

How Research Integrity, Reproducibility and Open Science Practices are Connected

Lex Bouter



my personal page

2025-11-17 How Research, Integrity Reproducibility and Open Science Practices are Connected – Netherlands Epidemiological Society- LM Bouter – 30 minutes plus 30 minutes discussion after both lectures.

Bouter LM. Research misconduct and questionable research practices form a continuum. *Accountability in Research* 2024; 31: 1255–1259.

<https://bit.ly/3YYaluu>

Bouter L. Why research integrity matters and how it can be improved.

Accountability in Research. 2024; 31: 1277-1286.

<https://research.vu.nl/files/219241433/5.248.pdf>

Bouter L. Tackling research misconduct. *British Medical Journal* 2024; 386: q1595. <https://bit.ly/3OkCOLO>

Bouter LM. Handling conflicts of interest concerns more than transparency. *Journal of Clinical Epidemiology* 2025; 182: 111801.

<https://research.vu.nl/files/410326008/2.564.pdf>

Bouter L, Sham MH, Kleinert S. The Lancet and World Conferences on Research Integrity Foundation Commission on Research Integrity. *Lancet* 2025; 406: 896-897. <https://bit.ly/4mQWF4u>

Content

- Prevalence of problems
- How things hang together
- Importance of transparency
- What research institutes can do

Level of researchers

Prevalence of Problems

Fabrication: **4%** at least once in the last 3 years

Falsification: **4%** at least once in the last 3 years

51% engaged frequently in at least 1 out of 11 QRPs in last 3 years

Level of publications

> 2 % of articles meet COPE retraction criteria (<0.1% are retracted)

4 - 40 % of the articles with photos these are manipulated

2% of articles are fake publications

10 – 54% of replication studies are successful

Guestimate: 1 in 7 publications are not trustworthy

Heathers J. Approximately 1 in 7 scientific papers are fake. OSF 2024 and MetaROR 2025.

<https://osf.io/5rf2m/files/23zcr>

<https://metaror.org/kotahi/articles/18/index.html#decisions-48d92343-cb23-4cfd-86d1-204a44431cb5>

Gopalakrishna G, ter Riet G, Vink G, Stoop I, Wicherts J M, Bouter L. Prevalence of questionable research practices, research misconduct and their potential explanatory factors: a survey among academic researchers in The Netherlands. PLoS One 2022; 17: e0263023.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0263023>

Oransky I. Retractions are increasing but not enough. Nature 2022; 608: 9.

<https://www.nature.com/articles/d41586-022-02071-6>

Bik EM, Casadevall A, Fang FC. The Prevalence of Inappropriate Image Duplication in Biomedical Research Publications. mBio 2016; 7: 10.1128/mbio.00809-16.

<https://doi.org/10.1128/mbio.00809-16>

Aquarius R, van de Voort M, Boogaarts HD, Reesink PM, Wever KE (2025). High prevalence of articles with image-related problems in animal studies of subarachnoid hemorrhage and low rates of correction by publishers. *PLoS Biol* 23(10): e3003438. <https://doi.org/10.1371/journal.pbio.3003438>

Van Noorden R. How big is science's fake-paper problem? *Nature News*: 6 November 2023. <https://www.nature.com/articles/d41586-023-03464-x>

Kelly D Cobey, Christophe A Fehlmann, Marina Christ Franco, Ana Patricia Ayala, Lindsey Sikora, Danielle B Rice, Chenchen Xu, John PA Ioannidis, Manoj M Lalu, Alixe Ménard, Andrew Neitzel, Bea Nguyen, Nino Tsertsvadze, David Moher (2023) Epidemiological characteristics and prevalence rates of research reproducibility across disciplines: A scoping review of articles published in 2018-2019. *eLife* 12:e78518. <https://elifesciences.org/articles/78518>

Tamarinde L. Haven and John P.A. Ioannidis. Reproducibility Failure in Biomedical Research: Problems and Solutions. *Annu. Rev. Med.* 2026. 77: 8.1–8.13

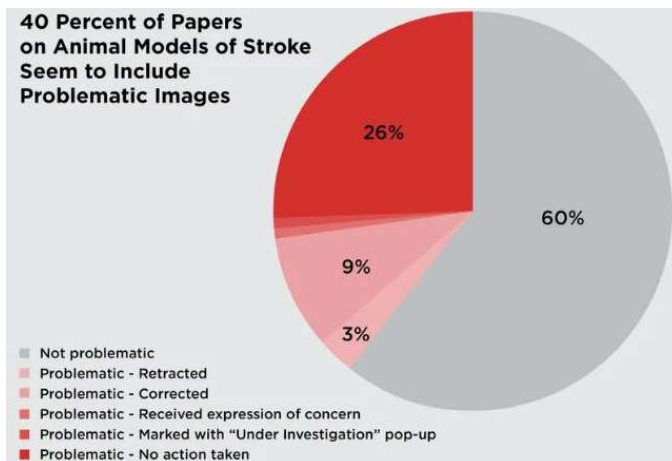
<https://publicationethics.org/>

<https://publicationethics.org/files/cope-retraction-guidelines-v2.pdf>

<https://publicationethics.org/files/redundant%20publication%20B.pdf>

High prevalence of articles with image-related problems in animal studies of subarachnoid hemorrhage and low rates of correction by publishers

René Aquarius^{1*}, Merel van de Voort^{1,2}, Hieronymus D. Boogaarts¹, P. Manon Reesink^{1,2}, Kimberley E. Wever²



- 609 publications were eligible for planned **systematic review**
- 40% of these were problematic due to **image-related issues**, of which 9 out of 10 had a corresponding author **in China**

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Aquarius R, van de Voort M, Boogaarts HD, Reesink PM, Wever KE (2025). High prevalence of articles with image-related problems in animal studies of subarachnoid hemorrhage and low rates of correction by publishers. *PLoS Biol* 23(10): e3003438. <https://doi.org/10.1371/journal.pbio.3003438>

Lius A. 40 Percent of Stroke Animal Studies May Have Problematic Images. *New Scientist* Oct 30, 2025. <https://www.the-scientist.com/40-percent-of-stroke-animal-studies-may-have-problematic-images-73673>

Fake publications are on the rise

- Produced by **Paper Mills** (using GAI)
 - Fabrication from scratch or by paraphrasing (plagiarism)
 - Authorship brokering
 - Citation boosting
- **Fake reviewers** submitting **fabricated review reports**
- **Bribed** (guest) **editors** (of special issues)
- **Predatory** and **highjacked journals**

5

We have no solid data on the frequency of these phenomena, but they definitely seem to be on the rise.

Byrne JA, Abalkina A, Akinduro-Aje O, Christopher J, Eaton SE, Joshi N, et al. (2024) A call for research to address the threat of paper mills. PLoS Biol 22(11): e3002931. <https://doi.org/10.1371/journal.pbio.3002931>.
<https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3002931>

COPE & STM report on paper mills:

<https://publicationethics.org/sites/default/files/paper-mills-cope-stm-research-report.pdf>

MA Oviedo-Garcia. Review Mill at MDPI. <https://predatoryreports.org/news/f/review-mill-at-mdpi>

Lonni Besançon I, Cabanac G, Labbé C, Magazinov A. Sneaked references: Fabricated reference metadata distort citation counts. J Assoc Inf Sci Technol 2024; 1–12. <https://asistdl.onlinelibrary.wiley.com/doi/10.1002/asi.24896>

Strinzel M, Severin A, Milzow K, Egger M. Blacklists and Whitelists To Tackle Predatory Publishing: a Cross-Sectional Comparison and Thematic Analysis. mBio 2019; 10: e00411-19 <https://journals.asm.org/doi/epdf/10.1128/mBio.00411-19>

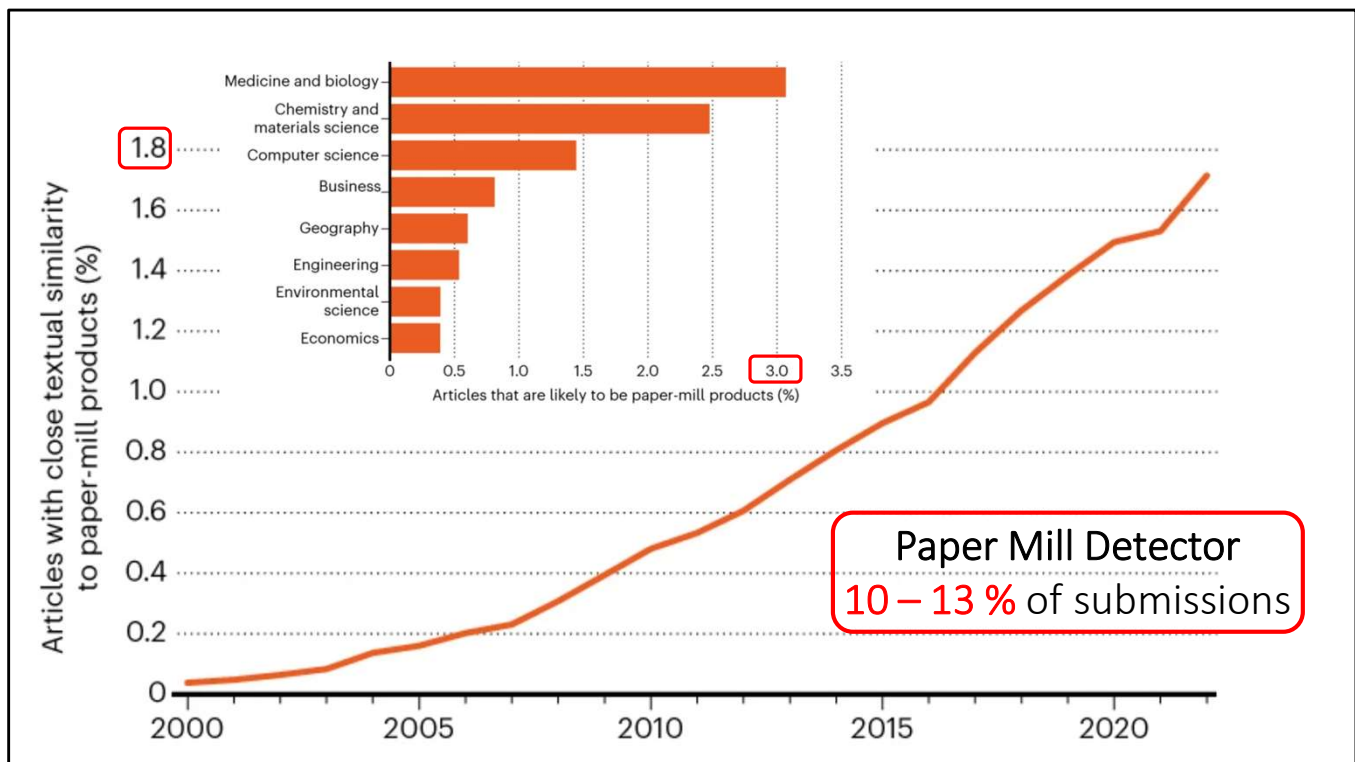
Grudniewicz A, Moher, D, Cobey KD and 32 co-authors. Predatory journals: no definition, no defence. Nature 2019; 576: 210-2.

Cobey CD, Grudniewicz A, Lalu MM, Rice DB, Raffoul H, Moher D. Knowledge and motivations of researchers publishing in presumed predatory journals: a survey. BMJ Open 2019; 9: e026516. <https://bmjopen.bmj.com/content/9/3/e026516>

Braak P, van Gorp D, Hukkelhoven, C, de Roo T. Predatory and questionable publishing practices : How to recognise and avoid them. Published March 20, 2024. <https://zenodo.org/records/10688081>

Retraction Watch Hijacked Journal Screener.

<https://retractionwatch.com/the-retraction-watch-hijacked-journal-checker/>
https://docs.google.com/spreadsheets/d/1ak985WGOgGbJRJbZFanoktAN_UFeExpE/edit?gid=5255084#gid=5255084



Van Noorden R. How big is science’s fake-paper problem? Nature News: 6 November 2023. <https://www.nature.com/articles/d41586-023-03464-x>

Prillaman M. ‘ChatGPT detector’ catches AI-generated papers with unprecedented accuracy: tool based on machine learning uses features of writing style to distinguish between human and AI authors. Nature News: 6 November 2023. <https://www.nature.com/articles/d41586-023-03479-4>

Katharine Sanderson. Science’s fake-paper problem: high-profile effort will tackle paper mills. Nature News 19 January 2024. https://www.nature.com/articles/d41586-024-00159-9?utm_medium=Social&utm_campaign=nature&utm_source=Twitter#Echobox=1705659987

Wittau J, Seifert R. How to fight fake papers: a review on important information sources and steps towards solution of the problem. Naunyn-Schmiedeberg's Archives of Pharmacology, published online: 6 July 2024. <https://link.springer.com/article/10.1007/s00210-024-03272-8>

Wiley Paper Mill Detection service:
<https://johnwiley2020news.q4web.com/press-releases/press-release->

[details/2024/Wiley-announces-pilot-of-new-AI-powered-Papermill-Detection-service/default.aspx](#)

Up to one in seven submissions to hundreds of Wiley journals flagged by new paper mill tool

<https://retractionwatch.com/2024/03/14/up-to-one-in-seven-of-submissions-to-hundreds-of-wiley-journals-show-signs-of-paper-mill-activity/>

Assessing the feasibility and impact of clinical trial trustworthiness checks via an application to Cochrane Reviews: Stage 2 of the INSPECT-SR project

Jack Wilkinson, et al. medRxiv 2024.11.25.24316905.

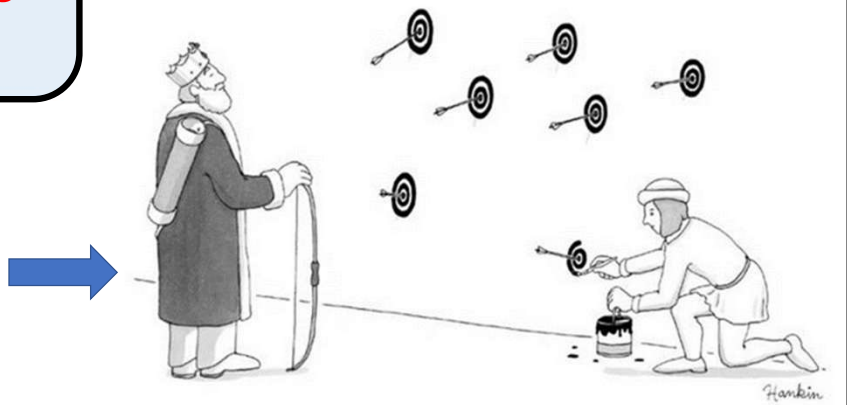
<https://doi.org/10.1101/2024.11.25.24316905>

Drivers of the Replication Crisis

- Selective reporting
- Low power
- P-hacking
- HARKing

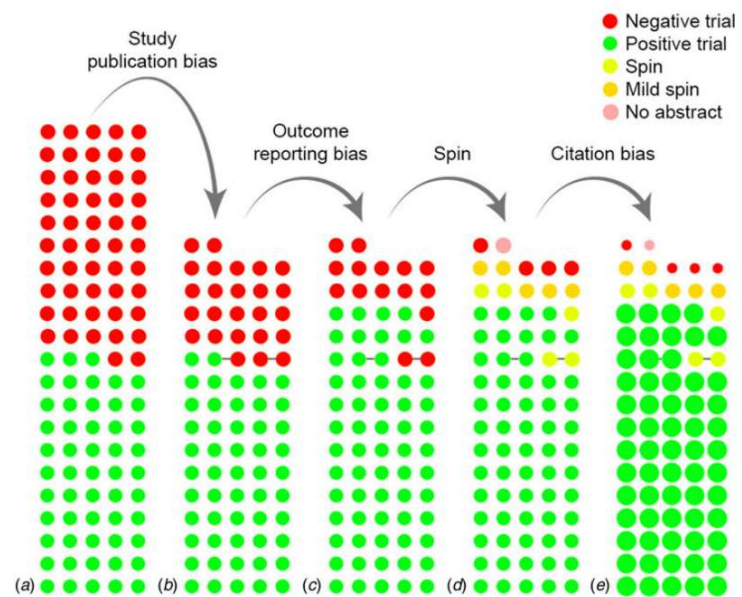
QRPs

Hypothesizing After
Results are Known



Wicherts et al - Degrees of freedom - checklist to avoid p-hacking - Front Psych 2016; 7: 1832. <https://www.frontiersin.org/articles/10.3389/fpsyg.2016.01832/full>

Selective reporting is driving the replication crisis

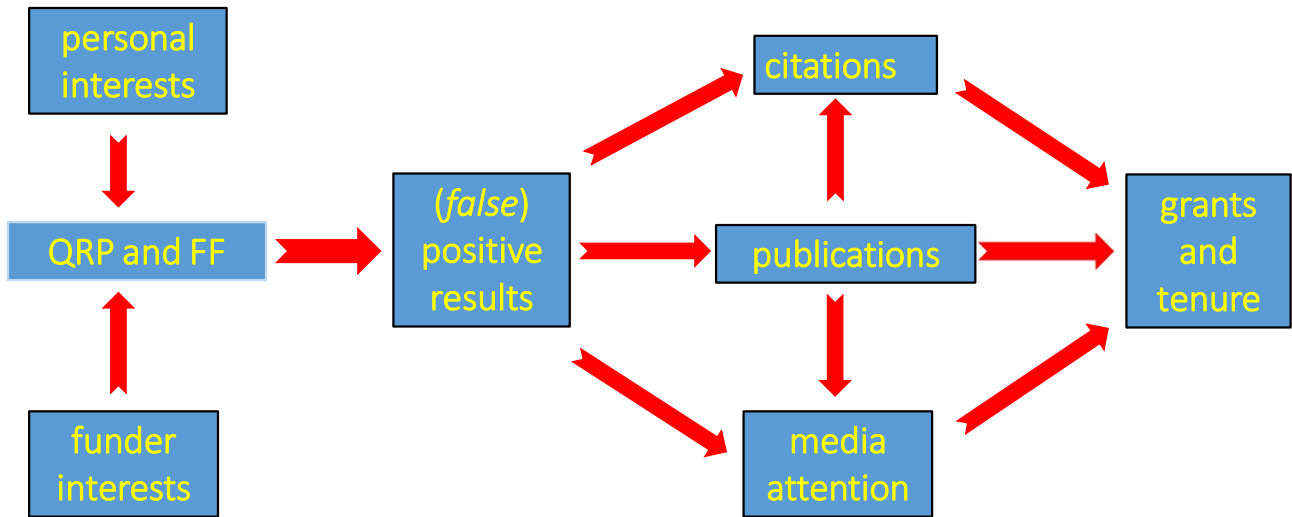


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This example concerns the fate of an inception cohort of 105 RCTs of the efficacy of anti-depression drugs from the FDA database. The cohort is complete in the sense that pharmaceutical companies must register all trials they intend to use to obtain FDA market approval before embarking on data collection. The FDA considered 50% of the trials to be positive after carefully looking at the results.

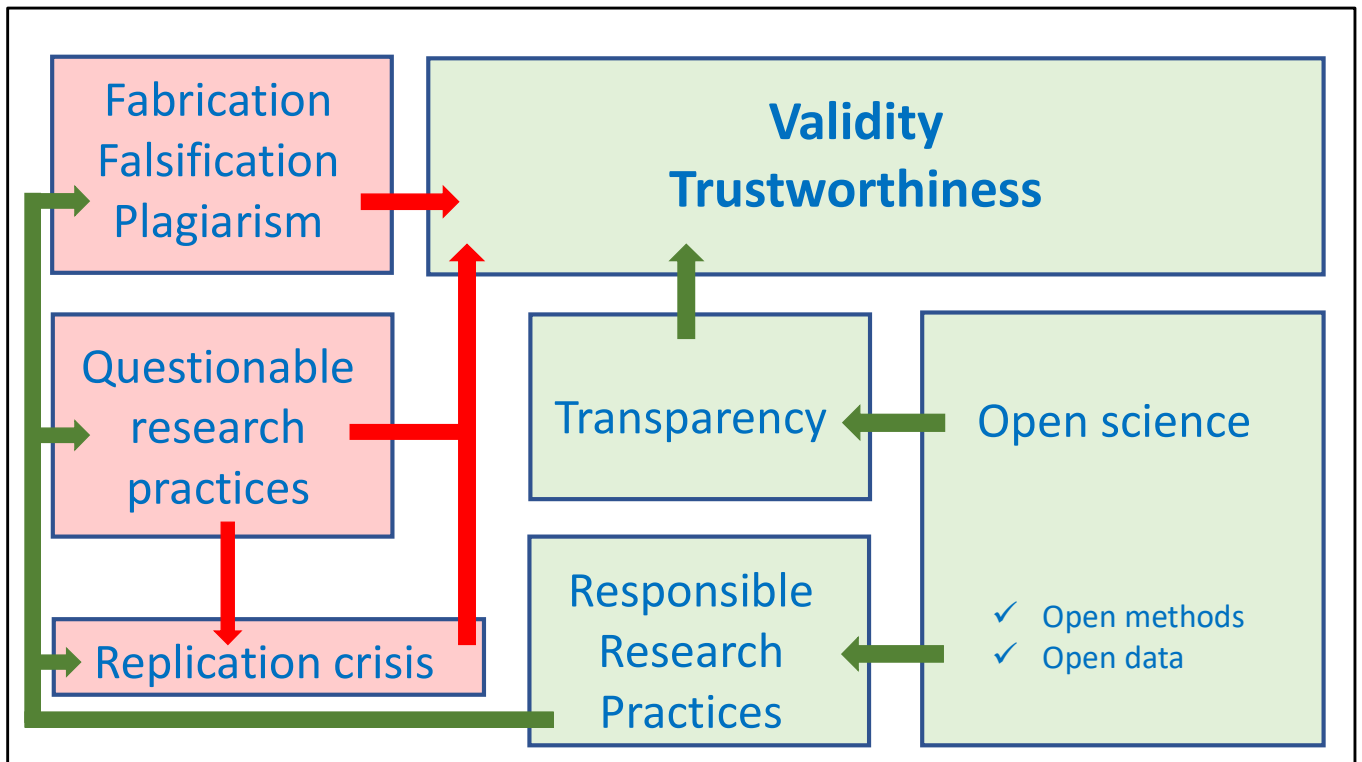
de Vries YA, Roest AM, de Jonge P, Cuijpers P, Munafò MR, Bastiaansen JA (2018). The cumulative effect of reporting and citation biases on the apparent efficacy of treatments: the case of depression. *Psychological Medicine* 1–3.
<https://doi.org/10.1017/S0033291718001873>

How things can go wrong



Planning	Data collection	Data processing	Data analysis	Write-up	Publication
Choosing biased manipulations	Placing undue influence on participants	Discretizing continuous variables	Choosing a poor model specification	Citing unreliable research	Creating multiple publications from the same study
Choosing biased measurements	Mixing pilot- and main-study data	Excluding data points	Choosing unjustified <i>p</i> value adjustment	Hypothesizing after the results are known (HARKing)	Declaring false authorship
Choosing overlapping measures to find significant results	Optional stopping	Missing data hacking	Neglecting assumptions for statistical models	Incorrect reporting of test statistics	Not linking the preregistration to the published study
Preregistering after the results are known (PARKing)	Selective sampling	Modifying measurements	Selecting a favorable random-number-generator seed	Making unsupported conclusions	Not making data accessible
Performing inappropriate power analysis		Redefining group-membership rules	Using ad hoc covariates	Not disclosing deviations from preregistration	Publishing studies selectively
		Using ad hoc exclusion criteria for participants		Omitting important details of the scientific process	
		Variable transformation fishing		Selective citing Selective reporting of hypotheses	
<div style="border: 2px solid red; padding: 10px; text-align: center;"> <p>The temptation to cut corners is huge We are good at working towards what we expect to find We need checks and balances in the proces trust, but verify</p> </div>				Selective reporting of indicator variables	
				Selective reporting of outcomes	
				Selective test reporting	
				Using irrelevant references	
				Using unjustified references	

Nagy T, Hergert J, Elsherif MM, et al. Bestiary of Questionable Research Practices in Psychology. *Advances in Methods and Practices in Psychological Science*. 2025;8(3). <https://journals.sagepub.com/doi/full/10.1177/25152459251348431>



Haven T, Gopalakrishna G, Tijdink J, van der Schot D, Bouter L. Promoting trust in research and researchers: how open science and research integrity are intertwined. *BMC Research Notes* 2022; 15: 302. <https://doi.org/10.1186/s13104-022-06169-y>

Bouter LM. Research misconduct and questionable research practices form a continuum. *Accountability in Research* 2024; 31: 1255–1259. <https://bit.ly/3YYaluu>

Bouter L. Why research integrity matters and how it can be improved. *Accountability in Research*. 2024; 31: 1277-1286. <https://research.vu.nl/files/219241433/5.248.pdf>

Both replicability and replication studies boost trustworthiness of research

1. What was the **likelihood of the findings** before the initial study was done?
2. What was the **study size** and the **methodological quality** of the initial study?
3. How many **replications** were performed and which % was successful?
4. What are the **stakes** at issue?

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Ioannidis JPA. Why replication has more scientific value than original discovery. Behavioral and Brain Sciences 2018; 41: e137

Bouter LM, ter Riet G. Empirical research must be replicated before its findings can be trusted. Journal of Clinical Epidemiology 2021; 129: 188-90.
[https://www.jclinepi.com/article/S0895-4356\(20\)31118-5/fulltext](https://www.jclinepi.com/article/S0895-4356(20)31118-5/fulltext)

Peels R, Bouter L. Replication and trustworthiness. Accountability in Research 2023; 30: 77-87. <https://doi.org/10.1080/08989621.2021.1963708>

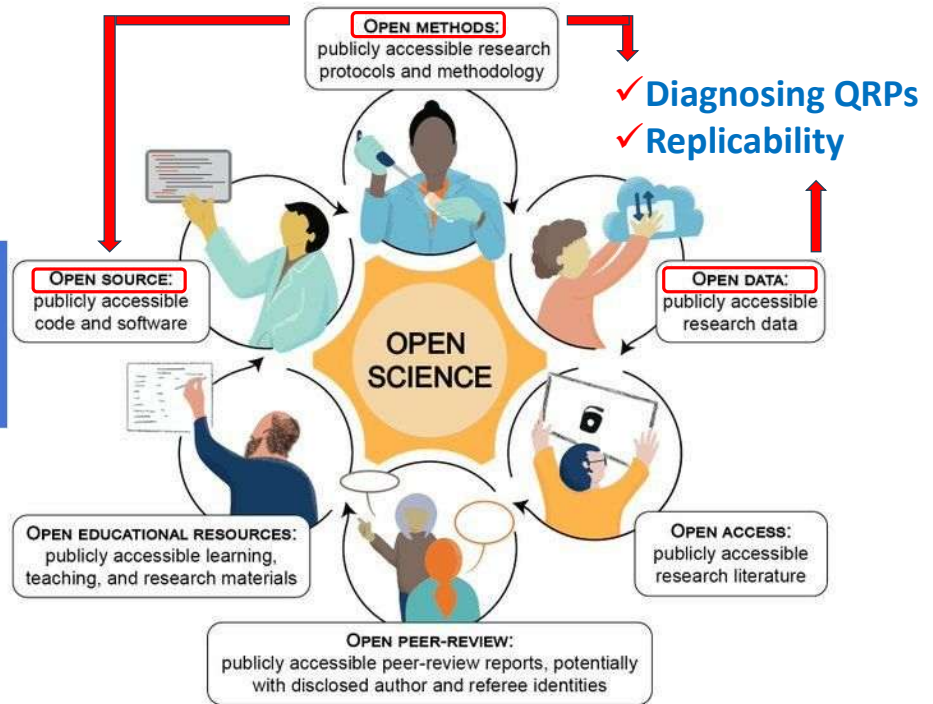
Open Science

can mean a lot of different things



Expanding universe:

- Open hardware
- Open funding practices
- Citizen science



Bertram B, Thoré E, Brodin T. Moving towards an open science community. LSE Impact Blog; 20 October 2023.

<https://royalsociety.org/blog/2023/10/moving-towards-an-open-science-community/>

<https://www.openscience.nl/en>

How these things hang together

- **Open methods** fosters **replicability** and also helps to detect **QRPs** e.g. selective reporting, p-hacking and hypothesizing after results are known (HARKing)
- **Open Data** and **Open Codes** enable **computational reproduction**
- **Unsuccessful replication** implies that findings of initial study, its replication, or both are untrue (not **valid**) due to:
 - random (sampling) error
 - deviation from the study protocol
 - variation in contextual factors not taken into account in the study protocol
 - research misconduct or QRPs
- **Successful replication** doesn't imply that the findings are true (**valid**), as also **bias** due to **methodological flaws** will be replicated consistently

John P.A. Ioannidis. Transparency, bias, and reproducibility across science: a meta-research view. J Clin Invest. 2024;134(22):e181923. <https://doi.org/10.1172/JCI181923>

Peels R, Bouter L. Replication and trustworthiness. Accountability in Research 2021. <https://doi.org/10.1080/08989621.2021.1963708>

Open Methods

- **registration** of essential features of study design
- publication or preprint of **full study protocol** (incl. data-analysis plan)
- **Registered Report**

Essential traits

- **prospective** (before start of data collection)
- **public** (embargo possible)
- **amendments** with time stamp



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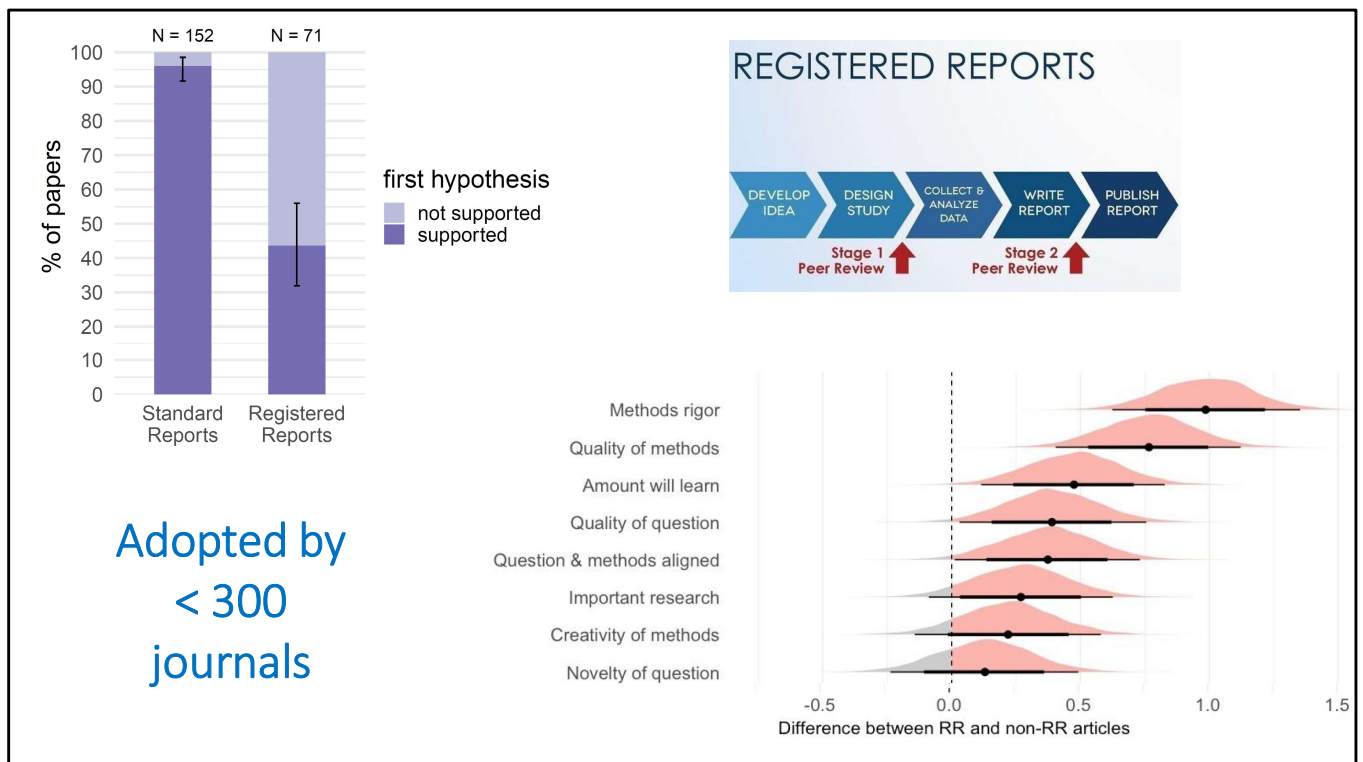
Nosek BA, Ebersole CR, DeHaven AC, Mellor D. The preregistration revolution. PNAS 2018;115:2600-6. <http://www.pnas.org/content/115/11/2600>

Allen C, Mehler DMA. Open science challenges, benefits and tips in early career and beyond. PLoS Biol 2019; 17(5): e3000246. <https://doi.org/10.1371/journal.pbio.3000246>

Daniël Lakens, Cristian Mesquida, Sajedah Rasti & Massimiliano Ditroilo (2024) The benefits of preregistration and Registered Reports, Evidence-Based Toxicology, 2:1, 2376046, <https://doi.org/10.1080/2833373X.2024.2376046>

Lakens D. When and How to Deviate From a Preregistration. Collabra: Psychology (2024) 10 (1): 117094. <https://online.ucpress.edu/collabra/article/10/1/117094/200749>

<https://www.cos.io/initiatives/prereg>



Chambers C. What's next for registered reports. *Nature* 2019; 573 187-189.
<https://www.nature.com/articles/d41586-019-02674-6>

Allen C, Mehler DMA. Open science challenges, benefits and tips in early career and beyond. *PLoS Biol* 2019; 17(5): e3000246. <https://doi.org/10.1371/journal.pbio.3000246>

Editorial. Nature welcomes Registered Reports. *Nature* 2023; 614: 594.
<https://www.nature.com/articles/d41586-023-00506-2>

Anne M. Scheel , Mitchell R. M. J. Schijen, and Daniël Lakens An excess of positive results: comparing the standard psychology literature with registered reports. *Advances in Methods and Practices in Psychological Science* April-June 2021, Vol. 4, No. 2, pp. 1–12. <https://journals.sagepub.com/doi/full/10.1177/25152459211007467>

Soderberg CK, Errington TE , Schiavone SR, Bottesini J, Thorn FS, Vazire S, Esterling KM, Nosek BA. Initial evidence of research quality of Registered Reports compared to the standard publishing model. *Nature Human Behaviour* 2021; 990–997

Henderson EL, Chambers CD (2022) Ten simple rules for writing a Registered Report. *PLoS Comput Biol* 18(10): e1010571. <https://doi.org/10.1371/journal.pcbi.1010571>

Lakens, D., Mesquida, C., Rasti, S., & Ditroilo, M. (2024). The benefits of preregistration and Registered Reports. *Evidence-Based Toxicology*, 2(1).
<https://doi.org/10.1080/2833373X.2024.2376046>

<https://cos.io/rr/>

Make reporting guidelines mandatory

Randomised trials	CONSORT	Extensions	Other
Observational studies	STROBE	Extensions	Other
Systematic reviews	PRISMA	Extensions	Other
Case reports	CARE	Extensions	Other
Qualitative research	SRQR	COREQ	Other
Diagnostic / prognostic studies	STARD	TRIPOD	Other
Quality improvement studies	SQUIRE		Other
Economic evaluations	CHEERS		Other
Animal pre-clinical studies	ARRIVE		Other
Study protocols	SPIRIT	PRISMA-P	Other
Clinical practice guidelines	AGREE	RIGHT	Other

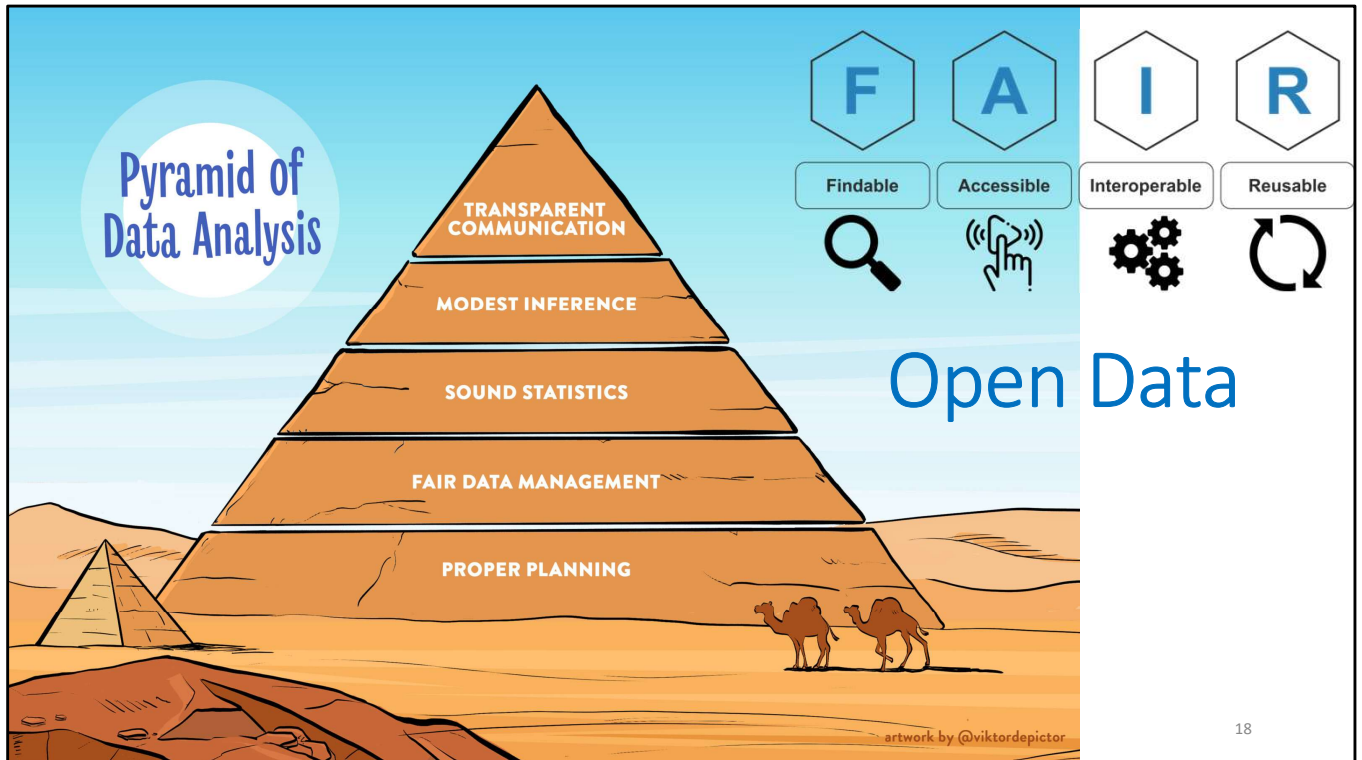


Enhancing the **QUALITY** and
Transparency Of health
Research

N = 692

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<http://www.equator-network.org/>

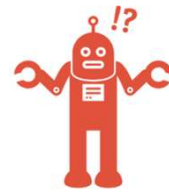


Wilkinson MD, et al. The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data* 2016; 3: 160018.
<https://www.nature.com/articles/sdata201618%22>

Wagenmakers EJ, Alexandra Sarafoglou A, Aczel B. Facing the Unknown Unknowns of Data Analysis. *Current Directions in Psychological Science* 2023; 32: 362 –368.
<https://journals.sagepub.com/doi/pdf/10.1177/09637214231168565>

<https://www.go-fair.org/fair-principles/>

What can research institutes do?



- Mandate **open** methods, **open** codes, and **open** data
- Offer good training in **research integrity** and **research methodology**
- Have good **supervision** and **quality control** installed
- Reform **researcher assessment** to prevent perverse incentives
- **Investigate signals** of faulty papers rapidly and inform journals
- Demand immediately **retraction** when indicated

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Munafó M, Noble S, Brownie WJ, Brunner D, Button K, Ferreira J, Holmans P, Langbehm D, Lewis G, Lindquist M, Tilling K, Wagenmakers EJ, Blumenstein R. Scientific rigor and the art of motor cycle maintenance. *Nature Biotechnology* 2014; 32: 871-873.

<https://www.nature.com/articles/nbt.3004>

Mejlgaard N, Bouter LM, Gaskell G, Kavouras P, Allum N, Bendtsen AK, Charitidis CA, Claesen N, Dierickx K, Domaradzka A, Reyes Elizondo A, Foeger N, Hiney M, Kaltenbrunner W, Labib K, Marušić A, Sørensen MP, Ravn T, Ščepanović R, Tijdink JK, Veltri GA. Research integrity: nine ways to move from talk to walk. *Nature* 2020; 586: 358-60.

<https://www.nature.com/articles/d41586-020-02847-8>

www.sops4ri.eu features 130 guidelines to promote aspects of research integrity

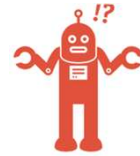
SPJM Horbach, Sørensen MP, on behalf of SOPs4RI. How to create and implement a Research Integrity Promotion Plan (RIPP).

https://sops4ri.eu/wp-content/uploads/Implementation-Guideline_FINAL.pdf

Template for writing a Research Integrity Promotion Plan for Research Performing Organisations.

https://sops4ri.eu/wp-content/uploads/Template-Research-Integrity-Promotion-Plan-RPOs_FINAL.pdf

What can journals and publishers do?



- Demand **open** methods, **open** codes, **open** data and **open** peer review
- Check reviewer **identity** and **quality** of review reports
- Perform **quality checks** in editorial office, e.g.:
 - text recycling and image manipulation
 - references to retracted papers
 - undeclared or not allowed use of GAI
- **Retract** immediately when indicated (much room for improvement!)



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Ross-Hellauer T, Bouter LM, Horbach SPJM. Open peer review urgently requires evidence: a call to action. PLoS Biology 2023; 21: [e3002255](https://doi.org/10.1371/journal.pbio.3002255).
<https://doi.org/10.1371/journal.pbio.3002255>

<https://www.stm-assoc.org/stm-integrity-hub/>

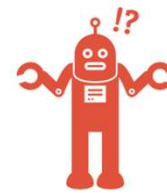
<https://www.irit.fr/~Guillaume.Cabanac/problematic-paper-screener>

<https://thebulletin.org/2022/01/bosom-peril-is-not-breast-cancer-how-weird-computer-generated-phrases-help-researchers-find-scientific-publishing-fraud/>

Wilkinson, Jack et al. A survey of experts to identify methods to detect problematic studies: stage 1 of the INveStigating ProBLEmatic Clinical Trials in Systematic Reviews project
Journal of Clinical Epidemiology, Volume 175, 111512
<https://www.jclinepi.com/action/showPdf?pii=S0895->

4356%2824%2900268-3

What can funding agencies do?



- Mandate **open** methods, **open** codes, and **open** data
- Demand that research institutes have good **training**, **supervision** and **quality control** installed
- Have **fair** and **open** selection procedures
- Take **quality assurance** seriously and **monitor** execution well
- Provide funds for **meta-research** (research on research)

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Horbach SPJM, Tijdink JK, Bouter LM. Research funders should be more transparent: a plea for open applications. Royal Society Open Science 2022; 9: 220750. <https://doi.org/10.1098/rsos.220750>

Horbach SPJM, Bouter LM, Gaskell G, Hiney M, Kavouras P, Mejlgaard N, Allum N, Aubert Bonn N, Bendtsen A, Charitidis CA, Claesen N, Dierickx K, Domaradzka A, Reyes Elizondo A, Föger N, Kaltenbrunner W, Konach T, Labib K, Marušić A, Pizzolato D, Ravn T, Roje R, Sørensen MP, Taraj B, Veltri GA, Tijdink JK . Designing and implementing a research integrity promotion plan: recommendations for research funders. PLoS Biology 2022; 20: e3001773. <https://doi.org/10.1371/journal.pbio.3001773>

www.sops4ri.eu features 130 guidelines to promote aspects of research integrity



These are great initiatives by and for Early Career Researchers.

<http://reproducibilitynetwork.nl/>

<https://reproducibilitea.org/>

<https://osc-international.com/open-science-community-the-netherlands/>

Academic novels on research integrity



Bouter L. Academic novels on research integrity. MetaArXiv (2025, September 16).
<https://doi.org/10.31222/osf.io/9ntxg>

The *Lancet*–World Conferences on Research Integrity
Foundation Commission on Research Integrity



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