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2018 GLOBAL STATE OF PEER REVIEW

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FOREWORD

As Publons has grown over the last six years, so too has awareness of the important role that peer review — and peer reviewers — play in our ecosystem.

However, there is still a substantial gap in our basic understanding of who the reviewers are, how much review work they undertake, the quality of those reviews, and what researchers think of it all.

Working with our colleagues at *ScholarOne* and *Web of Science*, we developed this report to shine some light on these questions. We hope it will prove to be a useful resource for the community and inform the development of the scholarly ecosystem in the coming years as we address the challenges of:

- ensuring the quality and efficiency of the literature in the face of rapidly increasing publication rates;
- the emergence of new, innovative models of peer review;
- the shift to open access and the emergence of predatory publishers; and
- increasing diversity in gender and geographic distribution.

One of the key findings in this report is that researchers from *emerging regions* are under-represented in the peer review process. While there are indications this trend may self-correct in the long run, we believe it is an urgent issue to address. We will struggle to meet the growing demands on the system without the contributions of the full global research community. The reality is that this peer review disparity is harming the development of non-Western researchers — fewer review invitations means fewer opportunities to see the latest research trends, learn what journals are looking for in a great manuscript, make professional connections with journal editors, and develop critical analysis skills.

With that said, I am proud to present the first edition of the *Global State of Peer Review* report. I hope you find it as informative to read as it was for us to create, and look forward to your feedback, ideas, and suggestions.

Regards,

DR ANDREW PRESTON
PUBLONS COFOUNDER
AUGUST 2018

ABOUT THIS REPORT

This inaugural *Global State of Peer Review* report has been developed to investigate the state of scholarly journal peer review.

To do that, we have focused on four big questions, each of which form a chapter in this report.

1. **Who is doing the review?**
2. **How efficient is the peer review process?**
3. **What do we know about peer review quality?**
4. **What does the future hold?**

We have combined one of the largest peer review surveys of the global research community with data derived from Clarivate Analytics' powerful cross-publisher sources.

Our primary Data sources:

- *Web of Science* — aggregated publication and research field data.
- *ScholarOne Manuscripts* — aggregated submission and peer review data.
- *Publons* — aggregated peer review data.
- *Publons' 2018 Global Reviewer Survey**:
  - Over 11,800 researchers globally, largely sourced from the Publons community and authors with articles indexed in *Web of Science*.
  - Interviews with key opinion leaders at five publishers.

This is one of the largest sets of data about peer review ever collated. We hope it will bring a new level of transparency to the world of peer review, as well as lay the groundwork for future iterations of this report that delve into more areas of peer review.

The datasets do include limitations, such as greater coverage of the hard sciences, i.e., Science, Technology, Engineering and Medical (STEM) research areas. While data covering peer review of the Humanities and Social Sciences (HSS) are included, they are not as well classified as the data for traditional STEM research areas. We acknowledge this and hope to explore the HSS disciplines in greater detail as the data become available.

See p**ages 54-57** in the appendix for a full description of the data, methodologies, limitations, and assumptions used throughout this report.

** Visit* ***zz****for the full Publons' 2018 Global Reviewer Survey report.*

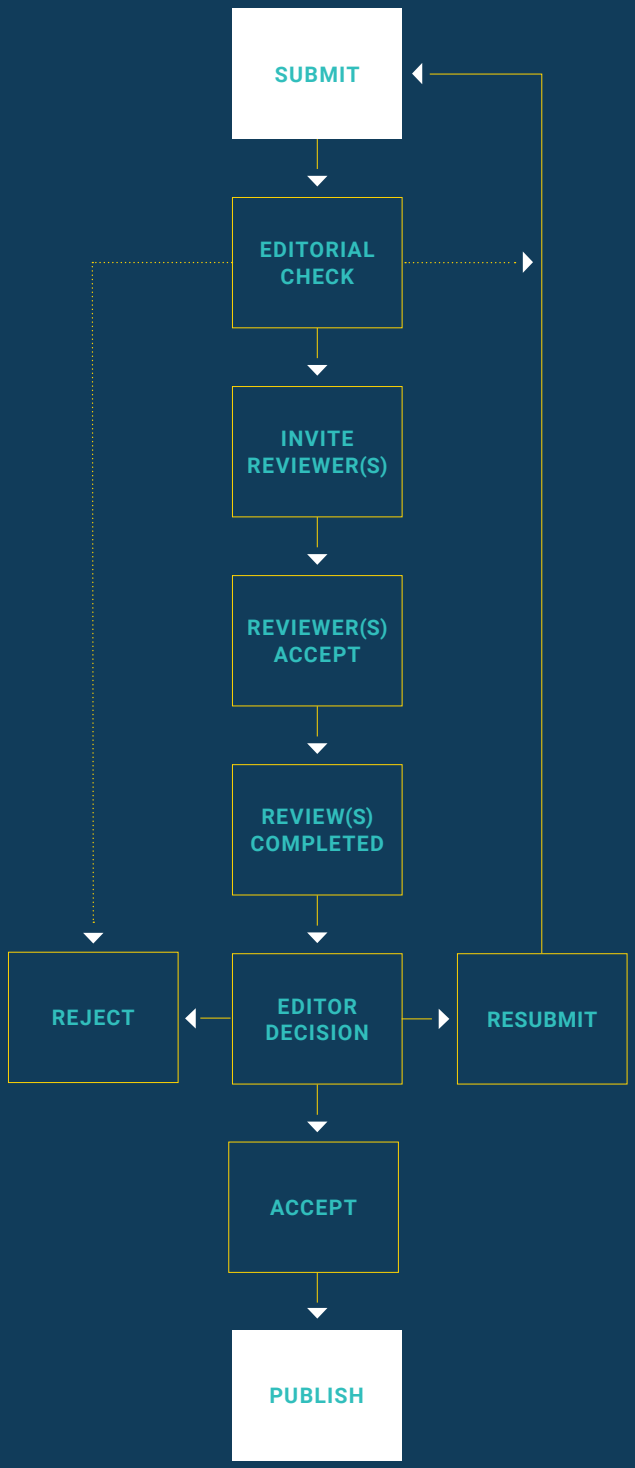
0 INTRO— DUCTION

WHAT IS PEER REVIEW?

Scholarly peer review (also known as **refereeing**) is the process of subjecting an author's scholarly work, research, or ideas to the scrutiny of others who are experts in the same field.

HOW IT WORKS

FIG.1 — THE BASIC PUBLISHING WORKFLOW



HISTORY

The peer review process is largely recognized to have begun in 1776 with the publication of *Philosophical Transactions* by the Royal Society and has evolved over hundreds of years.

During the 20th century, public funding for scientific research grew dramatically and so did the volume of published literature and corresponding peer review process.

"IF REVIEWERS ARE EDUCATED ON THE RESPONSIBILITIES AND EXPECTATIONS OF BEING A REVIEWER...THEY SPEND THE RIGHT AMOUNT OF TIME ON A REVIEW, THE EDITORS THEN RECEIVE COMMENTS IN A TIMELY FASHION, AND AUTHORS RECEIVE RICH AND VALUABLE FEEDBACK."

KRISTEN MARCHETTI, ASSOCIATE DIRECTOR OF PEER REVIEW, SAGE

TYPES OF PEER REVIEW

During the 20th century, most fields of research and journals settled into a "single-blind" peer review process where two or three reviewers provide the author and editor with feedback through one or more rounds of review.

While there are hints that more transparent forms of peer review are gaining mindshare (see chapter 4), the single-blind and double-blind peer review processes still dominate today.

For another view on the prevalence of different peer review models, we can look at how much transparency publishers and journals allow their reviews to have on Publons:

FIG.2 — COMMON AND EMERGING PEER REVIEW MODELS

SINGLE-BLIND – reviewers unknown to author

DOUBLE-BLIND – author and reviewers unknown to each other

TRIPLE-BLIND – authors, reviewers and editors all unknown to each other

OPEN-IDENTITIES – author and reviewers are aware of each other's identity

OPEN REPORTS – review reports are published alongside the relevant article

OPEN IDENTITIES & OPEN REPORTS – all parties known to each other and review reports are public

OPEN FINAL-VERSION COMMENTING – review or commenting on final "version of record" publications

FIG. 3 — PEER REVIEW POLICIES ON PUBLONS, BY JOURNAL

Data source: Publons

A breakdown of publisher-elected policies from a sample of 15,000 journals on Publons, where 63% (9,530) have a publisher-elected review display policy, and 37% (5,520) are unspecified.

	SIGNED (reviewer name published)	BLIND (name not published)
OPEN (review content published)	1.62%	0.15%
CLOSED (content not published)	0.11%	61.83%

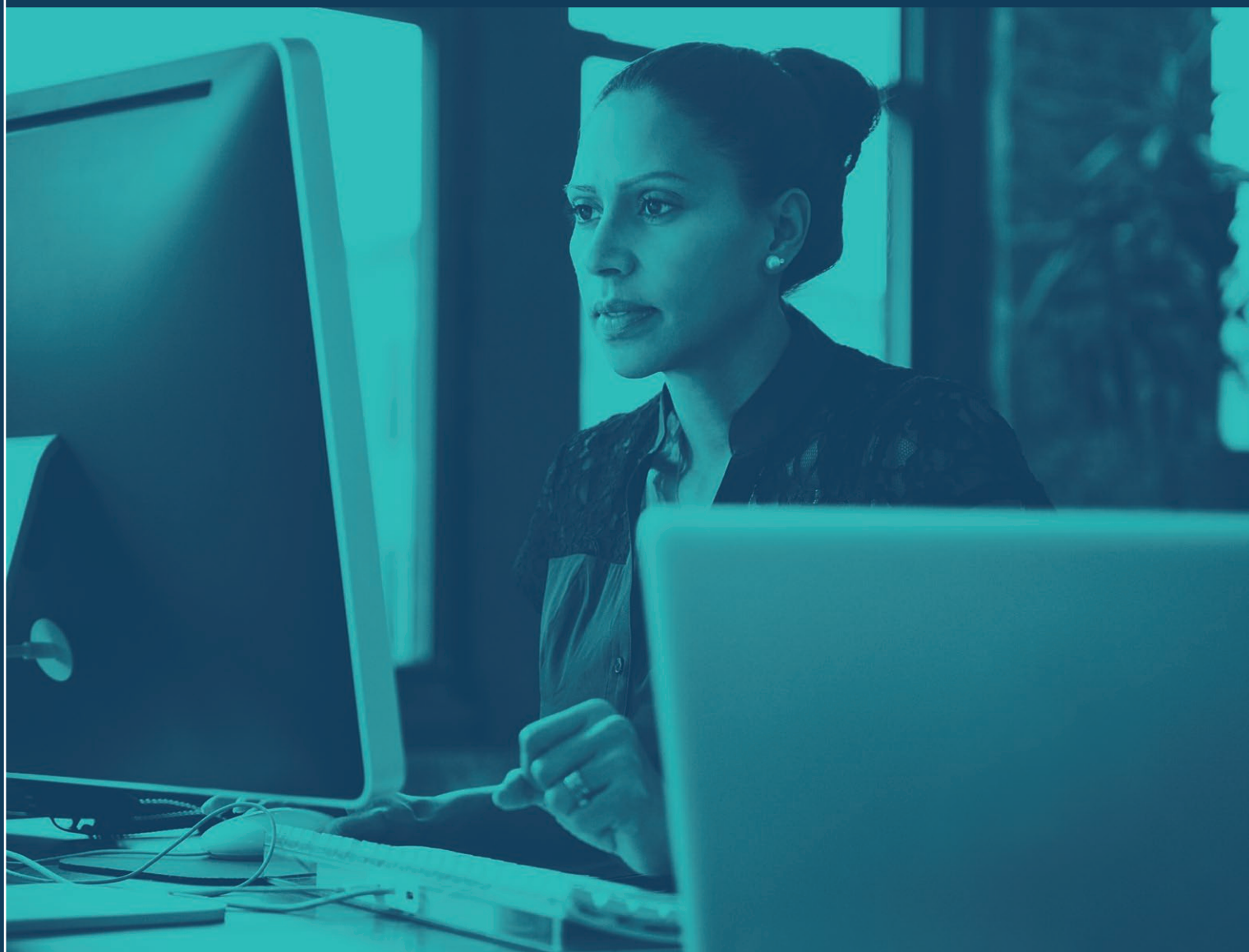
THE ROLE OF THE EDITOR

Regardless of the type of peer review, it's important to acknowledge the role of journal editors in the process.

The editor-in-chief sets the vision and direction of a journal, and editors make critical decisions about whether to publish a paper or not. They are the final arbiters in the question of whether a paper contains sound research and/or meets the criteria of the journal in question. This can be a challenging job when presented with conflicting opinions from multiple reviewers and authors.

Editors also do the hard work of selecting reviewers and sourcing reviews. Without them, it is unlikely that all manuscripts — particularly the tricky ones — would be reviewed. The hard work that goes on behind the scenes to make this happen is often forgotten in discussions about new peer review or publishing models.

The role of an editor is often a thankless one. But, it is a crucial part of the peer review process.



WHY IS PEER REVIEW SO IMPORTANT?

Peer reviewers and editors are gatekeepers of the research literature used to document and communicate human discovery.

Reviewers and editors work hard to ensure that only sound research is published. Where there are problems in research (slowing publication times, rising article retractions, predatory publishing), peer review is often at their root.

Notwithstanding these problems, peer review has done a remarkable job of scaling and allowing us to develop a trusted corpus of research literature as the academic research process industrialized, and then digitized, in the 20th century. This is evidenced by the dramatic increase in peer reviewed publication output since 1980 (see Figure 4).

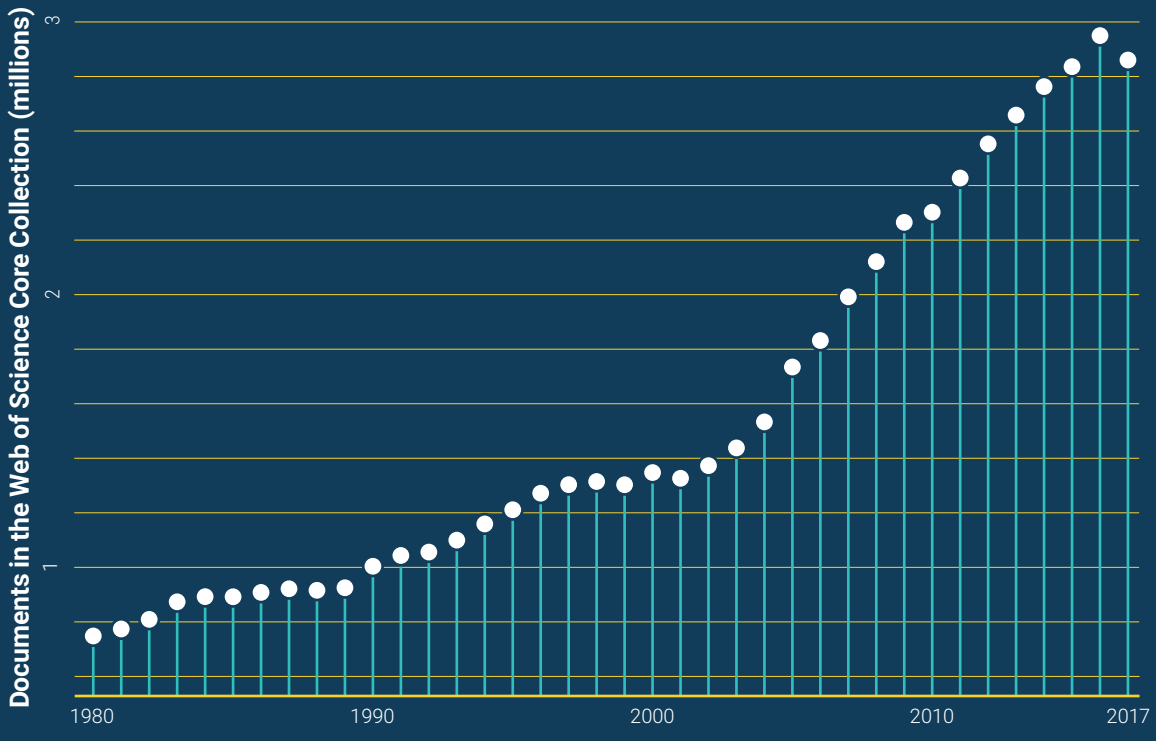
FIG.4 — GROWTH IN PUBLISHED RESEARCH INDEXED IN *WEB OF SCIENCE*, 1980–2017

Data source: Web of Science.

Number of articles indexed in Web of Science from 1980 to 2017. The dip in 2017 is because, at the time these data were extracted, not all content for 2017 had been received and indexed. Note that part of the rapid increase in early-to-mid 2000 can be attributed to an expansion of the Web of Science index.

2.6%

Annual growth in published article volume since 2013 (excl. 2017)



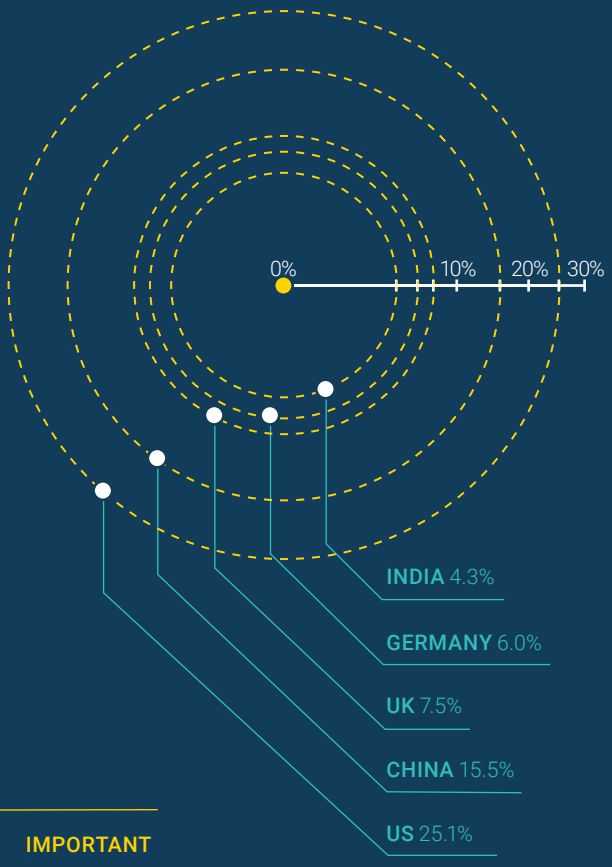
Since 2013, article publication volumes have grown by 2.6% per year while submissions have grown by 6.1% per year.

The world of research is now so large, varied, and geographically diverse that few editors have the breadth and depth of knowledge or the networks necessary to evaluate all submissions themselves. Outsourcing to expert peer reviewers is essential if an editor is to make an informed publication decision.

FIG.5 — TOP FIVE REGIONS BY PUBLICATION OUTPUT IN 2017

Data source: Web of Science

Articles indexed in Web of Science in 2017. Percentages represent at least one affiliation on publication.

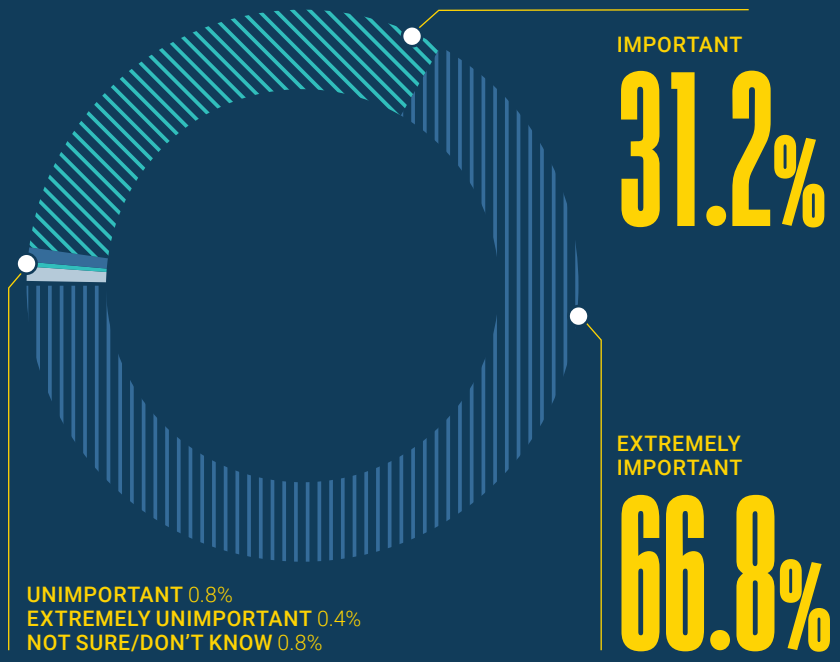


HOW IMPORTANT IS PEER REVIEW TO RESEARCHERS?

Importantly, our survey shows that researchers continue to regard peer review as a critical tool for ensuring the quality and integrity of the literature.

FIG.6 — HOW RESEARCHERS REGARD PEER REVIEW

Data source: Publons' 2018 Global Reviewer Survey 98% of respondents consider peer review either important (31.2%) or extremely important (66.8%) for ensuring the general quality and integrity of scholarly communication.



INCENTIVES MATTER

Publishing peer reviewed research has become the key indicator of research output and impact.

This is largely because the standards upheld by peer review mean that only research scrutinized by peers, and therefore meeting some quality threshold, is published. Consequently, funding, hiring, and promotion decisions are often tied to published research records.

When combined with shrinking research budgets, it is no surprise that researchers are increasingly desperate to publish and publish fast. The entire community recognizes this.

ASIDE

- As incentives drive researchers to publish as much as possible, some researchers have resorted to chopping results into smaller and smaller papers. This process is called salami slicing.
- In physics, where electrons, photons, and gluons are discussed daily, the minimum unit of publishable material — the thinnest possible salami slice — is referred to as the "publon". This is where the name "Publons" comes from.

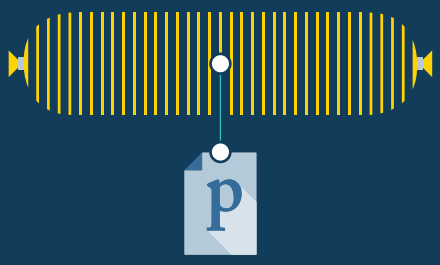
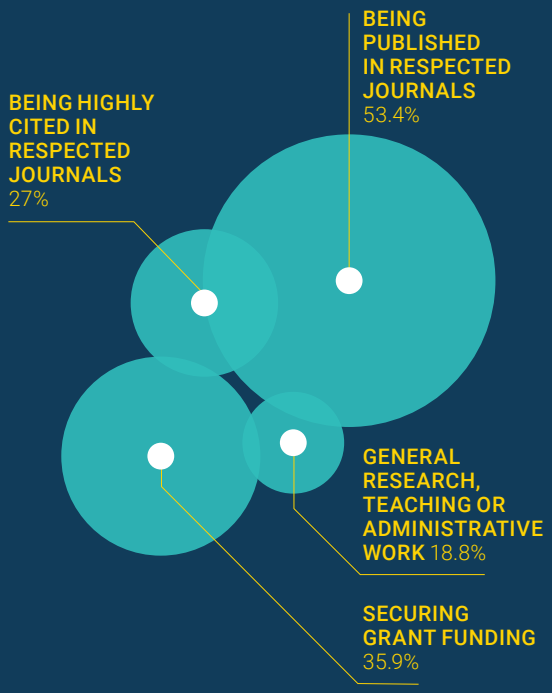


FIG.7 — TOP FOUR ACHIEVEMENTS MOST COMMONLY CITED AS BEING IMPORTANT TO OVERALL CAREER SUCCESS

Data source: Publons' 2018 Global Reviewer Survey

Respondents identified the following factors as contributing most to overall career success from a list of 12 options: "getting published in respected journals"; "being highly cited in respected journals"; "securing grant funding"; and "general research, teaching or administrative work".



"ENSURING THE INTEGRITY OF THE PEER REVIEW PROCESS IS VITAL AND AN INCREASING CHALLENGE THAT WE CANNOT FAIL TO MEET."

TAMI POTTEN, EDITORIAL DEVELOPMENT MANAGER, BRITISH INSTITUTE OF RADIOLOGY

It is clearly important (and lucrative) for researchers to publish peer reviewed articles and to act as editors for journals.

Historically, however, there has been no equivalent reward or incentive for peer reviewing. Researchers overwhelmingly believe there should be.

84.8%

of survey respondents think institutions should more explicitly require and recognize peer review contributions

FIG.8 — PERCEPTIONS ABOUT THE ROLE OF INSTITUTIONS IN RECOGNIZING PEER REVIEW

Data source: Publons' 2018 Global Reviewer Survey

WHY DO RESEARCHERS CHOOSE TO PEER REVIEW?

Despite comparatively weak incentives and recognition, peer review does happen. So why do researchers give up valuable research and teaching time to contribute? What motivates them?

Researchers see peer reviewing as part of their job, something they should reciprocate, and as a necessary part of contributing to the integrity of the published literature. They are also quite aware that it is a valuable way to stay up-to-date with research trends in their field.

Differences are observed across research fields within the dataset:

- Roughly 50% of researchers in Physics, Mathematics, Neuroscience, and Space Science cited "reviewing is part of my job" as the reason they review, while only 30% of respondents in Clinical Medicine gave priority to this response.
- Instead, most reviewers in Clinical Medicine cited "to improve my own writing skills" as the most common reason they chose to peer review.

FIG.9 — WHY RESEARCHERS PEER REVIEW

Data source: Publons' 2018 Global Reviewer Survey

Respondents were asked to select up to two reasons from a list of nine options.

PREVIOUS RESEARCH ON PEER REVIEW

Historically, studies of peer review have been hindered by the very nature of the process.

Single-blind peer reviews are not published and the name of the reviewer is not revealed, making it very difficult to do large-scale, cross-publisher studies of the peer review process. This has led to a rather complex and incomplete picture of peer review, and produced little overall consensus from the research community on key concerns, including transparency, accountability, and editorial bias.

Thankfully, this is slowly changing.

Researchers and publishers alike have been able to draw back the curtain on peer review in recent years as more and more scholarly communications systems move online. Also, open peer review, which is increasingly viewed across the industry as an important aspect of open science, has enabled a wealth of diverse research, helping the scholarly community collectively weigh up and scrutinize the various stages of the peer review process. This shift has led to a number of fundamental studies and initiatives over the past decade. While we cannot acknowledge all of these here, we would like to recognize some of the large-scale surveys that have engaged with peer reviewers to inform this work.

Like ours here today, most of these surveys were created in consultation with editors and publishers, and used to garner an understanding of reviewers' experiences and needs, with the ultimate goal of opening up and improving the future of the system:

- Sense About Science Peer Review Survey, 2009
- Wiley Peer Review Study, 2016
- Publishing Research Consortium Peer Review Survey, 2015
- PRE (AAAS) Survey, 2016
- Peer Review: A Global View, a Taylor & Francis survey, 2015

1 WHO IS DOING THE REVIEW?

In order to understand peer review, it is necessary to understand **who is contributing** to the peer review process.

This chapter explores who is doing the review by region, research field, and gender. *The Review Distribution Index* is presented, giving a measure of how the reviewing effort is distributed within research areas and regions. These data provide a basis for investigation into issues such as potential bias and distribution of the peer review workload.

KEY FINDINGS

- USA dominates absolute contributions to peer review, contributing 32.9% of all reviews compared to 25.4% of published article output.
- China reviews substantially less (8.8%) than its article output (13.8%) would predict.
- *Established regions* review more than *emerging regions* relative to their respective article outputs.
- Editors are disproportionately selected from *established regions*.
- Editors disproportionately select reviewers from their own region.
- Absolute review contributions are growing in all regions, but more rapidly in *emerging regions*. China, in particular, is rapidly increasing review output.
- There are few studies of gender in peer review, but early indications are that male participation is higher than female.

SUPPLY AND DEMAND OF PEER REVIEW, BY REGION

When a researcher submits a manuscript to a journal they create demand for peer review. When a researcher completes a review they are supplying peer review.

Figure 10 presents the supply and demand of reviews by region. USA supplies by far the most reviews. China ranks second, producing almost exactly as many reviews as the UK, despite creating more than twice the demand through manuscript submissions. *Emerging regions* such as India, Turkey, and Iran, all review substantially less than their manuscript submissions would suggest.

FIG.10 — PEER REVIEW SUPPLY AND DEMAND, BY REGION

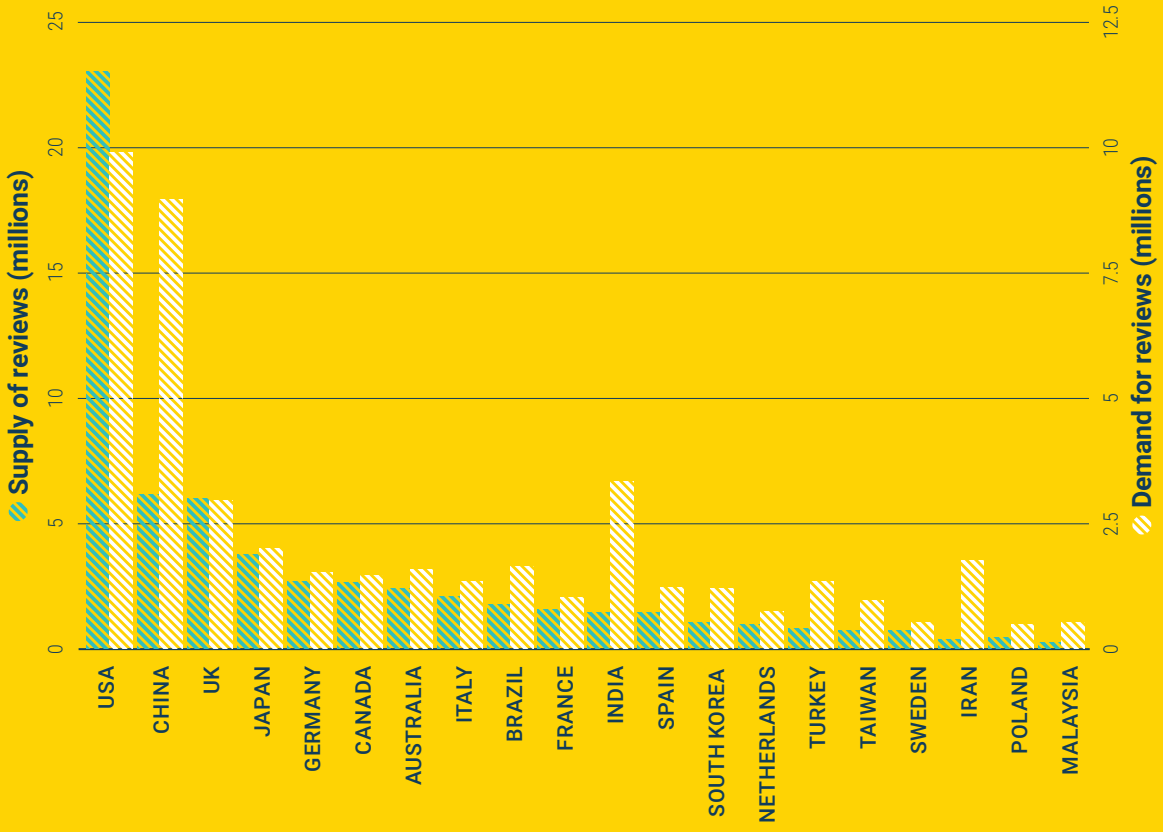
Data source: ScholarOne

The total number of completed reviews (left axis) and submitted manuscripts (right axis) across 20 selected regions.

Reviews 2013–2017:

Supply: Reviews completed

Demand: Manuscripts submitted



To further investigate *relative review rates*, the number of reviews a region has contributed per submitted manuscript has been charted against the number of publications that region contributed between 2013–17.

On the right are China and USA, the global research powerhouses.

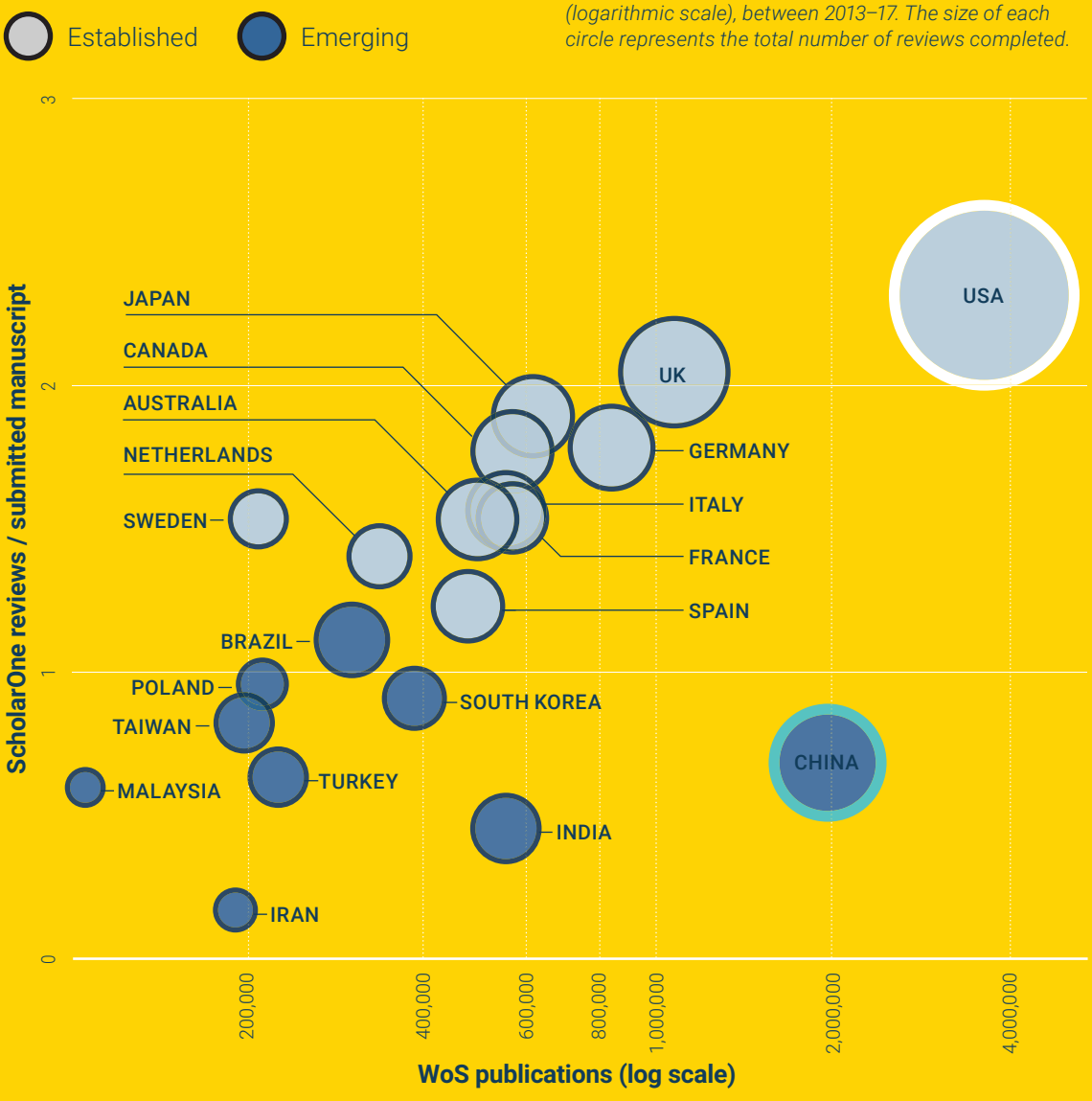
In the top two thirds of the chart are the 11 *established regions* that dominate the peer review process. Together they accounted for 66.1% of articles in *Web of Science* and 68.1% of *ScholarOne* reviews between 2013–2017.

In the bottom third are the nine *emerging regions*. These regions peer review less than their article output suggests. Together, the *emerging regions* accounted for 29.3% of *Web of Science* articles but performed just 18.9% of *ScholarOne* reviews between 2013–2017.

FIG.11 — RELATIVE PEER REVIEW CONTRIBUTIONS, BY REGION

Data source: ScholarOne.

Regions charted by the number of reviews they performed per submitted manuscript against total publication output (logarithmic scale), between 2013–17. The size of each circle represents the total number of reviews completed.



ESTABLISHED AND EMERGING REGIONS

In developing this report we selected the top 20 regions when ordered by combined research output (publications and reviews).

These regions were categorized into groups of *established and emerging regions* based on the typical classification of emerging economies.

Data were then aggrefated by these groups. Some key results are tabulated to the right. It is clear that *emerging regions* peer review less than their article output would predict. Why? To answer that question, we turn first to the editor.

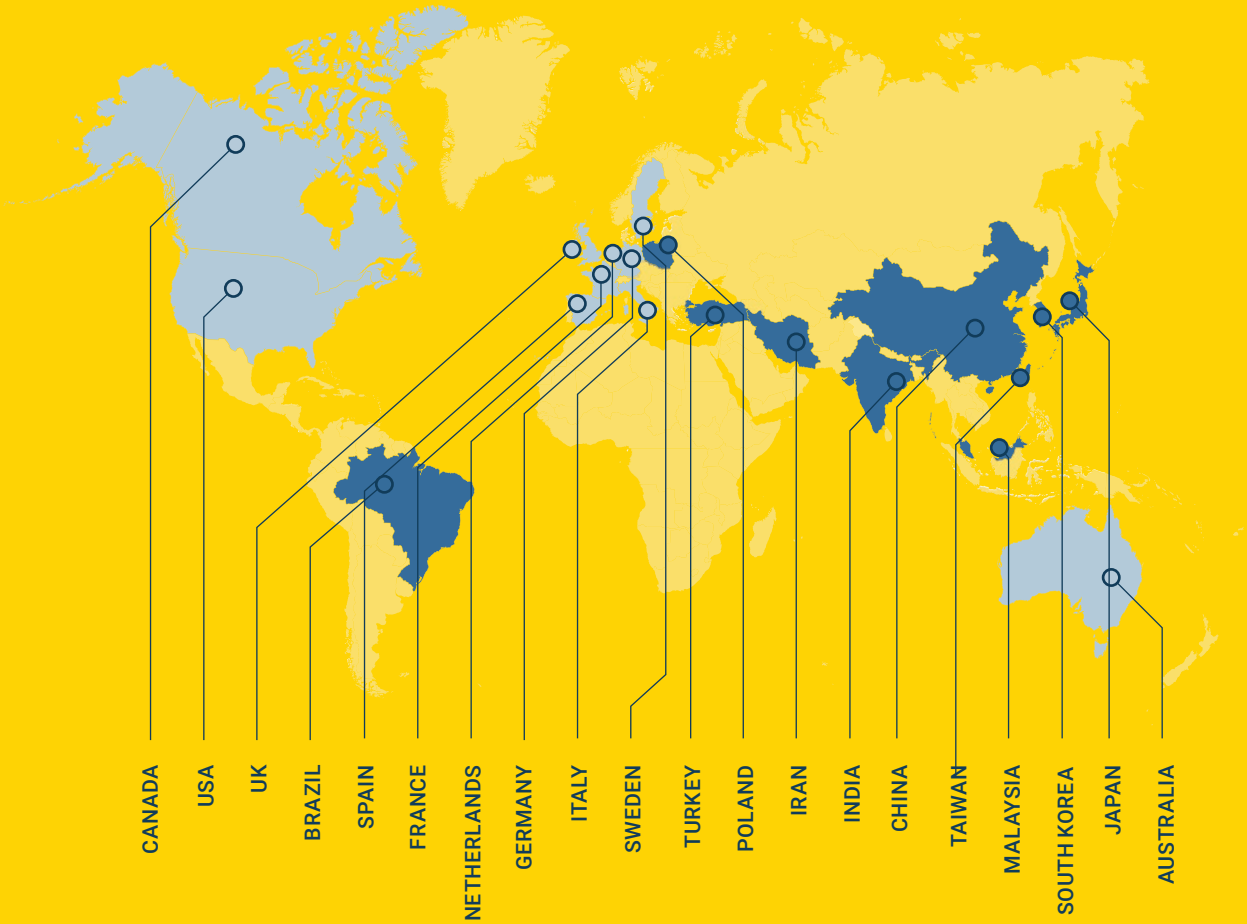
FIG.11B — KEY PEER REVIEW STATISTICS OF EMERGING AND ESTABLISHED REGIONS

Data source: Web of Science, ScholarOne & Publons

Established Regions	*Emerging Regions*	
66.1%	29.3%	**WOS PUBLICATIONS**
68.1%	99.1%	**REVIEWS**
1.95	0.66	**REVIEWS PER SUBMISSION**
16.4	15.1	**MEDIAN REVIEW TIME (DAYS)**
49.5%	56.6%	**REVIEW INVITATION AGREEMENT RATE**
527.5	249.9	**REVIEW LENGTH (WORDS)**
96.1%	3.9%	**EDITORS**

FIG.12 — TOP 20 REGIONS, BY RESEARCH OUTPUT

Data source: Web of Science, ScholarOne & Publons



SUPPLY AND DEMAND OF EDITORS

Editors play a critical role in the peer review process, particularly when it comes to selecting reviewers and sourcing reviews.

So where are all the editors, and who are they inviting to peer review?

Figure 13 compares the distribution of journal editors across selected regions with the distribution of publication output across those regions.

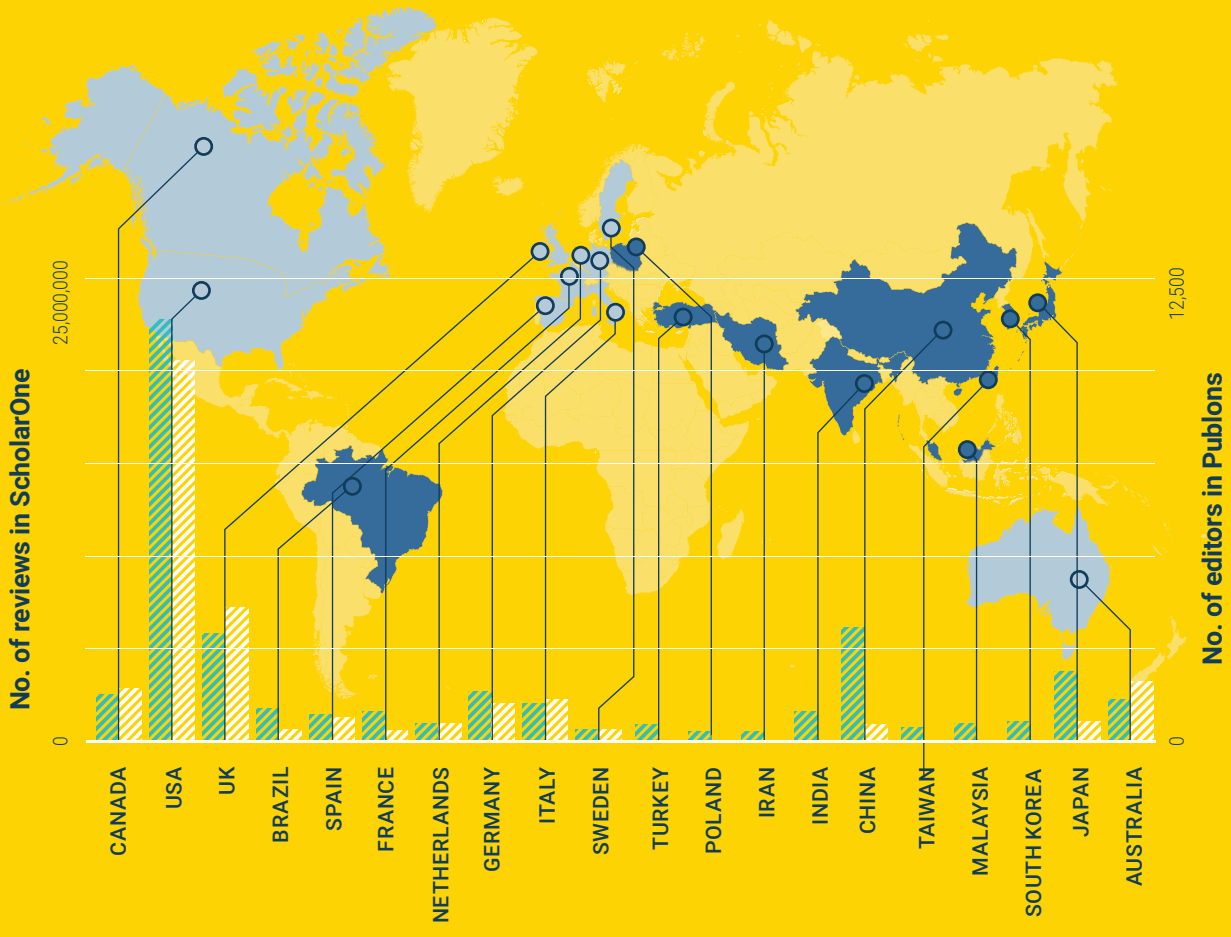
The group of *established regions* accounts for 96.1% of editors while *emerging regions* account for just 3.9%. This distribution of editors is a substantial divergence from what article or peer review output would predict.

96.1%

of Publons editors are from established regions

FIG.13 — DISTRIBUTION OF JOURNAL EDITORS AND PEER REVIEW ACROSS REGIONS

Data source: Publons & Web of Science



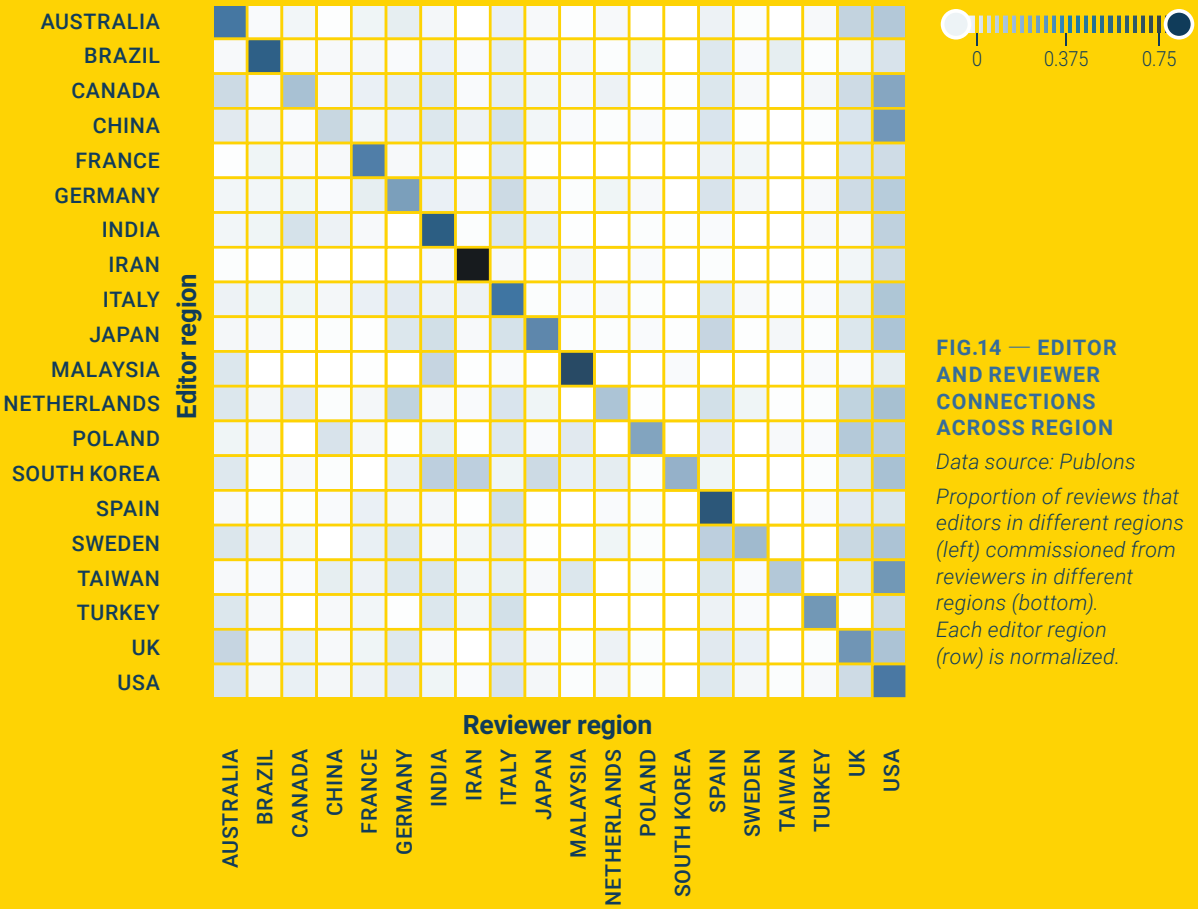


FIG.14 — EDITOR AND REVIEWER CONNECTIONS ACROSS REGION

Data source: Publons

Proportion of reviews that editors in different regions (left) commissioned from reviewers in different regions (bottom). Each editor region (row) is normalized.

The regions an editor and a reviewer are affiliated with for a given review are compared in Figure 14 in the form of a heatmap. The dark diagonal line down the chart shows that 38% of all reviews involve an editor and reviewer from the same region, substantially higher than the 14% rate expected if editors selected reviewers at a rate proportional to the amount of review that region completes.

Figure 14 suggests editors are more likely to be from *established regions* and are more likely to invite reviewers from their own region. This may partly explain why there are fewer reviewers from *emerging regions* than publication output would predict.

EDITORIAL COMMENT:

There are multiple reasons editors and reviewers might come from the same region:

- Editors may have preferences about who they invite.
- Reviewers could have preferences about who they review for.
- There may be regional differences in reviewer acceptance rates.
- An editor's network may be strongest in these places.
- Reviewing expertise may happen to sit in these regions.
- Review quality could vary by region.
- Editors may have preferences toward regions where English is spoken.

GROWTH IN REVIEW OUTPUT OVER TIME

While review output is growing in all regions, the output of *emerging regions* (led by China) is growing more rapidly, albeit from a smaller base.

In fact, since 2015, China has been reviewing more than the United Kingdom. This rate of growth is encouraging. Since 2015 we have been witnessing the emergence of these regions.

EDITORIAL COMMENT

Could review contributions lag behind article output? Presumably review contributions from *emerging regions* will continue to rapidly increase, so what will the world of peer review look like in 2025? We discuss this in chapter 4.

193%

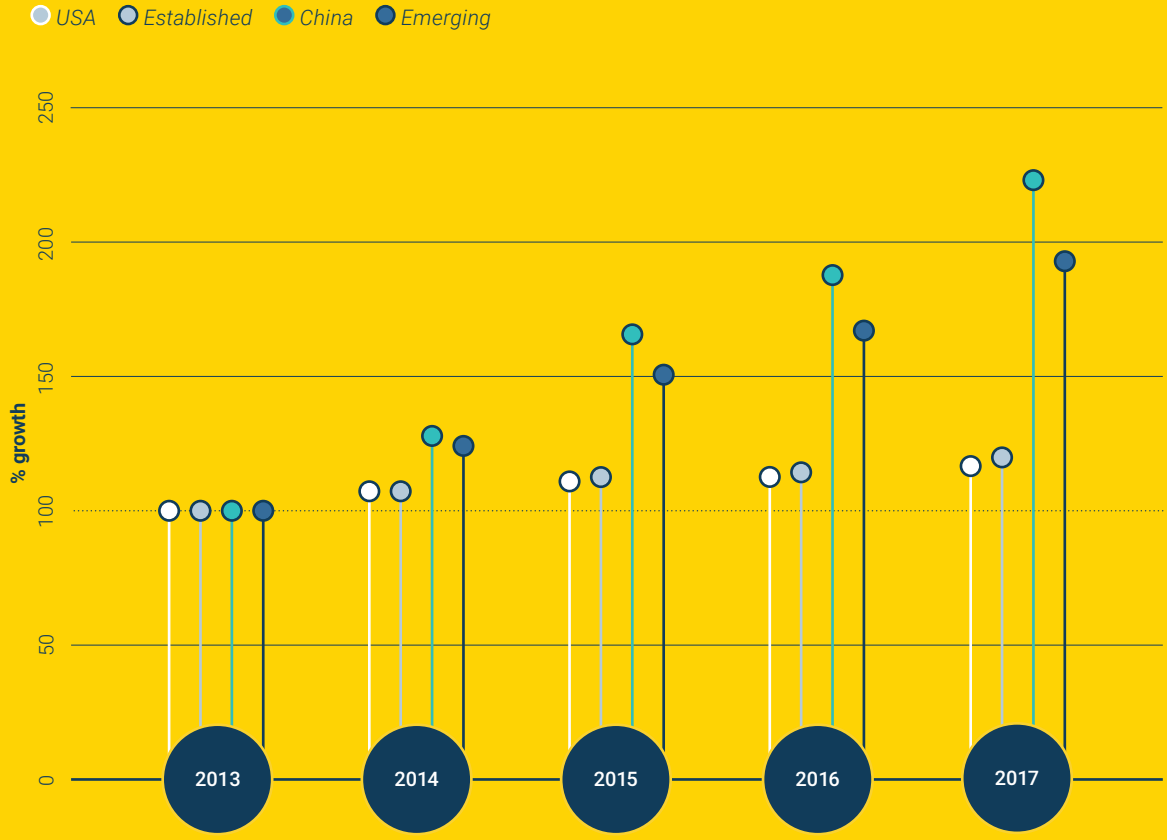
Growth of emerging regions' review volume 2013–17

224%

Growth of China's review volume 2013–17

FIG.15 — GROWTH OF REVIEW CONTRIBUTIONS OVER TIME, USING 2013 AS A BASELINE

Data source: ScholarOne



SUPPLY AND DEMAND OF PEER REVIEW, BY RESEARCH AREA

Reviewing practices across different research areas have been investigated by categorizing article submission and peer review completion data into 22 *Essential Science Indicator Research Areas*.

On average, 2.7 reviews are completed for each submission across all research areas, although there is a wide range of review intensity, relative to submission rates, between research areas. While Clinical Medicine is clearly the largest research area by publication output, on a review per submission basis, this fiel produces the fourth lowest number of reviews per submission.

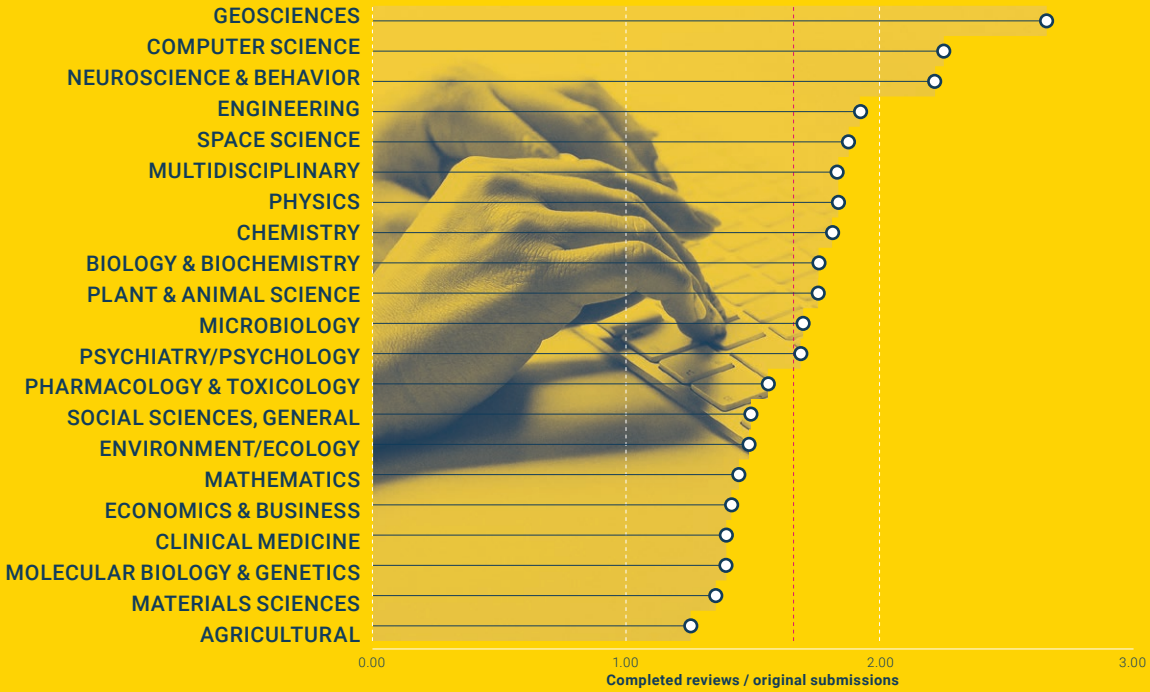
EDITORIAL COMMENT

The wide variety in review per submission rates is indicative of different cultures across research areas. This can be partly attributed to different approaches to peer review but will certainly be impacted by desk-reject rates: across our dataset, there were an average of 2.7 reviews per submission after desk rejects were removed from the sample. There may be other effects too — more data are required to explore further.

FIG.16 — RATIO OF REVIEWS COMPLETED, BY FIELD, 2013–17

Data source: ScholarOne

The ratio of peer reviews completed for each manuscript submission, across research areas. Red line shows the mean (1.6 reviews / submission). Note: these figures may be distorted by the relative size of the sample.



The growing representation of China in the hard sciences can be observed by comparing review volume across research area and region (Figure 17).

In general, reviewers from *emerging regions* play a relatively strong role in hard sciences. Figures 17 and 18 confirm that if there are researchers in a region with subject-matter expertise they will, eventually, be invited to review.

"THE PEER REVIEW COMMUNITY IS NOT DIVERSE ENOUGH AND WOULD CERTAINLY BENEFIT FROM TAPPING INTO A WIDER SPECTRUM OF EXPERTISE"

TAMI POTTEN, EDITORIAL DEVELOPMENT MANAGER, BRITISH INSTITUTE OF RADIOLOGY

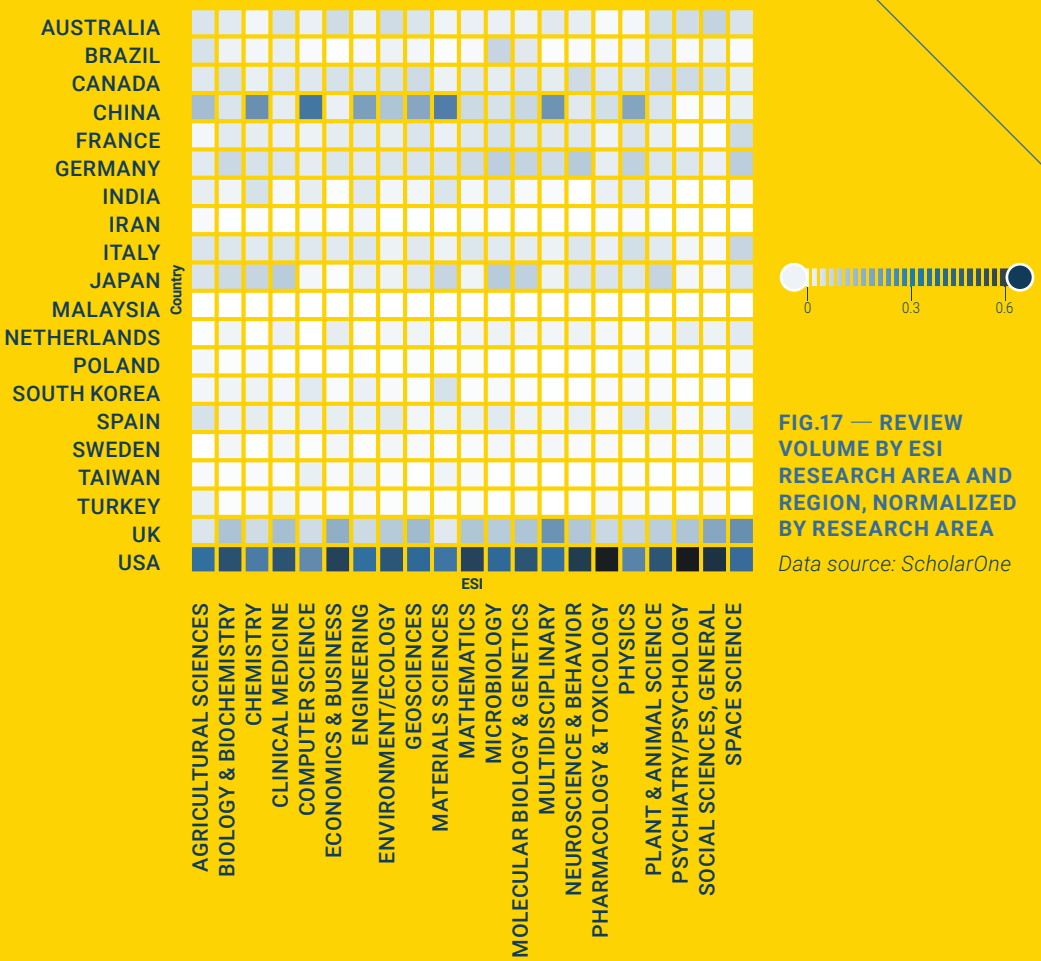


FIG.17 — REVIEW VOLUME BY ESI RESEARCH AREA AND REGION, NORMALIZED BY RESEARCH AREA

Data source: ScholarOne

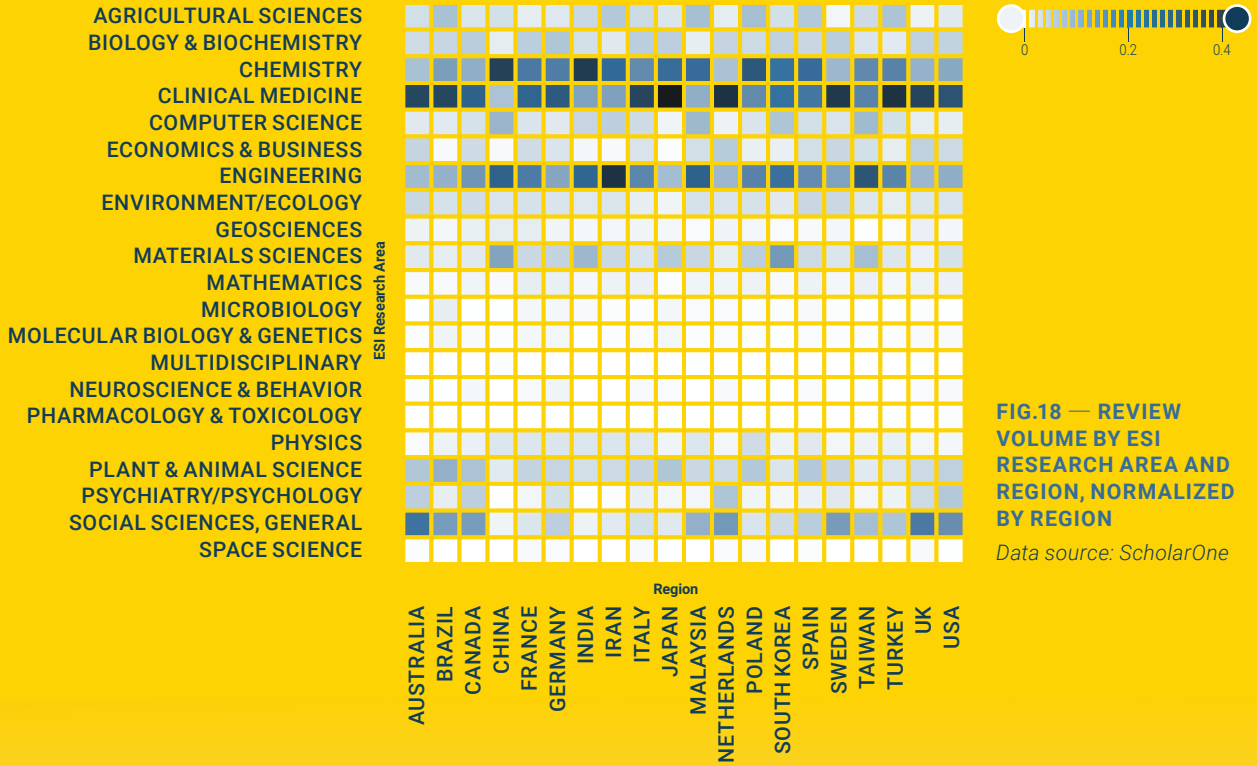


FIG.18 — REVIEW VOLUME BY ESI RESEARCH AREA AND REGION, NORMALIZED BY REGION

Data source: ScholarOne

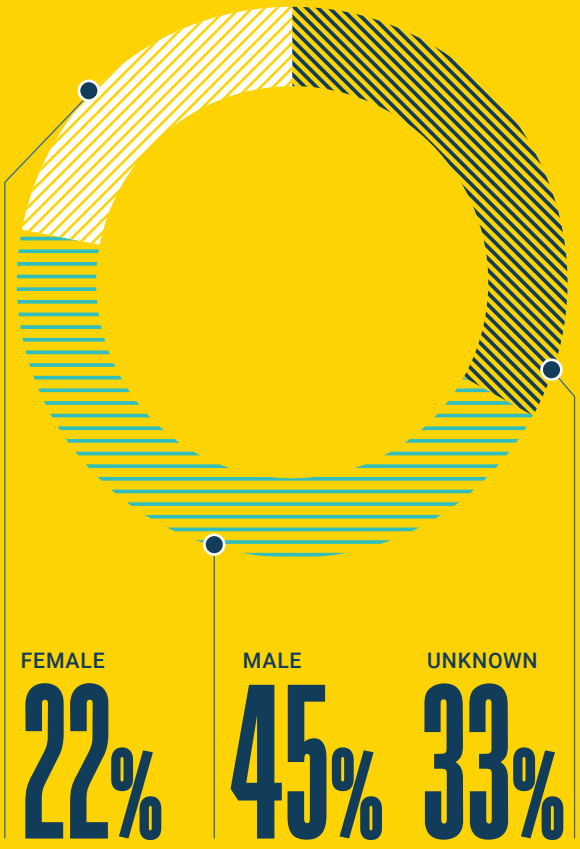
GENDER DISTRIBUTION

Using an algorithmic approach, which predicts gender based on name and region, the following gender distribution has been estimated for researchers on Publons.

While much more data are needed to draw firm conclusions, it seems women are underrepresented in peer review, or possibly in research as a whole.

FIG.19 — GENDER DISTRIBUTION FOR RESEARCHERS ON PUBLONS

Data source: Publons does not collect gender data. A tool that predicts gender based on names has been used to analyze the first names of researchers on Publons by comparing them against the tool's dataset of popular names for men and women worldwide.



ASIDE

A study by American Geophysical Union (AGU)) found that, while the proportion of female reviewers increased from 2012 to 2016, women of all ages had fewer opportunities to take part in peer review.

The AGU's analysis indicated that this bias is a result of (mostly male) authors and editors suggesting women as reviewers less often than they do men.

They found that of the reviewers suggested by male authors, 16% were female. Meanwhile, reviewers suggested by female authors were 22% female. Male editors subsequently subsequently invited only 18% female reviewers, while female editors went on to invite 22%.*

This is analogous to the finding in this report that editors are more likely to invite reviewers from their own region.

"SCHOLARLY COMMUNICATIONS HAS AN URGENT NEED TO INCREASE DIVERSITY AND INCLUSION IN EVERY ASPECT OF ITS ENTERPRISE, AND PEER REVIEW IS NO EXCEPTION."

PETER BERKERY, EXECUTIVE DIRECTOR, ASSOCIATION OF UNIVERSITY PRESSES

* www.nature.com/news/journals-invite-too-few-women-to-referee-1.21337

BREAKOUT: THE PEER REVIEW NETWORK

To convey the dimensions and interrelationships in the peer review landscape, Figure 20 visualizes a network in which research areas (dark blue and yellow nodes) are connected via common reviewers (dark blue clusters).

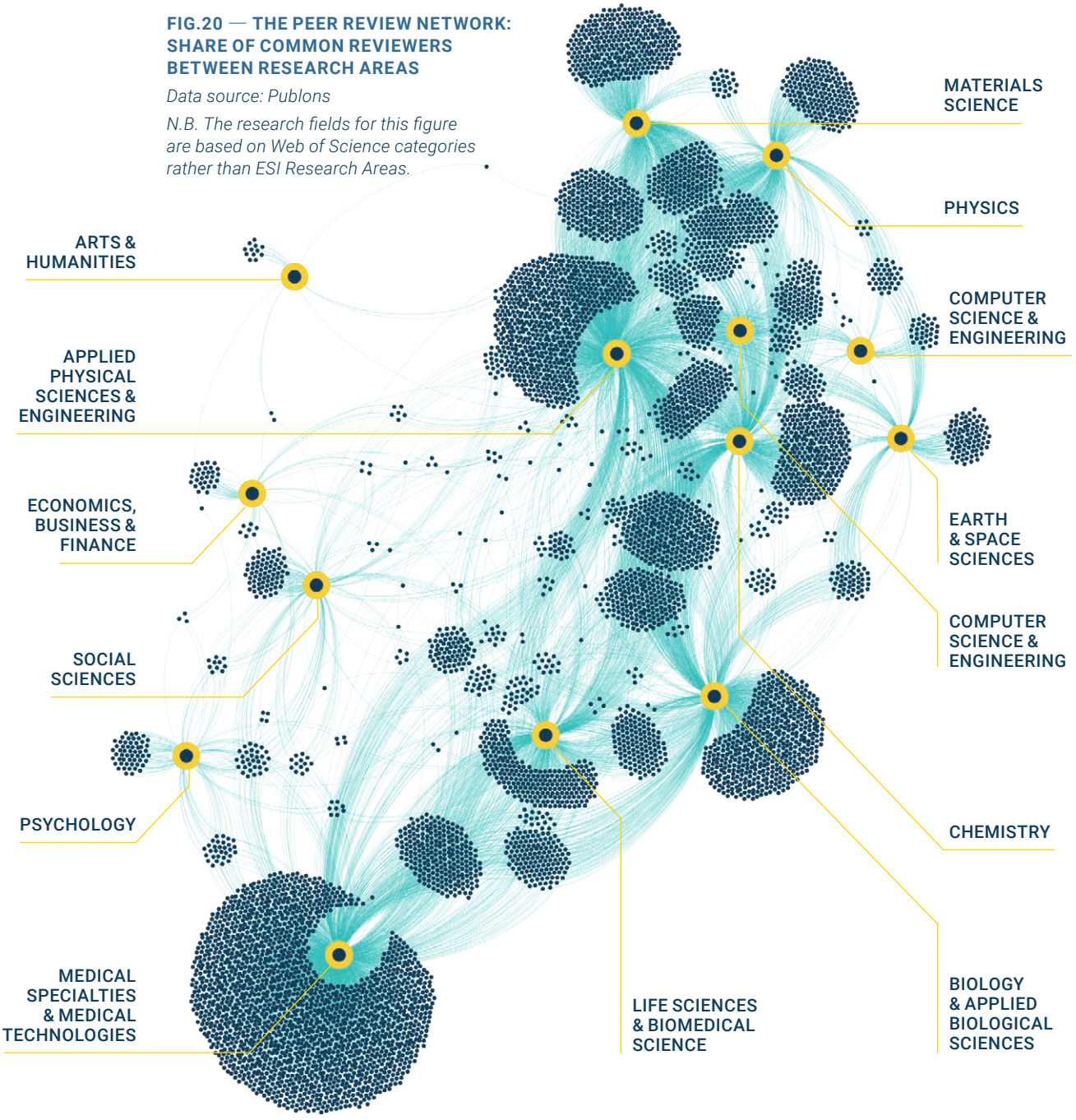
The dark blue clusters between research areas represent reviewers with common expertise.

For example, reviewers who only review Physics will be in one cluster, while those who review both Physics and Materials Science are in another cluster connecting the those two nodes. The research areas are connected to the journals for which reviewers do their reviews.

FIG.20 — THE PEER REVIEW NETWORK: SHARE OF COMMON REVIEWERS BETWEEN RESEARCH AREAS

Data source: Publons

N.B. The research fields for this figure are based on Web of Science categories rather than ESI Research Areas.



BREAKOUT: THE REVIEW DISTRIBUTION INDEX (RDI)

The RDI is based on the Lorenz curve:

- Most famously known for measuring income distribution within a population (Gini curve or Gini index).
- In a population where every researcher did the same number of reviews, the curve would be a straight, diagonal line connecting the bottom left corner to the top right corner.
- The more convex the curve, the more uneven the distribution of reviewers.
- The area between the curve and the straight line gives us a measure of that inequality.
- The greater the area the more uneven the distribution.

The distribution of peer review work can be represented similarly.

Imagine everyone in a population writes an equal share of reviews. Such a scenario (for example, 100 people, each completing one review) would result in an RDI coefficient of 0.

If the line is curved, the distribution of reviews performed is, to some degree, skewed across the population. A perfectly unequal distribution — one person in the population completing all reviews — is represented by an RDI coefficient of 1. The lower the coefficient, the more evenly distributed the reviewing workload is; the higher the coefficient, the more skewed the workload.

FIG.21 — THE REVIEW DISTRIBUTION INDEX

Data source: Publons

Within Publons ~10% of reviewers are responsible for ~50% of the peer review records.

	RDI
Established	0.599
Emerging	0.642

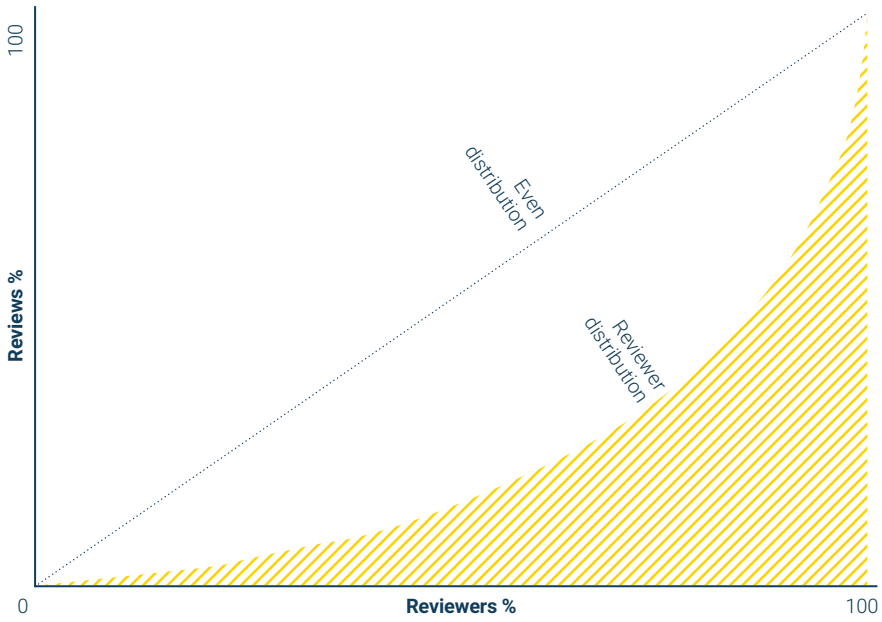
Publons data shows that

10%

of reviewers perform

50%

of all reviews



2 HOW EFFICIENT IS THE PEER REVIEW PROCESS?

It is critical for the quality of the literature that the peer review process is able to scale as article submissions grow.

75%

of journal editors say that *"finding reviewers and getting them to accept review invitations"* is the hardest part of their job.

2016 PUBLONS' EDITOR SURVEY

This chapter investigates the nuts and bolts of the peer review workflow.

KEY FINDINGS

- On average, an editor in 2017 needed to send out 2.4 peer review invitations to get one peer review report done. This has increased from an average of 1.9 invitations in 2013.
- Reviewers from *established regions* are less likely to accept and complete review assignments than reviewers in other regions.
- Reviewers most commonly decline review invitations because the article is outside their area of expertise and/or because they are too busy with their own research.
- The median time to complete a review is 16.4 days after accepting the review invitation.
- Reviewers from *emerging regions* tend to complete reviews faster than reviewers from other regions.
- Review turnaround time has been decreasing in some, but not all, research areas.

THE PEER REVIEW FUNNEL

The peer review process for a manuscript typically starts with the editor sending review invitations to one or more potential reviewers.

Ideally, all reviewers that receive an invitation would accept it and then go on to complete a review. This is not always the case. Potential reviewers drop off at each stage, forming a funnel (see Figure 23).

Reviewer completion rates are decreasing each year, while the total number of review invitations sent is increasing at 9.8% year-on-year (faster than the rate at which articles are accepted for publication, which is growing at 4.9% annually). Is this discrepancy a sign that reviewer fatigue is setting in?

9.8%

Increase year-on-year of reviewer invitations

4.9%

Annual growth in article acceptance rates

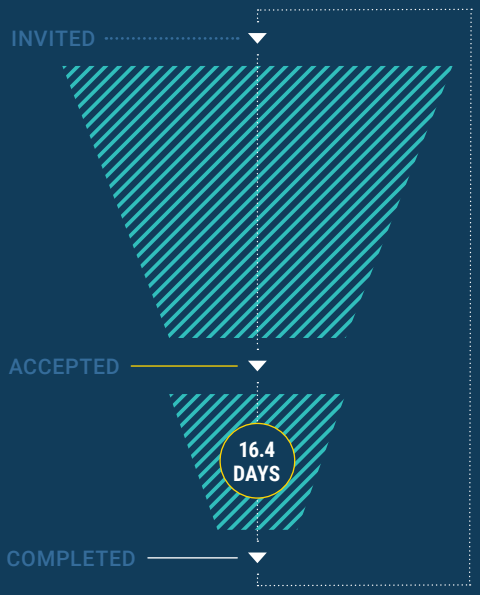


FIG.23 — THE PEER REVIEW FUNNEL

Data source: ScholarOne

Shows median time from agreeing to review through to completion of review report.

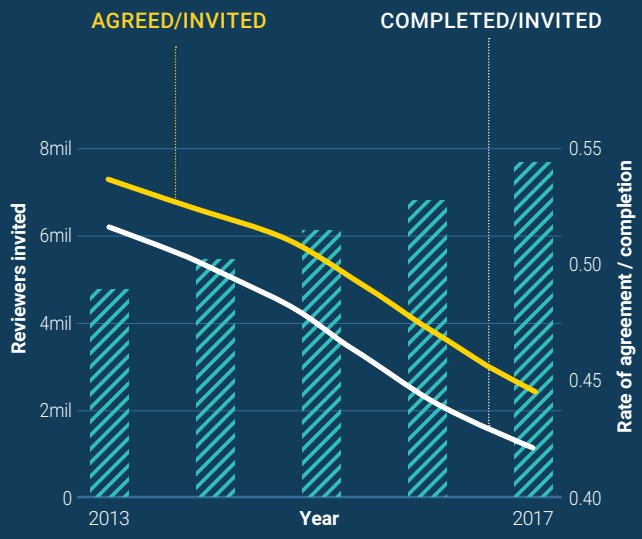


FIG.24 — TOTAL REVIEWERS INVITED, AND PROPORTION OF INVITATIONS AGREED TO AND REVIEWS COMPLETED, FROM 2013–17

Data source: ScholarOne

On the left y-axis are absolute numbers of invitations to review over the last five years. On the right y-axis are reviewer invitation agreement and completion rates.

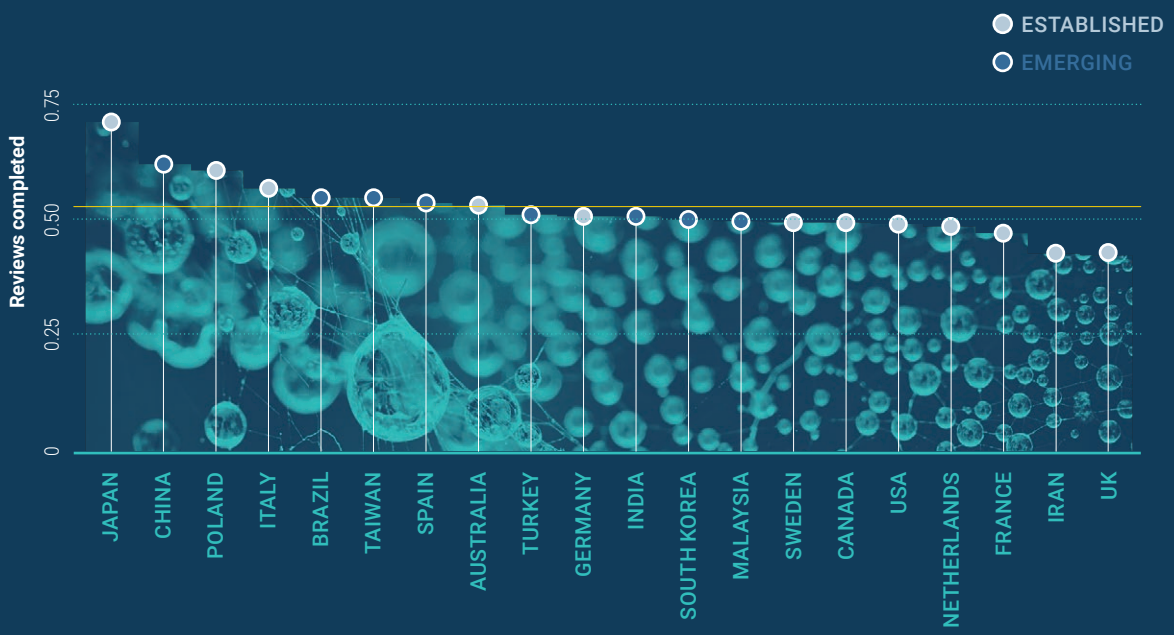


FIG.25 — REVIEWER COMPLETION RATES, BY REGION

Data source: ScholarOne

Rate at which reviewers complete review assignments after an invitation has been sent (not agreed to), across 20 regions between 2013–17. The yellow line shows the mean (51.3%).

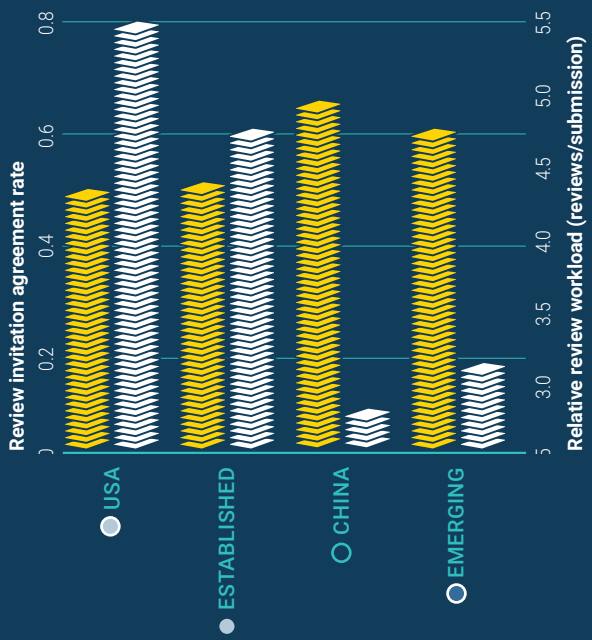
Looking at review completion rates by region, there is a tendency for *emerging regions* — China, Poland, Brazil, and Taiwan — to have higher completion rates. Together, the *established regions* have a completion rate of 49.5% compared with 56.6% for *emerging regions*.

FIG.26 — REVIEW INVITATION AGREEMENT RATES AND RELATIVE REVIEW WORKLOAD BY REGION

Data source: ScholarOne and Web of Science

Review invitation agreement rate

Relative review workload



Comparing reviewer workload (the number of reviews a region performs per accepted manuscript) with reviewer invitation agreement rates, reveals a negative relationship.

EDITORIAL COMMENTS

This implies that low review rates in *emerging regions* are not because reviewers do not want to review, but because they are not being asked to review.

49.5%

Established regions' agreement rate

56.6%

Emerging regions' agreement rate

WHY DO REVIEWERS DECLINE REVIEW INVITATIONS?

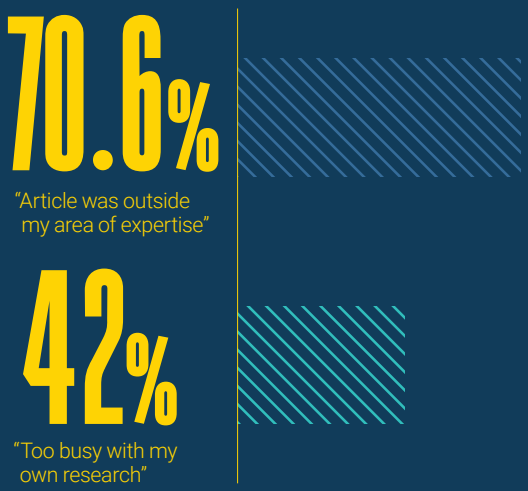


FIG.27 — THE MOST COMMON REASONS REVIEWERS DECLINE INVITATIONS

Data source: Publons' 2018 Global Reviewer Survey

Respondents were invited to select up to two options from a list of 12 common reasons for declining a review request.

EDITORIAL COMMENTS

Many researchers report "receiving requests to review articles outside their area of expertise". This could be due to increasing specialization in many research areas and the corresponding concentration of relative expertise into small groups of individuals, making it difficult for editors to understand the current subject-matter expertise of prospective reviewers.

Researchers appear to be facing a decision between working on their own research and helping — as a reviewer — to develop others' research. Should universities more formally require and recognize peer review contributions to better balance the incentives for peer review with the traditional focus on citation metrics? Researchers appear to favor the idea (see Figure 8).

"WE RECOGNIZE THAT THE INDIVIDUALS WE ASK TO REVIEW MANUSCRIPTS ARE FITTING THIS INTO THEIR BUSY SCHEDULES. WITH THIS IN MIND WE WANT THE REVIEW EXPERIENCE TO BE POSITIVE, EFFICIENT AND PROVIDE A GREAT LEARNING EXPERIENCE FOR ALL INVOLVED."

KRISTEN MARCHETTI, ASSOCIATE DIRECTOR OF PEER REVIEW, SAGE

BREAKOUT: HOW MANY REVIEWS ARE PERFORMED EACH YEAR?

Roughly 2.9 million peer reviewed articles were indexed in *Web of Science* in 2016. How many reviews are going on behind the scenes to support this?

No-one has these data so an estimate for 2016 has been made based on the following estimates which are based on our general knowledge of the industry but no specific data:

- Total publications in 2016: **2.9 million**
- Global manuscript acceptance rate: **55%**
- Total rejections: **2.5 million**
- Reviews per publication: **3** (two reviews in first round and one in second round)
- Reviews per rejection: **2** (two reviews in first round)
- Estimated number of reviews each year: **13.7 million**

However it is estimated, a lot of peer review is happening, placing a huge workload on researchers and delays that are potentially slowing down research by hundreds of thousands of years. A lack of transparency in the peer review process makes it difficult to know exactly how much review is done or the time it takes to perform.

5 hrs
Median hours spent writting each review in 2016

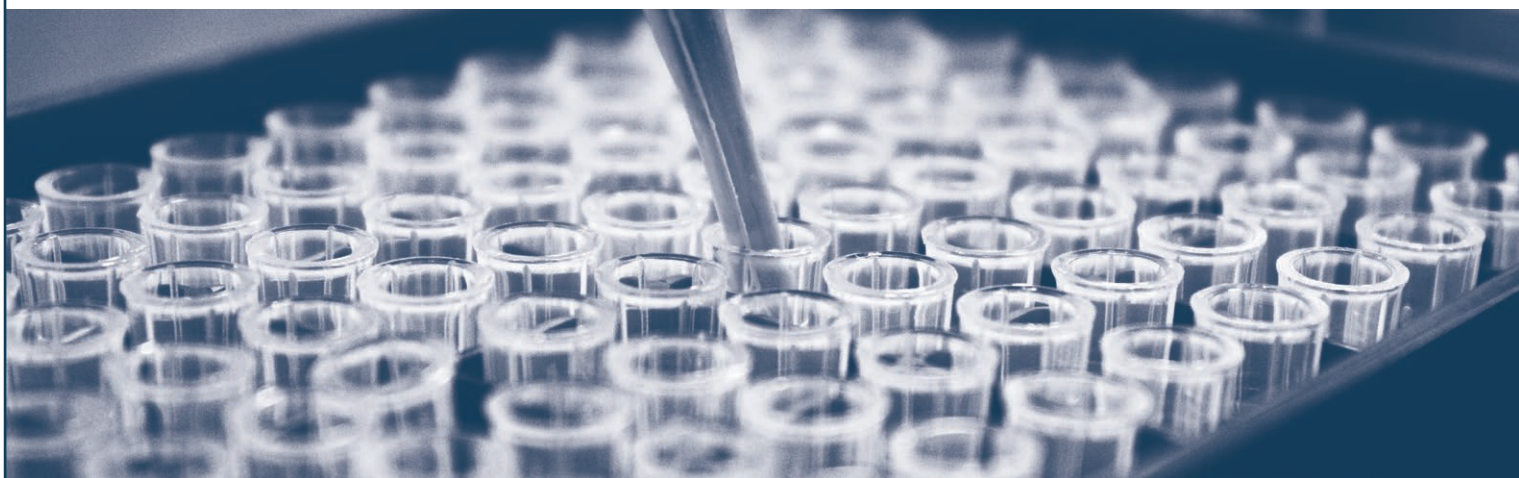
2.9 m
Estimated days spent rewiewing in 2016

19.2 d
Mean days to complete each review in 2016

260 m
Researcher-days spent waiting for reviews in 2016

13.7 m
Estimated reviews in 2016

N.B. this estimate for total number of reviews per year is used to scale the review counts presented throughout this report, allowing us to provide an estimate for the global market.



HOW LONG DOES IT TAKE TO WRITE A REVIEW?

It takes reviewers a median of 16.4 days to complete a review after agreeing to the assignment (the mean is 19.1 days).

Looking at how long it typically takes to complete a review, the distribution has a sharp peak at 12 days followed by a long tail (beyond 120 days). This right skew is evident in a histogram of all reviews and drags median and mean review times to the right of the peak.

Due to that skewed distribution, median review times have been used for all further analyses in this report.

The review times shown cover the period between agreement to review and delivery of the completed review. This excludes the time it takes an editor to find reviewers, for the reviewer to accept a review invitation, or for an editor to find a new reviewer if the original reviewer rejects the invitation.

These delays can quickly add weeks or months to the process. Even in the best case scenario, it is highly likely to be weeks between submission and acceptance for publication.

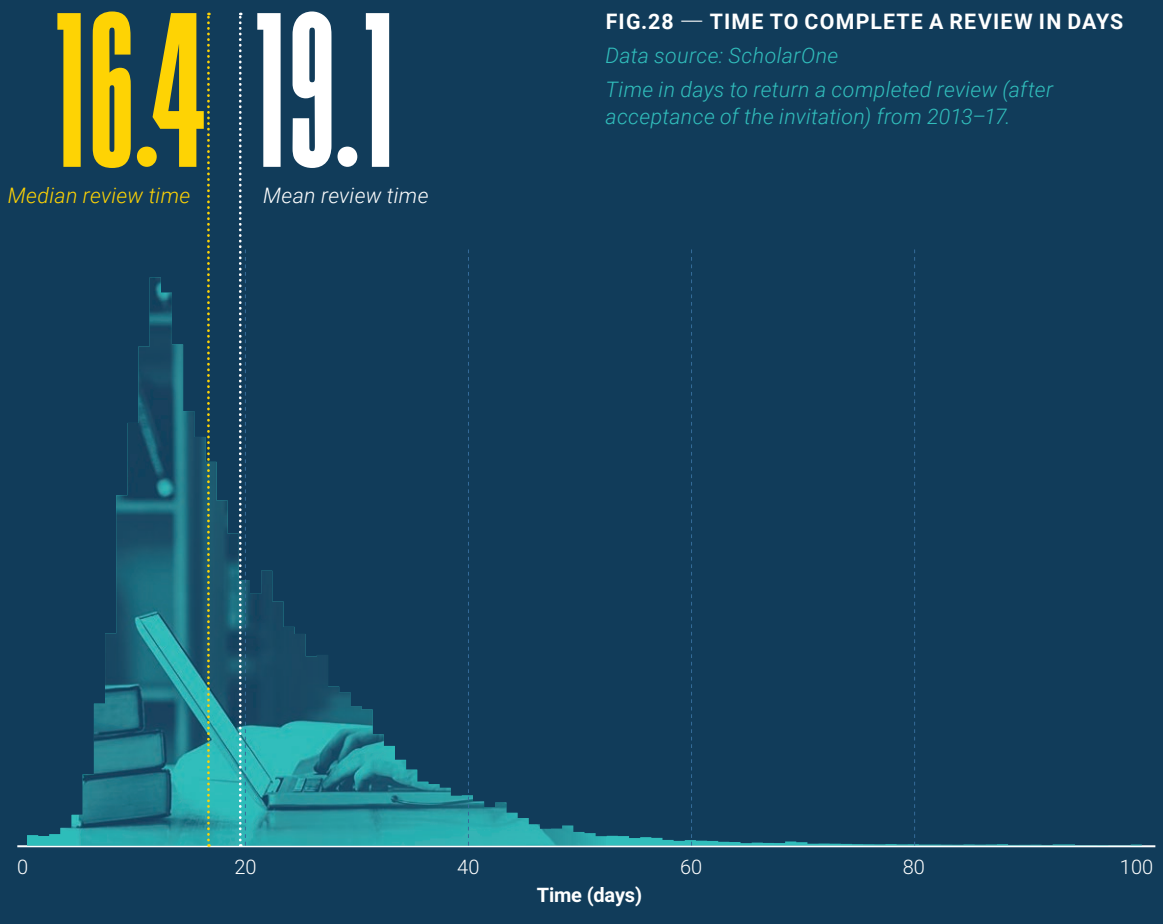


FIG.28 — TIME TO COMPLETE A REVIEW IN DAYS

Data source: ScholarOne

Time in days to return a completed review (after acceptance of the invitation) from 2013–17.

China and Japan return reviews the fastest, while Malaysia, Iran, and Canada are the slowest. The *established regions* are slower to review (median of 16.4 days) than the *emerging regions* (median of 15.1 days).

EDITORIAL COMMENT

As publishers push to improve publication times, the next frontier may well be more responsive reviewers sourced from *emerging regions*.

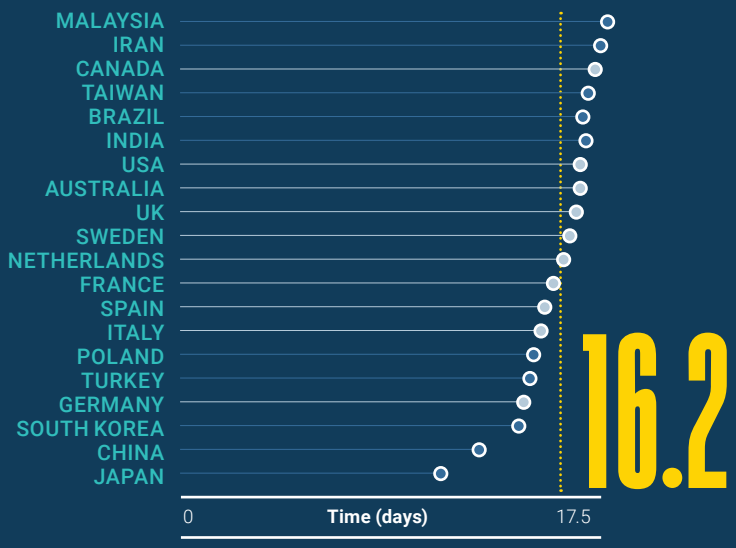


FIG.29 — MEDIAN TIME TO COMPLETE A REVIEW, BY SELECT REGIONS

Data source: ScholarOne

Established *Emerging*

Median time in days to return a completed review (after agreement to the invitation) from 2013-17, across 20 regions.

Median review time in days across all regions

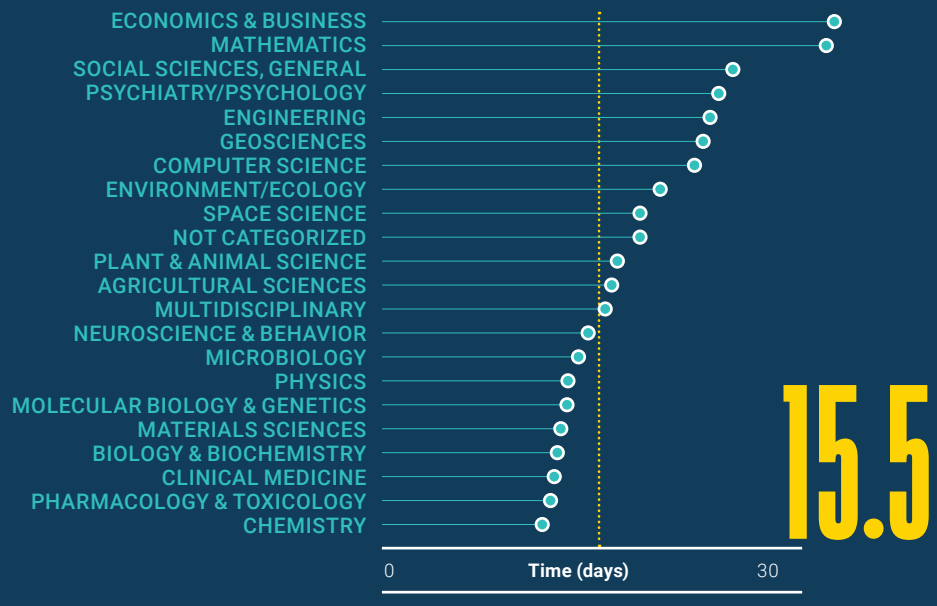


FIG.30 — MEDIAN TIME TO COMPLETE A REVIEW, BY ESI RESEARCH AREAS

Data source: ScholarOne

Median time in days to return a completed review (after agreement to the invitation), for all reviews from 2013-17, by Research Area.

Median review time in days across all fields (N.B. this dataset excludes reviews from journals that do not have an associated ESI field)

THE TORTOISE AND THE HARE: REVIEW TIME BY RESEARCH AREA

There are two ways to shorten the review cycle.

The first is to make the process of finding reviewers and confirming they are available to review as fast as possible. The second is to get reviewers to review faster.

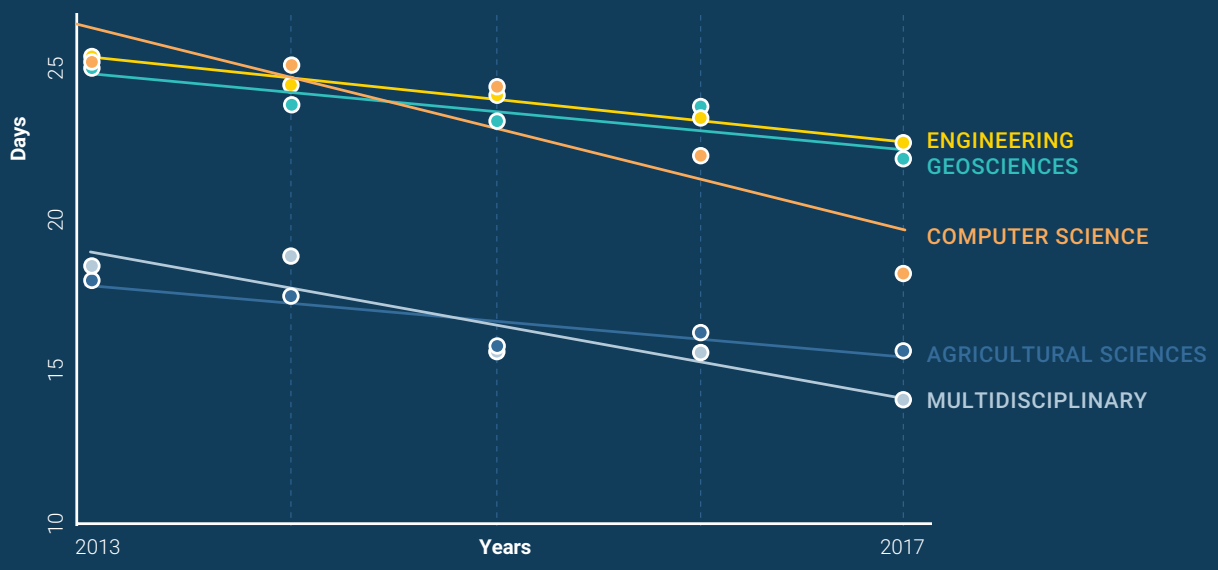
For some research areas — Computer Science, Multidisciplinary, Geosciences, Engineering, and Agricultural Sciences in particular — it appears publishers have found a way to speed up median review times by more than two days over the last five years.

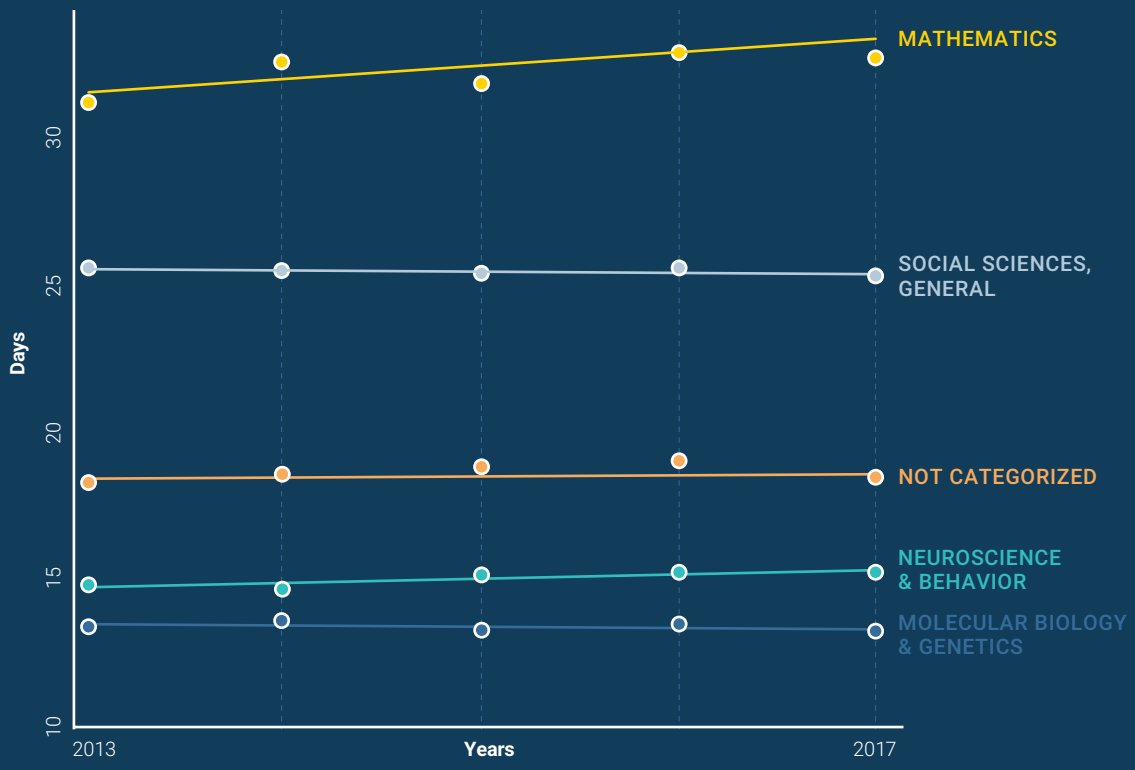
The downward trend over the five years (2013–17) holds when considering the aggregate dataset. As Figure 32 shows, review turnaround times has been decreasing concurrent with reviewers becoming less likely to agree to a review invitation!

FIG.31A (BELOW) & 31B (OVER PAGE) — MEDIAN TIME IN DAYS TO COMPLETE A REVIEW, BY SELECT RESEARCH AREAS FROM 2013–17

Data source: ScholarOne

In Fig.31A (below) we are showing the five largest decreases in review time. Fig.31B (next page) shows the five smallest decreases (including mathematics, where review time has increased). The straight lines show the linear fit.





	WEB OF SCIENCE PUBLICATIONS	MEDIAN REVIEW TURNAROUND TIME (DAYS)	AVERAGE NO. OF REVIEW INVITATIONS REQUIRED
2013	2,658,406	16.8	1.94
2014	2,762,875	16.6	2.01
2015	2,836,048	16.3	2.10
2016	2,949,895	16.3	2.24
2017	2,860,334	16.0	2.38

FIG.32 — COMPARISON OF WEB OF SCIENCE PUBLICATIONS, MEDIAN TIME IN DAYS TO COMPLETE A REVIEW, AND AVERAGE NUMBER OF REVIEW INVITATIONS SENT IN ORDER TO GET ONE REVIEW DONE

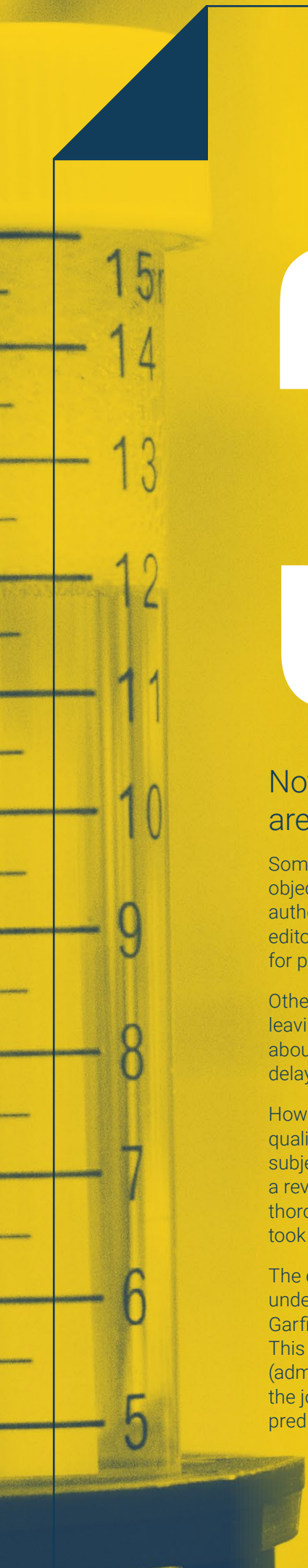
Data source: Web of Science and ScholarOne

N.B. Not all publications for 2017 were indexed at the time the data were pulled.

EDITORIAL COMMENT

Anecdotally, faster review times may be because journals are reducing the deadlines they set reviewers. This has been shown to reduce the time it takes to complete reviews without having a substantial impact on reviewer completion rates. Research seems to back this up.*

* www.aeaweb.org/articles?id=10.1257/jep.28.3.169



3 WHAT DO WE KNOW ABOUT PEER REVIEW QUALITY?

Not all peer reviews are created equal.

Some review reports are excellent, providing objective and constructive feedback to authors, and clear recommendations to editors about whether or not a paper is fit for publication.

Other reviews offer little useful information, leaving authors confused, editors unsure about the soundness of a paper, and ultimately delaying the sharing of knowledge.

How do we tell them apart? Measuring the quality of peer review is difficult, and arguably subjective. For example, does the "quality" of a review mean its length, clarity, helpfulness, thoroughness, or perhaps even how long it took to complete?

The current state of the art is akin to the understanding of the literature before Eugene Garfield pioneered the field of bibliometrics. This chapter investigates review length as an (admittedly weak) indicator of quality, and how the journal that commissions a review might predict the length of that review.

KEY FINDINGS

- Review length varies drastically by region; *established regions* write significantly longer reviews than *emerging regions*.
- Journals with higher *Journal Impact Factors* tend to receive longer reviews.
- *Emerging regions*, on average, review for journals with lower *Journal Impact Factors* and write shorter reviews.
- Editors of journals with higher *Journal Impact Factors* may solicit more reviews from *established regions* (who tend to write longer reviews).
- Journals with higher *Journal Impact* Factors tend to have faster review turnaround times.

DOES SIZE MATTER?

According to Publons data, the average length of a review report is 477 words.

There is a clear difference in average review length between *established* (528 words) and *emerging* (250 words) regions.

Why are there large differences between some regions? One hypothesis is that reviewers in *emerging regions* are less comfortable writing in English.

EDITORIAL COMMENT

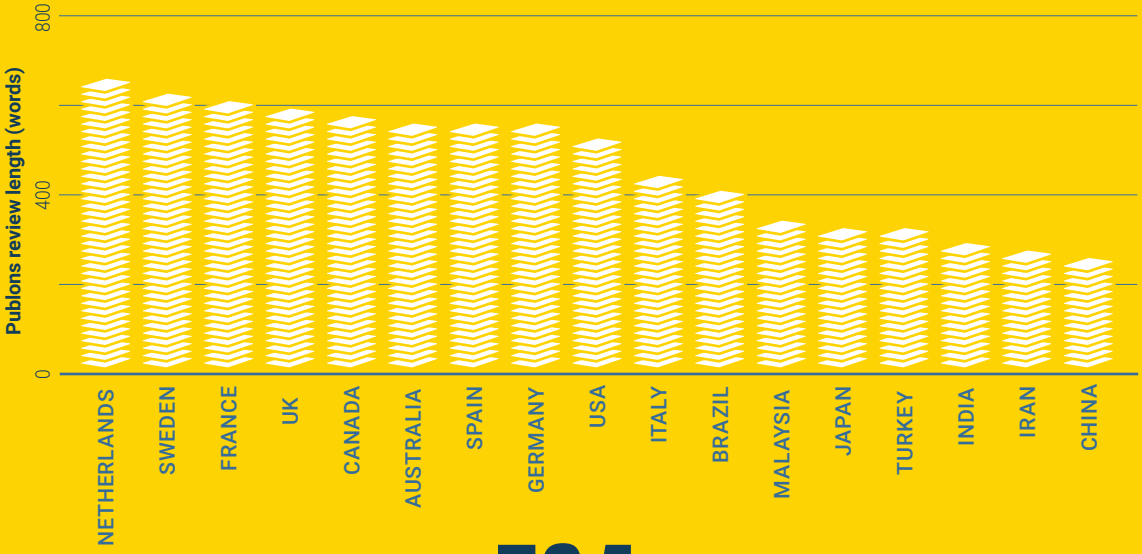
If editors value long reviews, or if non-native English speakers' reviews are harder to read, this might explain some of the bias toward reviewer selection observed from editors in Chapter 1.

528

Average review wordcount from established regions

250

Average review wordcount from emerging regions



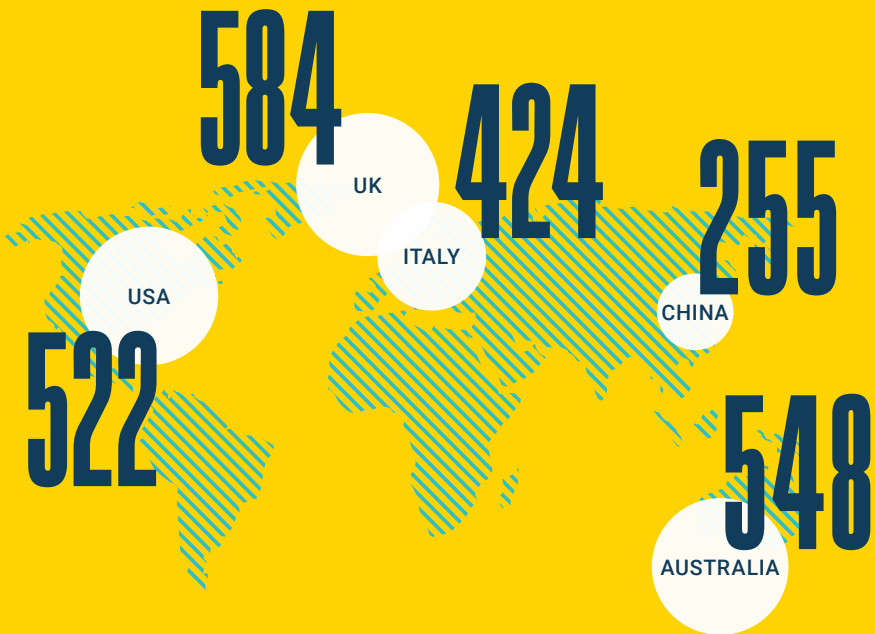


FIG.33 — MEAN REVIEW LENGTH, BY REGION

Data source: Publons

Fig.33A (above) shows the median review length (in words) for different regions, for all reviews performed by reviewers affiliated with that region in Publons.

Fig.33B (right) shows same data for select regions.

JOURNAL IMPACT FACTOR

Interestingly, we observe a shift to longer reviews as the *Journal Impact Factor* (JIF) increases.

This could mean that reviewers put more effort in when reviewing for journals with higher JIFs, or that editors at these journals focus on recruiting top reviewers who write longer reviews. If either of these were the case, JIF would be a predictor of review quality. There may, however, be confounding factors.

It is possible that editors of journals with higher JIFs solicit more reviews from regions that tend to write longer reviews, regardless of quality, or that higher JIFs are associated with subjects that tend to have longer reviews.

FIG.34 — REVIEW LENGTH BY JIF PERCENTILE

Data source: Publons

Review length (in words) is represented by box and whisker graphs. The box represents the upper and lower quartiles with the median shown. The whisker portions encompass 99% of the data. Each ventile contains approximately 4,500 reviews.The dashed line shows median review length (477 words).

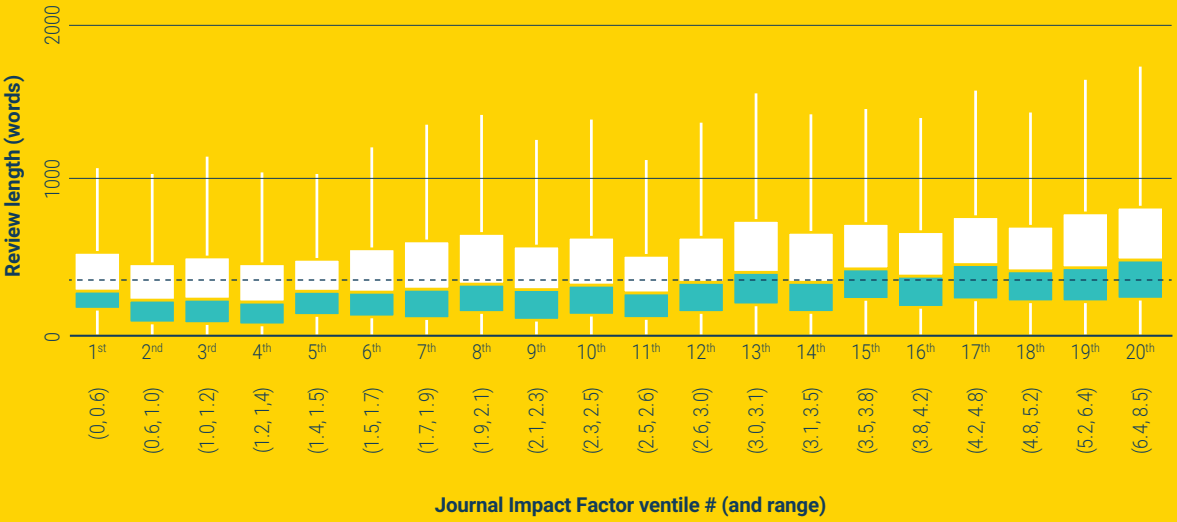
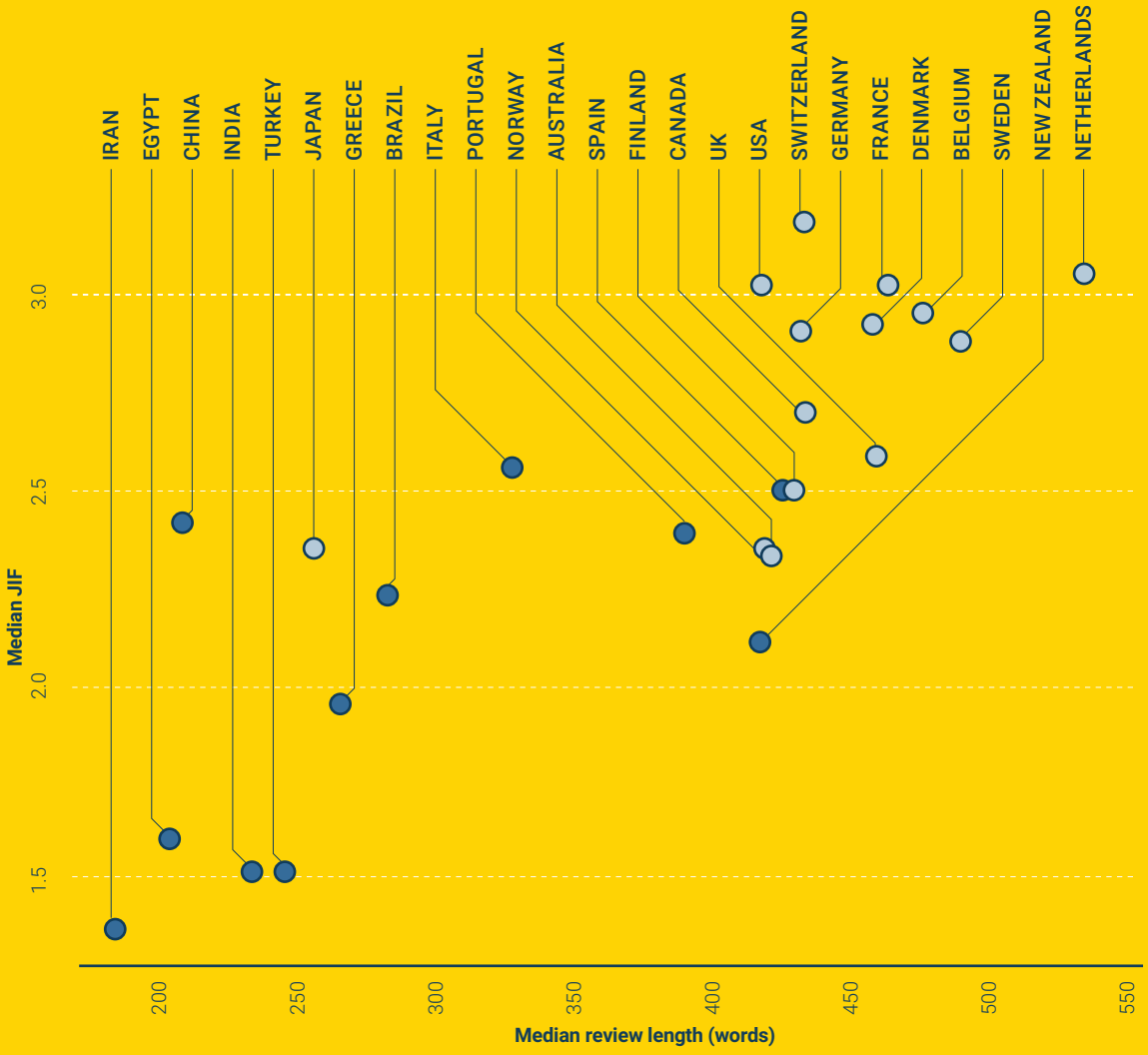


Figure 36 shows that India, Iran, Turkey, and Egypt have both the shortest review length and lowest median JIF.

Japan, China, and Brazil have median JIFs, in line with the lower end of the *established regions*.

Established regions tend to have longer median review lengths and higher median JIFs. This suggests that reviews for journals with higher JIFs are predominantly done by reviewers from *established regions*.



EDITORIAL COMMENT

Is language a sticking point for editors? Could the average length of a review from regions such as China and India reduce the likelihood they are asked to review even though they are, on average, more likely to accept a review invitation than other regions?

FIG.36 — MEDIAN REVIEW WORDCOUNT, BY JIF, ACROSS REGIONS

Data source: Publons

The median JIF and review length (in words) for different regions, for all reviews performed by reviewers affiliated with that region in Publons.

○ *Established* ● *Emerging*

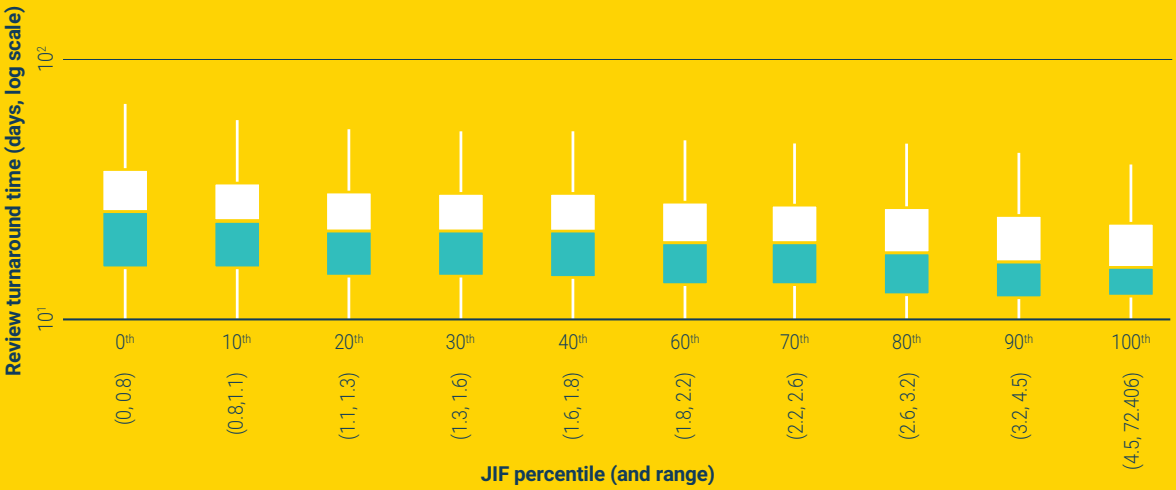
Turning to the question of motivation, we see that as a journal's JIF increases, the time it takes for a review to be completed decreases. Does the pull of reviewing for a prestigious journal boost reviewer motivation, and potentially also review length?

It seems clear that the JIF is correlated with review length and the time it takes to review, although the causation is not understood. There are also hints these variables could be related to review quality, although it is impossible to assert with confidence given the data available at the time of this report.

FIG.37 — MEDIAN DAYS TO COMPLETE A REVIEW, BY JIF PERCENTILE

Data source: Publons

Median number of days for a review assignment to be completed (after invitation agreed to), by JIF, from 2013–17. The box represents the upper and lower quartiles with the median shown. The whisker portions encompass 99% of the data. Data include many outliers and wide distributions, but also an observable trend — that the higher a journal's JIF, the faster the review time.



"ENSURING THE INTEGRITY OF THE PEER REVIEW PROCESS IS VITAL AND AN INCREASING CHALLENGE THAT WE CANNOT FAIL TO MEET."

TAMI POTTEN, EDITORIAL DEVELOPMENT MANAGER, BRITISH INSTITUTE OF RADIOLOGY

RESEARCHER PERCEPTIONS OF QUALITY

Researchers were asked how satisfied they are with the review process, providing some insight into researcher perceptions of review quality.

Researchers seem relatively happy with the quality and objectivity (if not speed) of the review reports they receive.

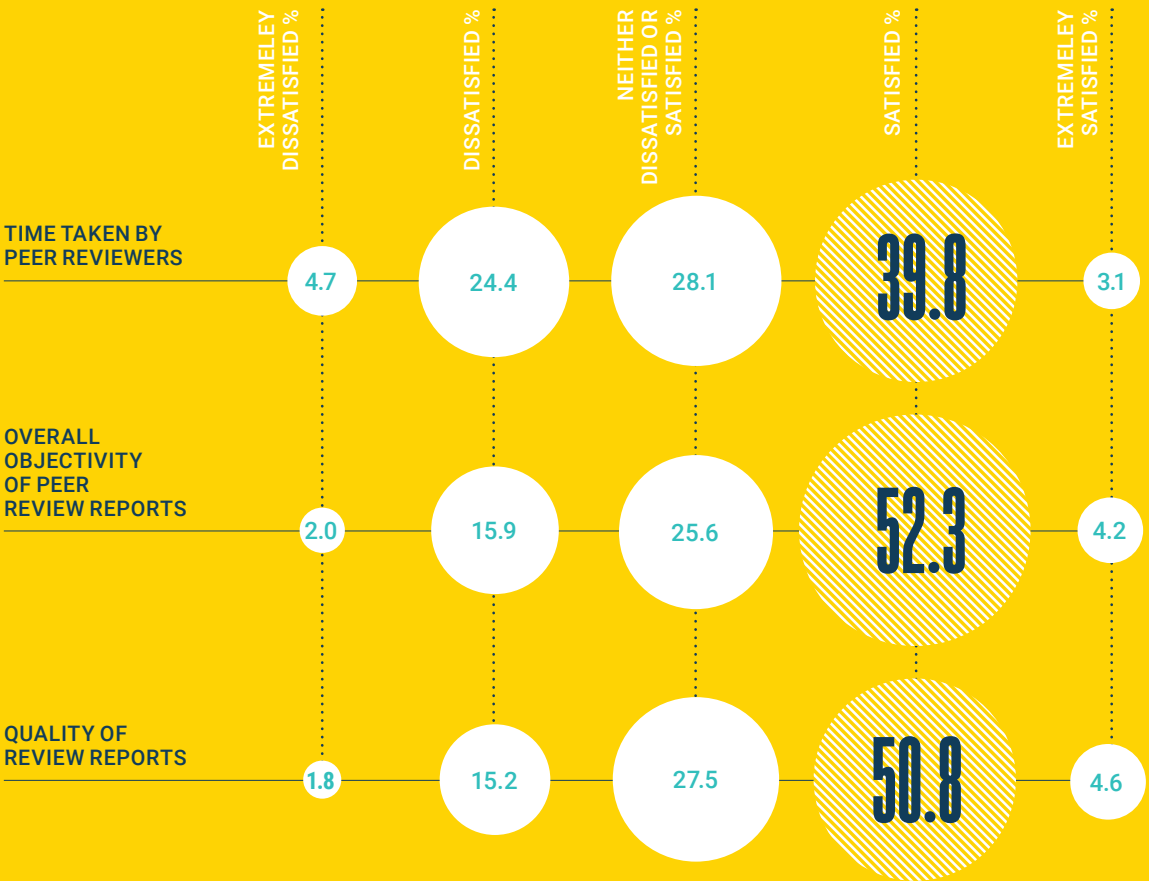
FIG.38 — RESEARCHER SATISFACTION WITH PARTS OF THE PEER REVIEW PROCESS

Data source: Publons' 2018 Global Reviewer Survey

We asked "Considering your typical peer review experiences, how satisfied are you with each of the following?"

"THE EMPHASIS BY OPEN ACCESS JOURNALS ON QUICK TURN-AROUND TIME PUTS PRESSURE ON OTHER JOURNALS TO KEEP UP, WHILE STILL UPHOLDING THE QUALITY OF THEIR PEER REVIEW PROCESS."

KRISTEN MARCHETTI, ASSOCIATE DIRECTOR OF PEER REVIEW, SAGE



DIRECT MEASURES OF REVIEW QUALITY

The scholarly community lacks a robust measure of review quality.

Current measures are indirect proxies like review length or the prestige of the journal that commissioned the review. In that sense, the current understanding of peer review quality resembles the understanding of research articles before the development of bibliometrics.

Is it possible to develop a technique for measuring the quality of peer review at scale? Three possible approaches include:

- **Sentiment analysis:** Use natural language processing to extract positive, neutral, or negative comments from reviews. Sentiment might be very interesting, but is ultimately unlikely to become a direct measure of review quality due to the fact good and bad reviews can be both critical and/or approving of manuscripts.
- **Editor evaluations:** Editors at many journals already rate reviewers on a simple Likert-style scale. These ratings are typically used internally, if at all. A move to increased transparency of review could involve more wide-scale usage of these evaluations. This has the potential to be extremely valuable to reviewers, but will require extra work for the editor.
- **Review quality evaluations:** The standard instrument or academic evaluation of review quality was developed decades ago. While it requires significant effort to evaluate a review using this protocol, it has been shown to be relatively consistent and reliable. Is there some way to automate this process?

The ability to measure the quality of review will become increasingly important as offerings, like the ability for reviewers to get recognition for their contributions, reach mainstream adoption. It is important that any measure is built on community consensus and is used across the industry for it to be useful in the way that citations have proven to be for bibliometric analysis.

Are there other ways to evaluate review quality? And, are there ways to work around the flaws of the systems outlined here? Further research in this area is encouraged.

> "THE PEER REVIEW SYSTEM IS FOUNDED ON TRUST – TRUST THAT EVERYONE INVOLVED IN THE PROCESS ACTS WITH INTEGRITY."
>
> **WILEY**

4 WHAT DOES THE FUTURE HOLD?

This report shows emergent trends in scholarly peer review: Article submissions and publication output continue to rise, putting greater strain on the peer review system. Meanwhile, reviewer invitation agreement rates are in decline. What does this mean for the future of peer review?

This chapter explores what the **peer review landscape** might look like in years to come, and reviewer perceptions about what could make a difference.

KEY FINDINGS

- The task of finding reviewers who will accept a review invitation is projected to get harder.
- The time a reviewer takes to complete a review assignment is decreasing -- but can this continue?
- Chinese review rates are increasing rapidly but it will be many years before they reach parity with established regions.
- 40% of survey respondents entered the reviewing pool only after publishing their first paper.
- Reviewers believe more training, greater recognition, and better incentives will have a positive impact on the efficacy of the peer review process.
- Younger reviewers are more likely to review for journals with open peer review models than older reviewers.

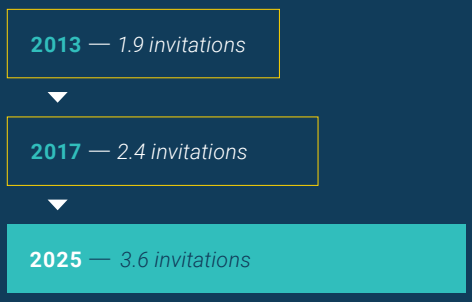
REVIEWER FATIGUE ON THE RISE

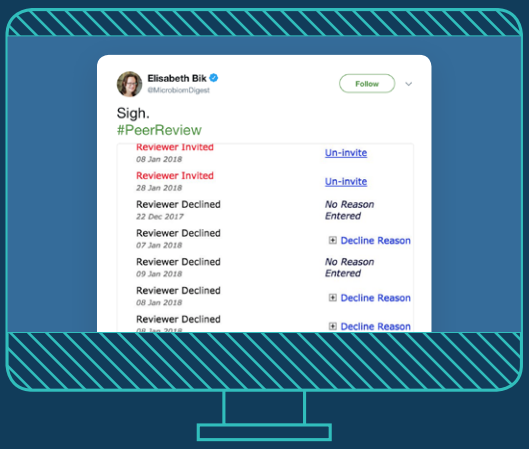
In 2013, an editor had to invite an average of 1.9 reviewers to get one review done.

By the end of 2017, this had increased to an average of 2.4 invitations for every completed review. If this trend continues, by 2025, an average of 3.6 invitations will be required to complete a single review.

FIG.39 — ACTUAL AND PROJECTED AVERAGE NUMBER OF REVIEW INVITATIONS REQUIRED TO GENERATE ONE COMPLETED REVIEW ASSIGNMENT

Data source: ScholarOne





** https://twitter.com/MicrobiomDigest/status/958325868115451905*

Anecdotally, it's becoming increasingly difficult to find researchers willing to review. Is this a sign that reviewer fatigue is setting in?

REVIEWERS ARE GETTING FASTER

In 2013, a reviewer took 16.8 days to complete a review.

By the end of 2017, this had decreased to 16.0 days. This change is more pronounced in specific research areas (see Figure 30), but if the trend continues, review turnaround times are projected to average 14.7 days by 2025.

16.8

Median time (in days) to complete a review in 2013

14.7

Projected median time (in days) to complete a review in 2025

THE RISE OF CHINA

China surpassed the UK in review output in 2015, and continues to grow rapidly, but still lags behind most *established regions* in terms of reviews per submission.

In 2017, China produced 0.8 reviews per submission compared with an average of 2.3 reviews per submission for all *established regions*.

It is questionable whether current growth rates for Chinese publication and review output will sustain over the long-term, but assuming that existing trends continue, it will take until 2031 until China is reviewing, on average, as much per submission as the group of *established regions*. China is, however, projected to reach reviewing parity with the United States, in absolute terms, in 2024.

0.8

China's reviews per submission, compared to

2.3

average reviews per submission across established regions.

SUPPLYING THE REVIEWER POOL

Demand for peer review is increasing concurrent with reviewers becoming less responsive to review invitations.

It is also clear that regions are reviewing at different rates relative to their research output (see Figure 11). This may be due to incentive structures that vary by region, or bias on behalf of those managing the system.

Whatever the reason, it pays to investigate current methods for supplying the reviewer pool and ask — are they sufficient to keep pace with the growing demand for peer review?

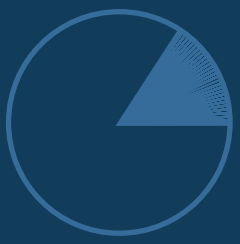
Figure 40 shows that 41% of survey respondents received their first review assignment only after an editor discovered them as a corresponding author. Meanwhile 39.4% never received any peer review training.

Could formal peer review training help introduce more researchers to the reviewer pool, sooner?

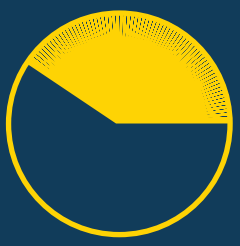
- 88% of survey respondents believe that peer review training is either important (46.3%) or extremely important (41.6%) for ensuring high quality peer review.
- 80% of respondents believe that more peer review training will have either a positive (58.7%) or extremely positive (20.9%) impact on the overall efficacy of the peer review process.

FIG.40 — HOW RESEARCHERS RECEIVED THEIR FIRST REVIEW REQUEST

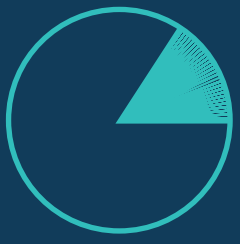
Data source:: Publons' 2018 Global Reviewer Survey



16.5%
Approached by an unknown editor



40.6%
After an editor discovers them as a corresponding author.



16.1%
Asked to undertake a review with or on behalf of a supervisor/PI

"MANY PUBLISHERS PROVIDE TRAINING AND SUPPORT FOR PEER REVIEWERS, BUT INSTITUTIONS NEED TO PLAY AN ACTIVE ROLE TOO. HAND-IN-HAND WITH THAT TRAINING COULD BE CERTIFICATION AND SHOULD BE RECOGNITION FOR PEER REVIEWERS TOO."

WILEY

A SHIFT TO GREATER TRANSPARENCY?

Do different journal review policies affect reviewers' willingness to accept peer review invitations? Does this differ by age group?

Overall, reviewers seem more likely to accept review invitations from journals using single-, double-, and triple-blind peer review models, than any of the open peer review variants listed in *Publons' 2018 Global Reviewer Survey.*

Probing further, there are differences in attitudes toward open peer review models across age groups:

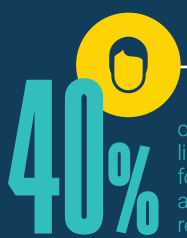
- 40% of respondents under 26 are likely or highly likely to review for journals that make author and reviewer identities, and review reports public, compared with only 22.3% of respondents aged between 56–65.

Could attitudes toward open peer review be shifting as a new crop of researchers enter the fray? Or do researchers become more wary of open peer review models as they grow older? And how will this change as open access continues to make gains?

FIG 41— THE EFFECT OF JOURNAL REVIEW POLICIES ON PEER REVIEW INVITATION ACCEPTANCE RATES

Data source: Publons' 2018 Global Reviewer Survey

	VERY UNLIKELY	UNLIKELY	MAKES NO DIFFERENCE	LIKELY	VERY LIKELY
Single-blind	2.9%	4.7%	19.3%	31.5%	41.7%
Double-blind	1.7%	2.9%	17.9%	29.6%	47.9%
Triple-blind	4.6%	9.2%	24.8%	26.1%	35.4%
Open identities	15.1%	27.3%	26.9%	20.6%	10.1%
Open reports	13.4%	24.5%	29.5%	22.4%	10.2%
Open identities and reports	18.6%	30.0%	26.3%	16.6%	8.6%
Open final-version commenting	13.8%	23.0%	32.2%	21.3%	9.7%



40% of respondents under 26 are likely or highly likely to review for journals that make author and reviewer identities, and review reports public.

22.3% of respondents aged between 56–65 answered in the same way.

CONSENSUS: INCENTIVES MATTER

Projecting the future state of peer review is fraught with uncertainty. Researchers, however, have a clear idea of what will make a difference: greater recognition and more formalized incentives for peer review.

83% of survey respondents stated that greater recognition and career incentives to peer review would have a positive (54.7%) or extremely positive (28.6%) impact on the overall efficacy of the peer review process.

83%

of survey respondents believe that greater recognition and career incentives for peer review would have a positive impact.

FIG.35 —RESEARCHER ATTITUDES TO MORE INCENTIVES FOR PEER REVIEW

Data source: Publons' 2018 Global Reviewer Survey

CLOSING REMARKS

The *2018 Global State of Peer Review report* marks the first time that we, as an industry, have had the means to draw together cross-publisher insights on who is doing peer review, how efficient the process is, what we know of the quality of peer review, and the big peer review trends to be worried or excited about.

Never before have we been able to link such broad data on reviewer opinions, reviewer behavior, manuscript submissions, research fields, researcher demographics, and publication outputs to pry open the black box of peer review.

This combination of data have shown:

- *Established regions* disproportionately dominate the peer review process, in large part due to compounding geographical biases in the appointment of editors and their reliance on local reviewers
- Notwithstanding these things, *emerging regions* in general, and China in particular, are rapidly increasing their peer review outputs — but are years and years away from bridging the gap
- What little information there is on gender in peer review shows gender inequality is no less of a problem than geographical inequality.
- The number of manuscript submissions and the number of review requests required to complete a review are increasing rapidly, meaning the task of finding reviewers who will accept a review invitation is likely to get even harder.
- *Emerging regions* are more likely to accept review invitations and complete reviews faster, but their reviews are much shorter in length.
- The vast majority of researchers think more training and recognition will improve the efficacy of peer review, and that universities need to be doing more to acknowledge peer review contributions.

An overarching finding of this report is that now that peer review is easily measurable and verifiable, there is no longer any excuse to exclude it from analyses of research and researchers. Rather than being hidden away in journal silos and relegated to a small, unverifiable mention at the end of a long curriculum vitae, peer review can — and should — be used to gain a more complete picture of research and the standing of researchers. Understanding and addressing these issues in

peer review may well be the key to maintaining public faith in — and justifying funding of — academic research.

This report only scratches the surface. We can learn so much about research from peer review. As review transparency increases, so too will the opportunities to analyze the quality of peer reviews, their prescient evaluations of yet-to-be-published research trends, and any interplay between a researcher's impact on their field as a peer reviewer, an editor, and an author.

In the near term, some clear, immediate action points arise from the findings in this report. As an industry, we need to get better at training researchers to be great peer reviewers, both to ensure that reviewers are up to their important task, and to expand the reviewer pool by giving journal editors the confidence to approach qualified reviewers outside their personal networks.

We also need to expand our concept of "reviewer recognition" beyond simply listing the number of completed reviews on a profile. The high proportion of researchers that reject review invitations they are perfectly qualified to complete, along with the near consensus that research institutions should more explicitly recognize peer review contributions, show there is still a long way to go to remedy the incentives imbalance. Funders, institutions, publishers, researchers, and the organizations that connect and serve them, all have a part to play in supporting researchers to do what is best for research.

We at Publons look forward to the day that writing a great review to help a peer improve their work is recognized as a greater contribution to the field than collecting the scraps from the lab floor to submit to any journal that promises publication.

DANIEL JOHNSTON,
PUBLONS COFOUNDER

APPENDICES

PARTIES INVOLVED IN PREPARING THE REPORT

This report has been prepared by Publons in collaboration with ScholarOne and Web of Science.

Publons, ScholarOne, and Web of Science are part of Clarivate Analytics, the global leader providing trusted insights and analytics that accelerate the pace of innovation.

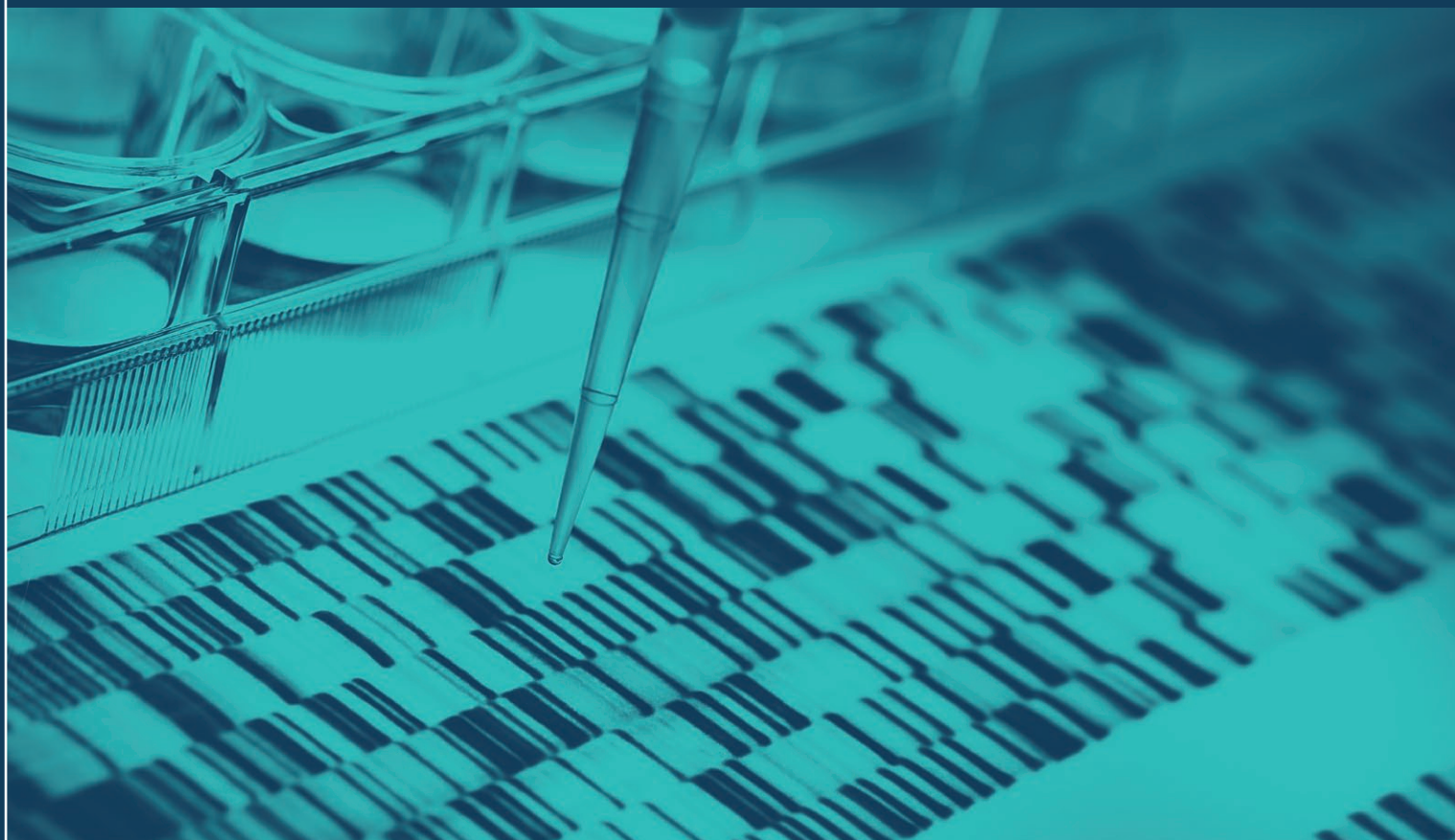
GLOSSARY

Terminology, abbreviations, and definitions used.

COMPLETED REVIEWS	Reviews that have been completed and returned to the journal.
DESK REJECT	Where a journal editor rejects a submitted manuscript before commissioning any peer reviews, usually because they deem the manuscript outside the journal's scope or obviously not meeting the journal's quality standards.
DOUBLE-BLIND PEER REVIEW	Authors and reviewers are unknown to each other.
EMERGING REGIONS	China, Brazil, Turkey, India, Iran, South Korea, Taiwan, Malaysia, and Poland. These regions are typically referred to as *emerging economies*.
ESTABLISHED ECONOMIES	USA, Germany, Italy, Spain, France, Netherlands, Sweden, Canada, Australia, UK, and Japan. These regions are not typically referred to as *emerging economies*.
ESSENTIAL SCIENCE INDICATORS RESEARCH AREAS	22 broad specialty fields (research areas), each associated with a discrete set of journals indexed by Clarivate Analytics. These are tracked in *Essential Science Indicators* (ESI), a component of *Web of Science*.
INCITES	Bibliometric benchmarking and analytics package based on *Web of Science* Core Collection data.
JOURNAL IMPACT FACTOR	A measure of the frequency with which the "average article" in a journal has been cited in a particular year or period. The annual JCR Impact Factor is a ratio between citations and recent citable items published. Thus, the Impact Factor of a journal is calculated by dividing the number of current year citations by the source items published in that journal during the previous two years.
MANUSCRIPT / SUBMISSION	A manuscript that has been submitted to a journal to consider for publication, but may not yet be reviewed and has not yet been accepted or rejected for publication.
OPEN IDENTITIES	Reviewers and authors are aware of each others' identities.
OPEN IDENTITIES AND OPEN REPORTS	Reviewers and authors are aware of each others' identities and review reports are public.
OPEN FINAL VERSION COMMENTING	Review or commenting on the final "version of record" publication.
OPEN REPORTS	Review reports are published alongside the relevant article.
PEER REVIEW	Also known as refereeing, this is the process of subjecting an author's scholarly work, research, or ideas to the scrutiny of others who are experts in the same field.
PREDATORY PUBLISHING	Predatory open-access publishing is an exploitative business model that involves charging publication fees to authors without providing the editorial and publishing services associated with legitimate journals (open access or not).
PUBLISHED ARTICLE OUTPUT / ARTICLE OUTPUT	The total number of scholarly articles accepted for publication, based on articles indexed in *Web of Science*.
PUBLONS' 2018 GLOBAL REVIEWER SURVEY	A global online survey of 11,838 researchers conducted by Publons between May–July 2018. The survey aims to gauge attitudes and perceptions toward peer review of scholarly journals. Full survey report available at: publons.com/community/gspr
REVIEWER INVITATION AGREEMENT RATE	The rate at which review invitations are accepted, but not necessarily completed, by peer reviewers.

REVIEWER COMPLETION RATE	The rate at which review invitations sent out by editors result in a completed peer review report being submitted.
REVIEW DISTRIBUTION INDEX	A measure of the distribution of review workload within a population.
RELATIVE REVIEW RATES	The number of reviews performed per manuscript submission.
SCHOLARONE MANUSCRIPTS	A cross-publisher peer review workflow management tool owned by Clarivate Analytics.
SINGLE-BLIND PEER REVIEW	Reviewers are unknown to the authors.
TRIPLE-BLIND PEER REVIEW	Authors, reviewers and editors are all unknown to each other.

WEB OF SCIENCE	An online, subscription-based scientific citation indexing service with a comprehensive citation search. Originally produced by the Institute for Scientific Information (ISI), it is now maintained by Clarivate Analytics. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialized sub-fields within an academic or scientific discipline.
WEB OF SCIENCE CORE COLLECTION	A curated collection of over 20,000 peer reviewed, high-quality scholarly journals published worldwide (including open access journals) in over 250 Science, Social Sciences, and Humanities disciplines. Conference proceedings and book data are also available. A full list of the indices contained in the *Web of Science Core Collection* is available at: images.webofknowledge.com/images/help/WOK/hp_database.html



METHODOLOGY

Data, statistics, research areas, and assumptions used in this report.

The data that provides the basis for this report was extracted between April and August 2018, from a range of Data sources.

These Data sources, and their limitations are:

- ***ScholarOne Manuscripts***
  A cross-publisher peer review workflow management tool used by thousands of journals globally.

  Anonymised and aggregated data were extracted for the reporting period 2013–17. This resulted in a dataset of over 10 million original submissions and 15 million peer reviews.

  Reviews that took more than six standard deviations longer than the mean to complete were filtered out (less than 0.03% of reviews). Total review and submission counts were scaled so that the absolute numbers used throughout the report approximately match our estimates for global peer review outputs (page 31).

  The dataset included reviews from all rounds of review, regardless of whether the manuscript was eventually accepted or rejected.

  Approximately 55% of journals using *ScholarOne* are indexed in Science Citation Index Extended and Social Science Citation Index and have a *Journal Impact Factor* and publication types are biased towards Science, Technology, Engineering, and Mathematics (STEM) areas and larger volume publications. The median publication size is 144 submissions/year.

  Data in *ScholarOne* does not cover every major publisher, but comprises a representational grouping of larger commercial publishers, associations, and societies. The size of the *ScholarOne* dataset means it is reasonable to assume it approximates the wider industry, although biases may appear if the distribution of, e.g., *Journal Impact Factors,* were different in *ScholarOne* relative to the rest of the market, or if use of the tool resulted in efficiencies not experienced by journals that don't use a peer review management tool. We have no reason to expect this, although note that ScholarOne is a commercial product and could select against relatively lower budget journals.

  Note that manuscript submissions counts include manuscripts that are desk-rejected, i.e., never sent for peer review.

- ***Publons***
  A cross-publisher peer review database containing over 2.2 million reviews and 400k+ peer reviewers globally at the time data were pulled. Publons data used in this report come from an aggregated and anonymised sample containing over 15,000 scholarly journals.

  Publons data are limited to reviews, reviewers, and editors that self-elect to use the platform to track their reviewing and editorial work.

  Regional information is extracted from a user-input country field.

- ***Web of Science Core Collection***
  A curated collection of over 20,000 peer reviewed, high-quality scholarly journals published worldwide in over 250 Science, Social Sciences, and Humanities disciplines. Conference proceedings and book data are also available. A full list of the indices contained in *Web of Science Core Collection* is available at images.webofknowledge.com/images/help/WOK/hp_database.html

  The dataset used for this report includes the *Emerging Sources Citation Index* (ESCI).

- **Publons' 2018 Global Reviewer Survey** A global online survey of over 11,000 researchers conducted by Publons between May–July 2018. The survey aims to gauge attitudes and perceptions toward peer review of scholarly journals. Full survey report available at: publons.com/community/gspr

The tables and figures in this report are based on one or more of these underlying Data sources. The Data source used is referenced next to each table, figure, and statistic.

Research Area Classification Schemas
22 broad specialty fields (research areas) are used generally throughout the report, each associated with a discrete set of journals indexed by Clarivate Analytics. These are tracked in *Essential Science Indicators* (ESI), a component of *Web of Science*.

ESI Research Areas were assigned to reviews, reviewers, editors, and submissions based on the journal that commissioned the review. Primary research areas were extracted by associating *Web of Science* categories with *ScholarOne* titles and then mapping to an ESI Research Area. For journals associated with multiple categories, the mapping was to the category in which the title had the highest JIF percentile.

Web of Science categories are assigned by editors during indexing into the Science Citation Index and Social Science Citation Index, which means that this filter primarily selects for journals with a *Journal Impact Factor*. For this reason, only about 60% of *ScholarOne* reviews have an ESI research area. This has the potential to add bias to studies based on research area since it presumably selects for relatively strong journals.

We also note that research activity is not evenly distributed across the ESI Research Areas. The classification schema is skewed to STEM fields — all of the Humanities and Social Sciences are grouped into three research fields. We hope to commission further detailed studies into the Humanities in future years.

Note that ESI re-categorizes papers in "multidisciplinary" journals such as Science, Nature, PNAS, etc., by scrutinizing each paper's cited and citing references, and assigning one of the 21 other categories based on algorithmic analysis of the citations. The actual ESI designation "Multidisciplinary" is used for papers that, for lack of citation density or other reason, cannot be assigned a specific field. This makes it hard to draw any conclusions with respect to Multidisciplinary research in this report.

In some figures (see details in next section), alternative research area classification schemas are used due to limitations in mapping the underlying data to the ESI Research Area schema.

Regions
The top 20 regions, when ordered by combined submissions and reviews in *ScholarOne*, were selected. These 20 regions were then categorized into groups of *established* and *emerging regions* based on the typical classification of *emerging regions*. We note that the *established* and *emerging* groups risk being dominated by the United States and China, respectively, due to the relative scale of their research output.

For *Publons*' data, a reviewer's or editor's affiliated region is determined by where the user has reported their current affiliated place of work to be located.

For *ScholarOne* data, a reviewer's region is derived using the self-reported location of the reviewer. About 87% of researchers who completed a review have an assigned region.

DETAILS, ASSUMPTIONS AND LIMITATIONS FOR FIGURES IN THIS REPORT

A summary of key considerations, limitations and caveats for tables and figures used in this report.

GENERAL	All data were aggregated and anonymised by contributing organisations prior to analysis. All *ScholarOne* data have been scaled to match our estimates for the total number of reviews occurring globally (see Chapter 2). Three significant figures are used in general. Any more detail than this is unlikely to be statistically signficant.
FIG.1	A simplified approximation of the publishing workflow.
FIG.2	A simplified illustration of common peer review models used in scholarly publishing. We acknowledge this is not exhaustive and other nomenclature can be applied to the models referenced.
FIG.3	A sample of 15,000 journals with more than 10 unique review records on Publons is used. 63% (9,530) have a publisher-elected review display policy, and 37% (5,520) are unspecified.
FIG.4	Publications indexed in the *Web of Science* Core Collection (including the *Emerging Sources Citation Index*). At the time the data were extracted, not all content for 2017 had been received and indexed. Part of the rapid increase in early-to-mid 2000 can be attributed to an expansion of the *Web of Science* indices.
FIG.10	Manuscript submissions include manuscripts that are desk-rejected, i.e., never sent for peer review.
FIG. 11B	Because articles can have multiple authors, and authors can come from multiple regions, *Web of Science* articles can be double counted, which means that percentages per region are over-inflated (by roughly 30%) relative to reviews, as reviews have only one author.
FIG.13	Figure 13 uses Publons data. The sample is relatively small (21,963 reviews in this case) and may suffer from bias as it depends on researchers who have self-selected to use Publons. The regions used in the figure differ from those used throughout the rest of the report; they are the top 22 that editors in Publons have an affiliation with.

FIG.19	None of the Data sources used in this report collect gender data. Figure 19 relies on a tool that compares the first names of researchers on Publons against the tool's dataset of popular names for men and women worldwide. This provides about 40% coverage, which is enough information for relative predictions, but its limitations should be taken into consideration when reading the results. This is especially true given that names from certain regions may be difficult to parse. Genders were inferred from researcher names and regions using the python module "gender_guesser 0.4.0". The library accepts all unicode characters but the database primarily contains Latin names.
FIG.20	*Web of Science* research field classifications are used as opposed to the ESI Research Areas used elsewhere in the report. This is due to limitations mapping the underlying Data source to ESI Research Area classification schema.
FIGURES 21 & 22	Data used to generate the Review Distribution Indices and coefficients are limited to reviewers who have self-elected to sign up to the Publons platform. In regions with a smaller representation on Publons, it is more likely the distribution of review work will be skewed.
FIGURES 25 & 29	Japan is an outlier both in review invitation agreement rates and review turnaround times. This could be partly due to the fact that a higher proportion of Japanese journals are configured to simply assigned review tasks rather than sending out an invitation first. We investigate this further. Reviewer responsiveness: Effectively there are two schema for managing reviewers in *ScholarOne Manuscripts*: — 1. Select, invite, assign, and score. — 2. Select, assign, and score. Roughly 5% of sites use the second, invite-free scheme, so aside from Figure 13, where we chose to show all stages of reviewer responsiveness, we have opted to use all data representing the "select" and "assign" phases.
FIGURES 29, 30, 31A & 31B	Reviews for journals that do not have an associated ESI Research Area are excluded from this dataset. This biases the data to reviews for journals with higher JIFs, as these journals are more likely to have an associated ESI Research Area.
FIG.33	Reviewers are affiliated with a region in Publons based on the location of the institution that they self-report to be working at or affiliated with.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