

Why does science need immediate and substantial reform?

Dr William Xiang Quan Ngiam

54th Brazilian Congress of Pharmacology and Experimental Therapeutics



My **goals** for this talk

1. Review the reproducibility crisis in science.
2. Discuss the role of journals in the crisis, and in science.
3. Explain why we need publication reform.
4. Encourage taking action to reform science.

Exponential growth of scientific publications

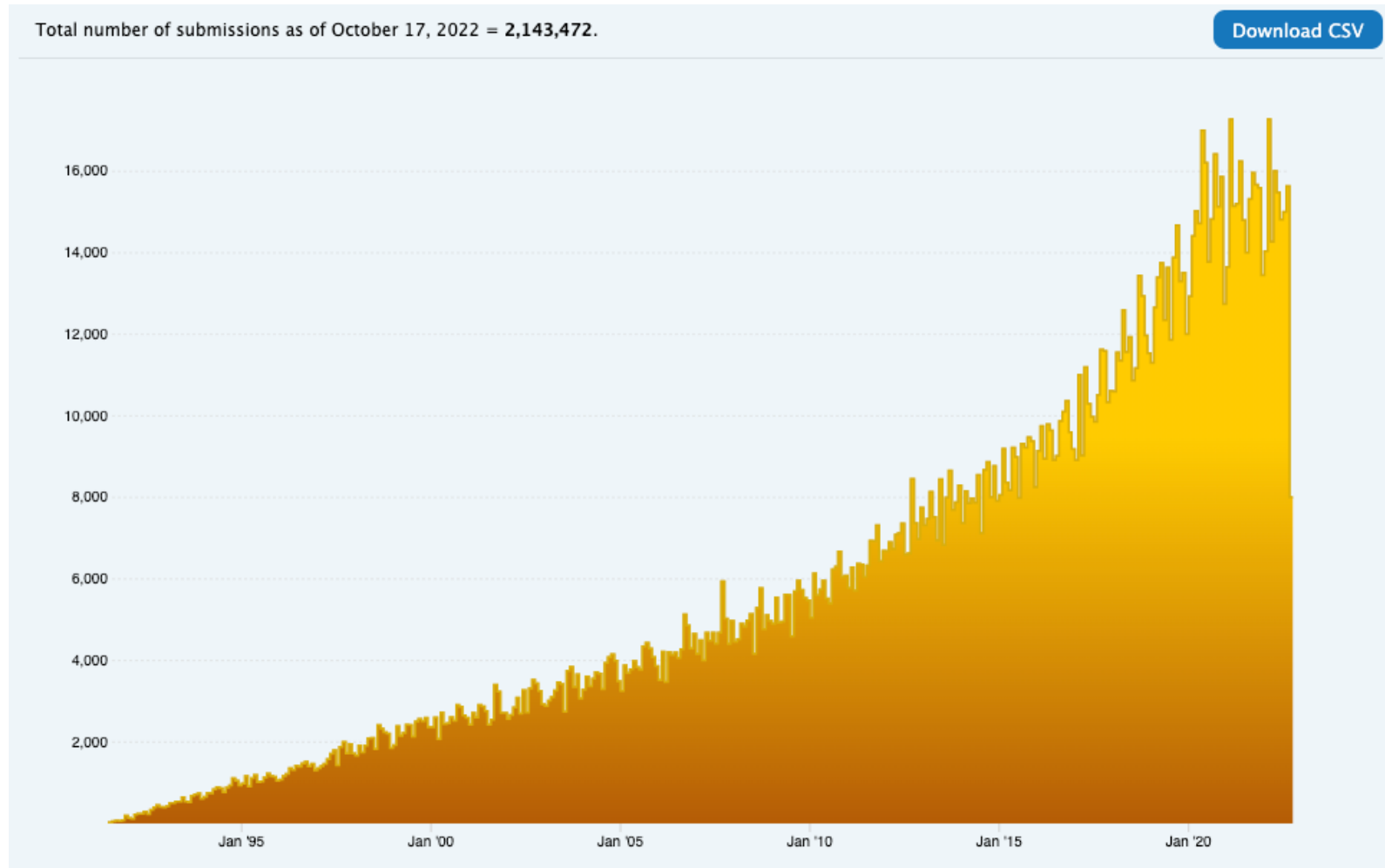


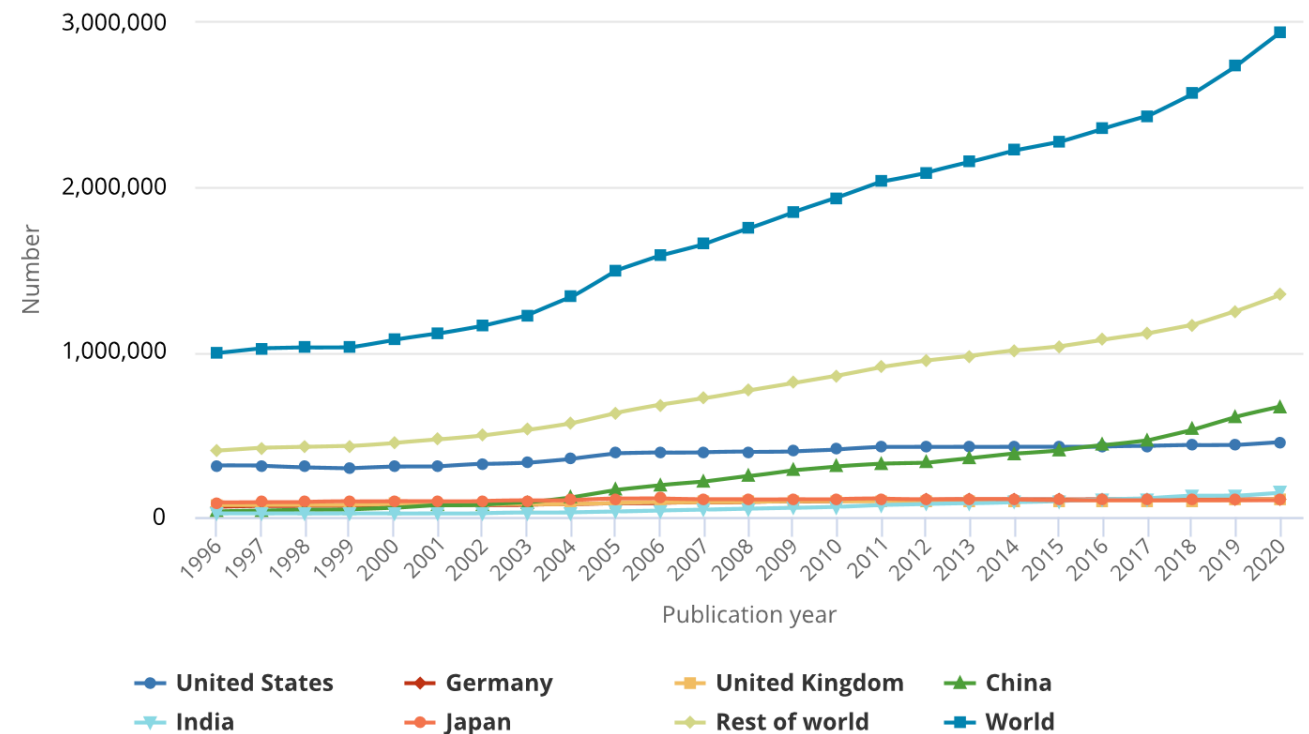
Figure taken from arxiv.org on the number of submissions over time. https://arxiv.org/stats/monthly_submissions

Exponential growth of scientific publications

- Estimated to have reached **2.9 million articles** in 2020 (National Science Board, National Science Foundation)
- Increasing by approximately **4% each year** (Pan, Petersen, Pammolli and Fortunato, 2016)

National Center for Science and Engineering Statistics | NSB-2021-4

Figure PBS-2
S&E articles, by selected region, country, or economy and rest of world: 1996–2020

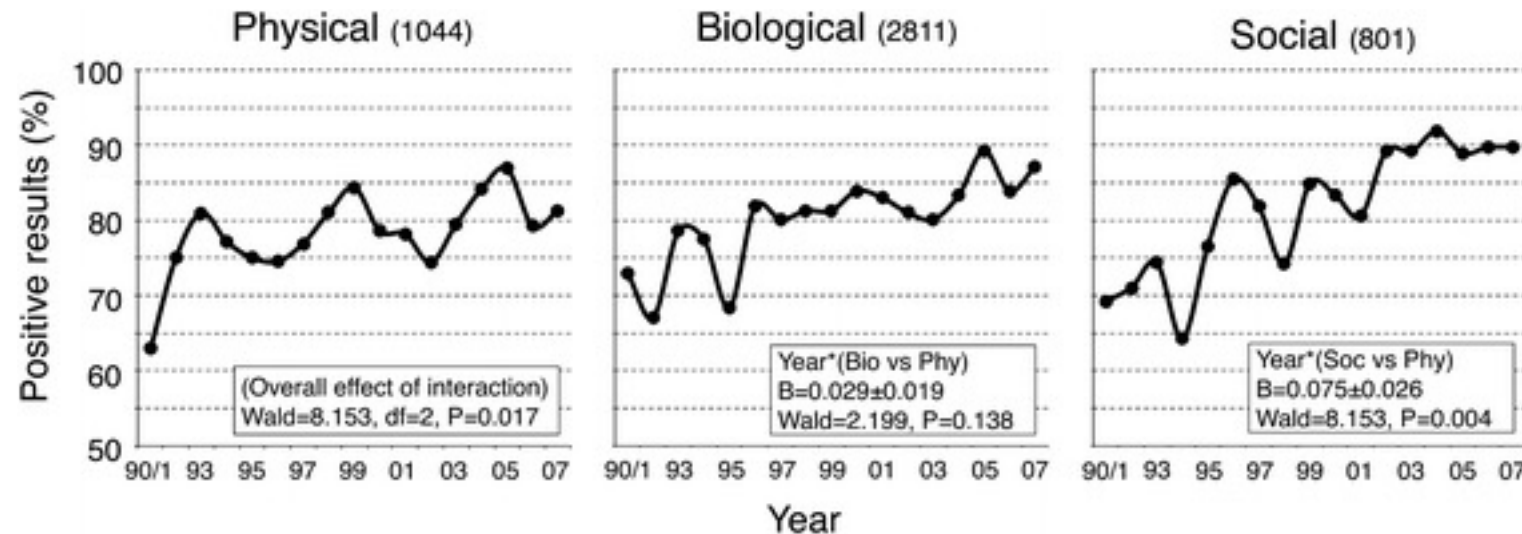


Review by National Center for Science and Engineering Statistics. <https://ncses.nsf.gov/pubs/nsb20214/publication-output-by-country-region-or-economy-and-scientific-field>

Pan, R. K., Petersen, A. M., Pammolli, F., & Fortunato, S. (2018). The memory of science: Inflation, myopia, and the knowledge network. *Journal of Informetrics*, 12(3), 656-678. <https://arxiv.org/abs/1607.05606>

The decline of negative results

- The proportion of papers reporting a positive result has been **increasing** from **~70%** in 1990 to **~90%** by 2005 (Fanelli, 2012)



- In the recent psychology literature, this proportion is estimated to be **~95%** (Scheel, Schijen and Lakens, 2021)

Figure from Fanelli, D. (2012). Negative results are disappearing from most disciplines and countries. *Scientometrics*, 90(3), 891-904.
Scheel, A. M., Schijen, M. R., & Lakens, D. (2021). An excess of positive results: Comparing the standard Psychology literature with Registered Reports. *Advances in Methods and Practices in Psychological Science*, 4(2), 25152459211007467.

The reproducibility crisis

- The widespread concern that published studies do not replicate or cannot be reproduced in the first place
 - Psychology – 35 out of 97 studies (36.1%) reproduced the positive result originally published in journals. (*Reproducibility Project: Psychology* – Open Science Collaboration, 2015)
 - Cancer Biology – 39 out of 97 studies (40.2%) reproduced the positive result originally reported in high-impact articles. (*Reproducibility Project: Cancer Biology* – Errington et al., 2021)
 - Economics – 11 out of 18 studies (61.1%) reproduced the positive result originally published in high-ranking journals. (Camerer et al., 2016)
- The replications often report smaller effect sizes than the original publications

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, 349(6251), aac4716.

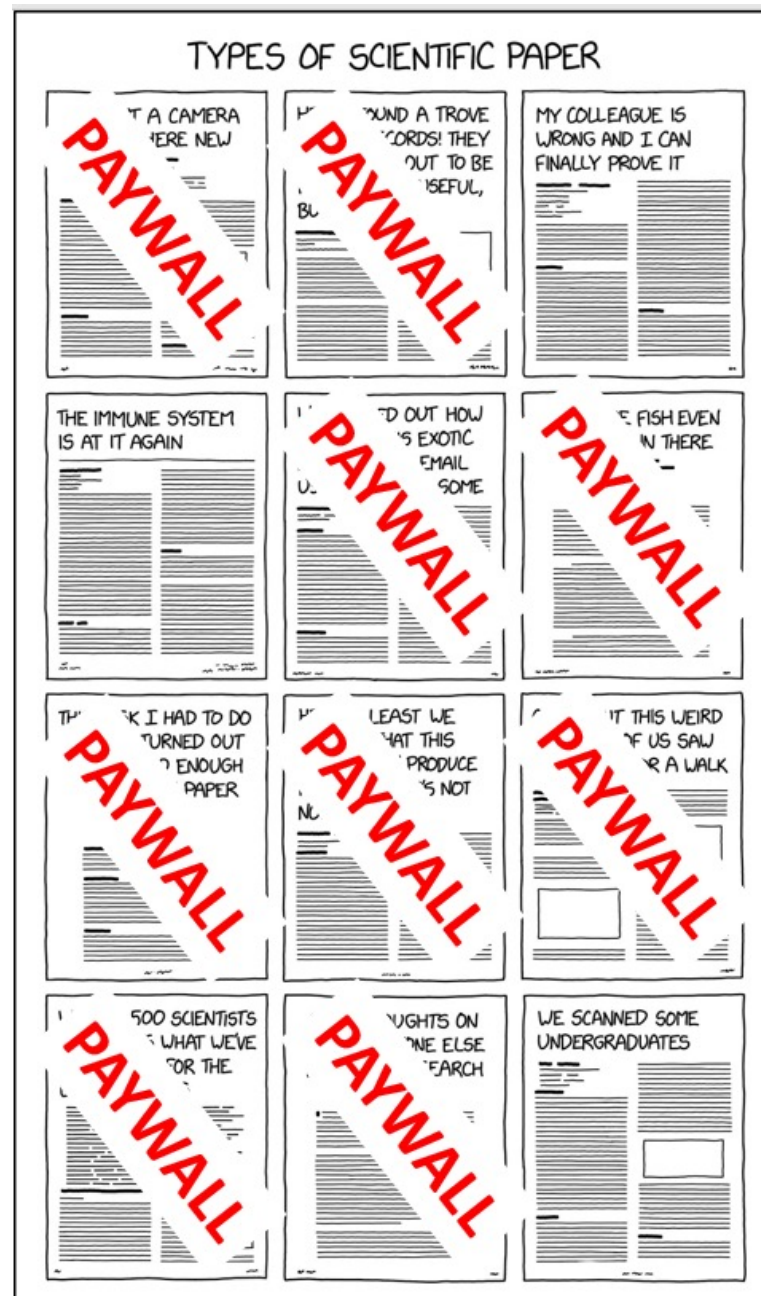
Errington, T. M., Mathur, M., Soderberg, C. K., Denis, A., Perfito, N., Iorns, E., & Nosek, B. A. (2021). Investigating the replicability of preclinical cancer biology. *Elife*, 10, e71601.

Camerer, C. F., Dreber, A., Forsell, E., Ho, T. H., Huber, J., Johannesson, M., ... & Wu, H. (2016). Evaluating replicability of laboratory experiments in economics. *Science*, 351(6280), 1433-1436.

What **responsibilities** should journals have?

- Administer **quality control** of scientific output via peer review
- Organize and **update the scientific record**
- Curate **communication** between scientists, and between scientists and the public
- **Copy-editing** of research manuscripts

Paywalls



<https://twitter.com/AndrewBarnas/status/1388161745684996098/photo/1>

Original comic: <https://xkcd.com/2456/>

Article processing charges

ELSEVIER

Article Publishing Charge (APC) price list

All prices excluding taxes. Prices as of date: 12-Sep-2022

ISSN	Title	Business model	List price *		
			USD	EUR	GBP
0006-2952	Biochemical Pharmacology	Hybrid	3,700	3,240	2,900
2772-3712	Clinical Complementary Medicine and Pharmacology	Open access	1,600	1,400	1,260
1532-0456	Comparative Biochemistry and Physiology - Part C: Toxicology & Pharmacology	Hybrid	3,000	2,630	2,350
1471-4892	Current Opinion in Pharmacology	Hybrid	2,980	2,610	2,340
2590-2571	Current Research in Pharmacology and Drug Discovery	Open access	2,500	2,190	1,960
1382-6689	Environmental Toxicology and Pharmacology	Hybrid	3,590	3,140	2,820
0014-2999	European Journal of Pharmacology	Hybrid	2,790	2,440	2,190
0924-977X	European Neuropsychopharmacology	Hybrid	3,000	2,630	2,350
1567-5769	International Immunopharmacology	Hybrid	2,840	2,490	2,230
0378-8741	Journal of Ethnopharmacology	Hybrid	3,500	3,060	2,750
0028-3908	Neuropharmacology	Hybrid	3,930	3,440	3,080
0163-7258	Pharmacology & Therapeutics	Hybrid	5,110	4,470	4,010
0091-3057	Pharmacology Biochemistry and Behavior	Hybrid	3,330	2,920	2,610
0278-5846	Progress in Neuro-Psychopharmacology & Biological Psychiatry	Hybrid	3,720	3,260	2,920
1094-5539	Pulmonary Pharmacology and Therapeutics	Hybrid	3,270	2,860	2,570
0273-2300	Regulatory Toxicology and Pharmacology	Hybrid	3,800	3,330	2,980
0041-008X	Toxicology and Applied Pharmacology	Hybrid	3,810	3,340	2,990
1537-1891	Vascular Pharmacology	Hybrid	3,460	3,030	2,710

Profit margins of scientific publishing companies

- Elsevier made an operating profit of £982 million in 2019, £1,021 million in 2020, £1,001 million in 2021, at an operating margin of ~36-37% according to their annual reports.

Profit	Company	Industry
10%	BMW	automobiles
23%	Rio Tinto	mining
25%	Google	search
29%	Apple	premium computing
35%	Springer	scholarly publishing
37%	Elsevier	scholarly publishing

<http://wp.me/ph4jF-km> CC-BY Alex Holcombe

Estimated monetary value of reviewers' time

Research Integrity and Peer Review

[Home](#) [About](#) [Articles](#) [Submission Guidelines](#)

Research | [Open Access](#) | [Published: 14 November 2021](#)

A billion-dollar donation: estimating the cost of researchers' time spent on peer review

[Balazs Aczel](#) , [Barnabas Szaszi](#)  & [Alex O. Holcombe](#)

[Research Integrity and Peer Review](#) 6, Article number: 14 (2021) | [Cite this article](#)

38k Accesses | **17** Citations | **3032** Altmetric | [Metrics](#)



View PDF



ELSEVIER

Earth-Science Reviews

Available online 7 October 2022, 104198

In Press, Journal Pre-proof



The authors name and address was included above the abstract in the submission. If it is difficult to stop, it is

Laurence Noel Warr

Show more

+ Add to Mendeley Share Cite

<https://doi.org/10.1016/j.earscirev.2022.104198>


[Get rights and content](#)

Spotted by Brad Wyble. <https://twitter.com/bradpwyble/status/1580169516897558529/photo/1>

Brembs, B. (2018). Prestigious science journals struggle to reach even average reliability. *Frontiers in human neuroscience*, 37.

Time taken to correct the record

In 1987, the NIH found a paper contained fake data. It was just retracted.

 DEPARTMENT OF HEALTH & HUMAN SERVICES Public Health Service

Memorandum

D290250

Date April 28, 1987

From Acting Director, National Institute of Mental Health

Subject Investigation of Allegations of Scientific Misconduct
under Grants MH-32206 and MH-37449

To Administrator, Alcohol, Drug Abuse, and Mental Health Administration

Screenshot of Retraction Watch website.

<https://retractionwatch.com/2022/10/13/in-1987-the-nih-found-a-paper-contained-fake-data-it-was-just-retracted/>

Self-correction in science



James Heathers

@jamesheathers

In reality, mechanisms to correct bad science are slow, unreliably enforced, capricious, run with only the barest nod towards formal policy, confer no reward and sometimes punitive elements for a complainant who might use them.

10:46 AM · Feb 28, 2019 · Twitter Web Client

Promoting transparency and openness in research

- Publishing preprints
- Diversifying scientific outputs through Open Science
 - Open data
 - Open materials
 - Open code
- Increasing experimental rigor with Registered Reports

Some additional suggestions

- Submit your research to [diamond open-access journals](#) (see the Directory of Open Access Journals (DOAJ) at <https://doaj.org/>)
- [Stop reviewing](#) for journals of large for-profit scientific publishers
- Sign the [San Francisco Declaration on Research Assessment](#) (<https://sfdora.org/>)
- [Do not use journal-based metrics](#) like Impact Factors or heuristics like prestige as indicators of research quality

Science needs immediate reform

- The number of scientific publications is exponentially increasing, but without clear quality control
- Publishing companies place paywalls on scientific articles, depend on but do not compensate the work by scientists, and charge substantial article processing fees, making extreme abnormal profits
- We need to reform scientific publishing by promoting research transparency through open scholarship



Open Access

Dr William Xiang Quan Ngiam



@will_ngiam



wngiam@uchicago.edu