of human judgement? Without discussion, the use of AI may further disrupt people's ability to trust content.
- Few researchers believe the public understand the concept of peer review (see **Understand the barriers facing the public**). For many, the solution to increasing understanding of research findings lies in providing context and easy-to-understand explanations. More needs to be done to **create a common and trustworthy language for research publishing, which can meet the diverse landscape of the 2020s**. For example, if content carries the peer review label, what does that mean? And what if it says that a light-touch review was conducted or that it was replicated? Or checked only for the soundness of the science, excluding data? Can we make it faster and easier for the public and researchers alike to identify content that has been reviewed and curated?

What is Elsevier doing?

At Elsevier, we are committed to improving the many tools that researchers have at their disposal to complete and communicate the important work they do. Scopus, which helps researchers find and analyze data, is being further improved with sophisticated analytics to help the user navigate to trusted content. ScienceDirect's full-text scientific content is being enhanced with smart, intuitive functionality.

To improve signal quality (a key topic in this study), **Elsevier has set up a new center tasked with examining and advancing the evaluation of research across all fields.** The International Center for the Study of Research (ICSR)* will work closely with the research community to review and develop metrics with the aim of creating a more transparent and robust approach to research assessment.

Streamlining the process of peer review is also a major goal for Elsevier, particularly with the number of submissions we receive increasing year on year. We have completed a pilot for an online **peer review tool "Peerful"** that enables referees to annotate, tag and discuss a manuscript, and answer journal-specific manuscript quality questions. Our hope is that Peerful will not only improve the reviewer experience, but the speed of peer review itself. We have also created a certified peer review course** in collaboration with our editors. And we are making peer review more transparent: review reports are being published on ScienceDirect for a number of journals in Psychology.

Partner with us

Finding solutions to these challenges won't be easy. It will involve all stakeholders in the research ecosystem pooling knowledge and resources to work together. We invite you to join us. If you would like to be part of the discussion with Elsevier and Sense about Science, or want to find out more about this study, please contact us at newsroom@elsevier.com.

* www.elsevier.com/icsr

** https://researcheracademy.elsevier.com/navigating-peer-review/certified-peer-reviewer-course/introduction-certified-peer-reviewer-course

Methodology

About the survey

Questionnaire

The questionnaire was designed by Elsevier's customer insights team and reviewer experience experts and Sense about Science. The survey included some questions from the 2009 survey, to allow us to see change over time, but largely covered topics that we had not explored before.

Survey tool

The survey was programmed in ConfirmIT's professional author module, allowing the designers control over the layout and flow of the survey to ensure maximum respondent engagement, as well as GDPR compliance in the way personal details were handled. The survey was co-branded (Elsevier and Sense about Science) and was available as an online survey in English only.

Sample source

To ensure the survey was as representative as possible, we sourced a researcher sample from a database of 3.6 million researchers. The criteria was that they had published in a reputable scholarly journal, book or serial between 2015 and 2018.

Incentive

For each completed response, $2 was donated to charity (researchers could choose between UNICEF, MSF, Save the children, Alex's Lemonade Stand, and DebRA).

Results

3,133 researchers responded, equating to a 3.2 percent response rate (excludes undeliverable emails). The survey took 15 minutes to complete (median average). Fieldwork took place in May 2019. Although we oversampled for countries where we expected a lower level of response, it was difficult to get a completely representative profile, therefore responses have been weighted to be representative of the global researcher population by country (UNESCO 2014 data). Base sizes shown in this report are unweighted, unless otherwise stated. Due to the effects of rounding, percentages in charts / tables may not sum to 100.

Statistical testing

The maximum error margin for 3,133 responses is ± 1.5 percent at 90 percent confidence levels. When comparing main group and subgroup we have used a Z-test of proportion to identify differences between the overall average and the subgroup (90 percent confidence levels). Differences are indicated by a tick; a red tick for lower than the global average, and a green tick for higher.

About the interviews

Ten supplementary interviews were conducted by Sense about Science with researchers from various countries at different points in their career. Some journal editors were included. We asked a subset of the survey questions and the interviews lasted between 60 minutes and 90 minutes. The interviews were anonymous, unless participants agreed to be named, and are intended to provide context and more nuanced insights to provide greater depth to this report.

References

1 Sumner, P. et al. The association between exaggeration in health related science news and academic press releases: retrospective observational study. BMJ 2014;349:g7015. 10 December 2014. doi: https://doi.org/10.1136/bmj.g7015

2 Research futures: Drivers and scenarios for the next decade. Elsevier. February 2019. https://www.elsevier.com/connect/elsevier-research-futures-report

3 Johnson, R., Watkinson, A., & Mabe, M. The STM Report An overview of scientific and scholarly publishing. Fifth Edition. STM Association. October 2018. https://www.stm-assoc.org/2018_10_04_STM_Report_2018.pdf

4 Plume, A. & van Weijen, D. Publish or perish? The rise of the fractional author… Research Trends. September 2014. https://www.researchtrends.com/issue-38-september-2014/publish-or-perish-the-rise-of-the-fractional-author/

5 Kovanis, M. et al. The Global Burden of Journal Peer Review in the Biomedical Literature: Strong Imbalance in the Collective Enterprise. PLOS One. 10 November 2016. https://doi.org/10.1371/journal.pone.0166387

6 Global State of Peer Review. Publons. 2018. https://publons.com/community/gspr

7 Altbach, P. G., & de Wit, H. Too much academic research is being published. University World News. 07 September 2018.

8 Shamseer, L. et al. Potential predatory and legitimate biomedical journals: can you tell the difference? A cross-sectional comparison. BMC Medicine. BMC Med. 2017; 15: 28. 16 March 2017. doi: 10.1186/s12916-017-0785-9

9 STM statement on the increase of unethical and deceptive journal practices. STM. August 2018. https://www.stm-assoc.org/2018_08_09_STM_statement_on_the_increase_of_unethical_and_deceptive_journal_practices.pdf

10 Dubowitz, V. Critical Review Ahead of Publication. Neuromuscular Disorders Volume 29, Issue 6, Page 412, June 2019. DOI: https://doi.org/10.1016/j.nmd.2019.06.007

11 Bauchner, H. The Rush to Publication: An Editorial and Scientific Mistake. JAMA. 2017;318(12):1109-1110. doi:10.1001/jama.2017.11816 https://jamanetwork.com/journals/jama/fullarticle/2654797

12 F1000Research website. https://f1000research.com/

13 Definition of research integrity. University of Bath. n/d. https://www.bath.ac.uk/corporate-information/definition-of-research-integrity/

14 Bollen, K. et al. Social, Behavioral, and Economic Sciences Perspectives on Robust and Reliable Science. Report of the Subcommittee on Replicability in Science Advisory Committee to the National Science Foundation Directorate for Social, Behavioral, and Economic Sciences. May 2015. https://www.nsf.gov/sbe/AC_Materials/SBE_Robust_and_Reliable_Research_Report.pdf

15 Baker, M. 1,500 scientists lift the lid on reproducibility. Nature. 25 May 2016 | Corrected: 28 July 2016. https://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970

16 Gasson, K., Herbert, R. & Ponsford, A. Fractional Authorship & Publication Productivity. ICSR Perspectives. 2019. https://dx.doi.org/10.2139/ssrn.3392302

17 Cyranoski, D. Rise and fall: Why did Hwang fake his data, how did he get away with it, and how was the fraud found out? Nature News. 11 January 2006. https://www.nature.com/news/2006/060109/full/060109-8.html

18 Anderson, K. The Editor — A Vital Role We Barely Talk About Anymore. Scholarly Kitchen. 23 September 2014. https://scholarlykitchen.sspnet.org/2014/09/23/the-editor-a-vital-role-we-barely-talk-about-anymore/

19 The Future of Research. Batelle. 16 October 2017. https://inside.battelle.org/blog-details/the-future-of-research

20 Mark Ware Consulting. Publishing Research Consortium Peer Review Survey 2015. May 2016. http://www.publishingresearchconsortium.com/index.php/134-news-main-menu/prc-peer-review-survey-2015-key-findings/172-peer-review-survey-2015-key-findings

21 Steps towards transparency in research publishing. Nature. September 2017. 549, 431. doi:10.1038/549431a

22 What might peer review look like in 2030? BioMed Central & Digital Science. April 2017. http://events.biomedcentral.com/wp-content/uploads/2017/04/SpotOn_Report_PeerReview-1.pdf

23 Heaven, D. AI peer reviewers unleased to ease publishing grind. Nature. 22 November 2018. https://www.nature.com/articles/d41586-018-07245-9

24 Rougier, N. P. R-words. GitHub. 2016. https://github.com/ReScience/ReScience-article/issues/5

25 Khan, H. & Mehmani, B. Getting to grips with peer review: A report from Sense about Science's latest workshop. Reviewers' Update. 6 August 2019. https://www.elsevier.com/connect/reviewers-update/getting-to-grips-with-peer-review

26 Funk, C. & Rainie, L. Public and Scientists' Views on Science and Society. Pew Research Center. January 2015. http://www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/

27 Myths and facts about immunization. World Health Organization (Regional Office for Europe). 2015. http://www.euro.who.int/__data/assets/pdf_file/0005/339620/Myths-and-facts.pdf?ua=1

28 Davenport, C. & Landler, M. Trump Administration Hardens Its Attack on Climate Science. The New York Times. 27 May 2019. https://www.nytimes.com/2019/05/27/us/politics/trump-climate-science.html

29 Wellcome Global Monitor – First Wave Findings (2018). Conducted by Gallup. 2019. https://wellcome.ac.uk/sites/default/files/wellcome-global-monitor-2018.pdf

30 Contradictory nutrition news creates consumer confusion. Science Daily. 28 January 2014. https://www.sciencedaily.com/releases/2014/01/140128153814.htm

31 Jackson, C. The public mostly trusts science. So why are scientists worried? Science. 18 February 2018. https://www.sciencemag.org/news/2018/02/public-mostly-trusts-science-so-why-are-scientists-worried

32 Kullenberg, C. & Kasperowski, K. &. What Is Citizen Science? - A Scientometric Meta-Analysis. PLOS One. January 2016. doi:10.1371/journal.pone.0147152

33 Ross, C. How we're using research and evidence to make sure public engagement has a big impact. Wellcome Trust. 7 November 2018. https://wellcome.ac.uk/news/how-were-using-research-and-evidence-make-sure-public-engagement-has-big-impact

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Sense about Science is an independent charity that promotes the public interest in sound science and evidence in public life. A small team working with thousands of supporters, from world leading researchers to community groups, we focus on socially and scientifically difficult issues where evidence is politicized, neglected or misleading, and we change regulations, standards, systems and culture to respond to the public interest in quality and accountability. https://senseaboutscience.org/

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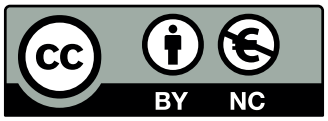
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