The future of reproducibility: a publisher's perspective

Liz Allen, PhD
Director of Open Research Development & Innovation, Taylor & Francis

Taylor & Francis Group
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What I will cover

1. Some reflections on research reproducibility
2. Where can publishers make a difference?
3. Introducing the TIER2 project publisher pilots
4. Summary & more reflections

What I will cover

1. **Some reflections on research reproducibility**

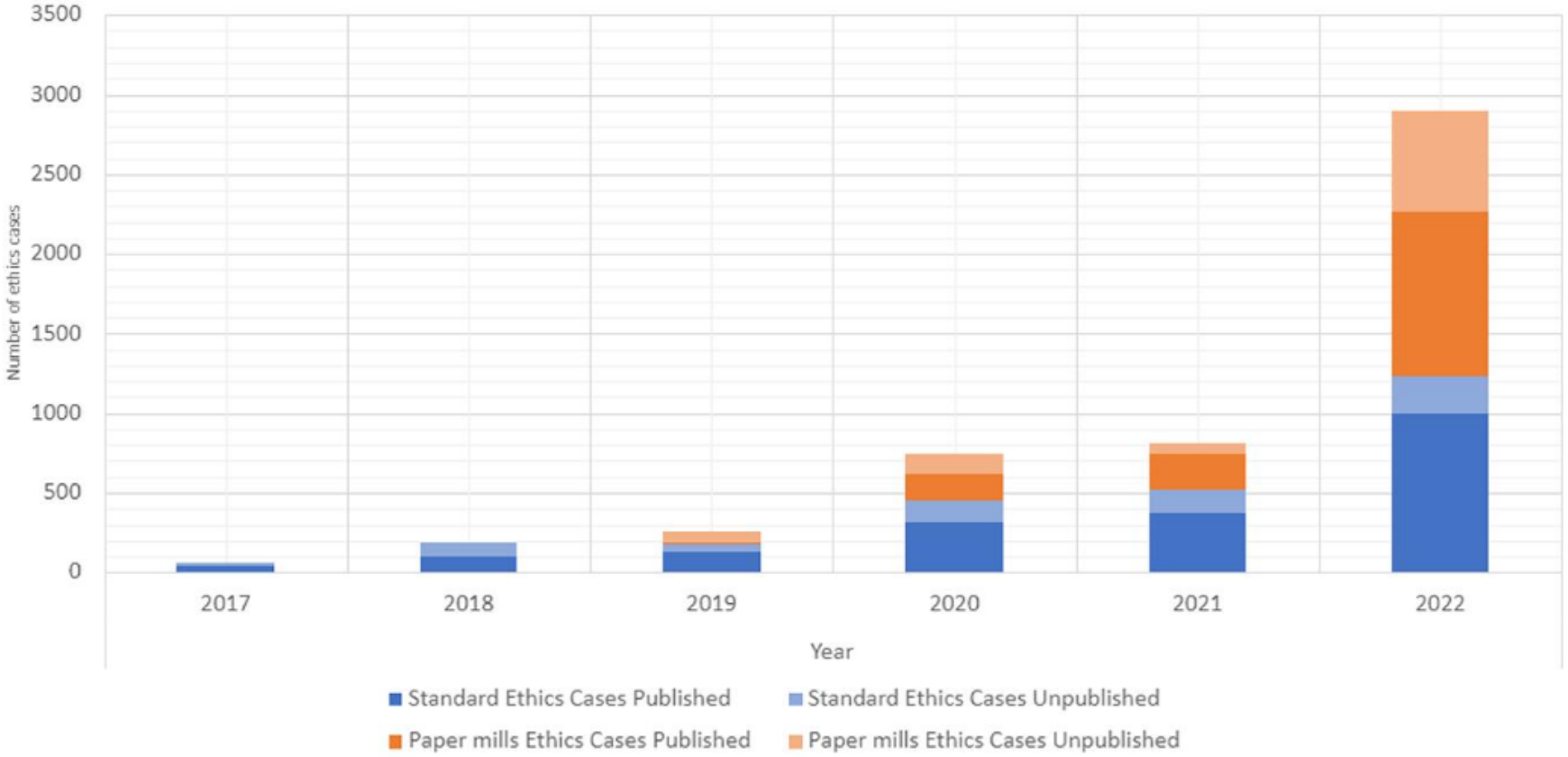
(Ir) reproducibility of research: it's complicated!

- **Definition & goal of 'reproducibility'** - *trust, fact, use, reuse, reduce waste?*
- **Lack of training** - *research methods, data, sharing etc*
- **Peer review of 'grant' / research**
- **Pressure to publish & 'positive' results bias**
- ***Incentives* to share all results & (relevant) outputs**
- ***Ability* to share all results & outputs**
- **Ability to *find* the research you need replicate**

https://doi.org/10.5281/zenodo.5521077

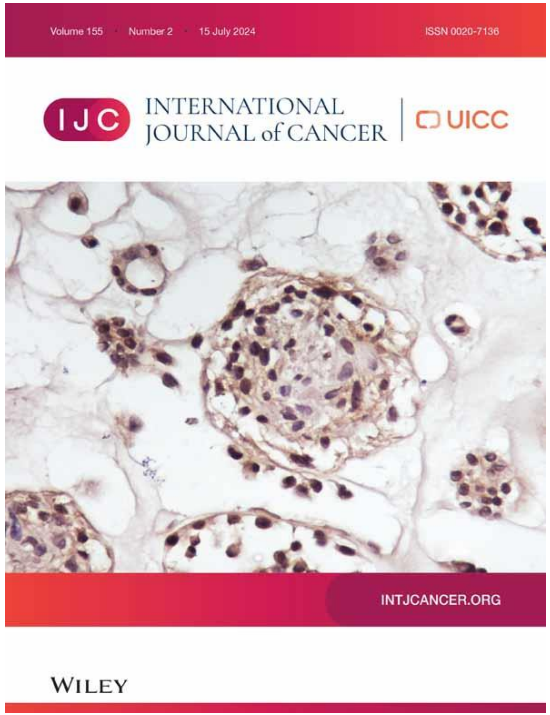
- **Variable editorial policies & practices (inc peer review) at publishers**
- **Increasing & evolving complexity of ethics & research integrity issues**

Trend in # of ethics cases: 2017-2022 (Taylor & Francis)



Alam, Sabina and Wilson, Laura. "Perspectives from a publishing ethics and research integrity team for required improvements" Journal of Data and Information Science, vol.8, no.3, 2023, pp.1-14. https://doi.org/10.2478/jdis-2023-0018

“Is it fraud or just a lot of spelling mistakes?”



https://www.science.org/content/article/hundreds-cancer-papers-mention-cell-lines-don-t-seem-exist

(Ir) reproducibility of research: it's complicated!

- Lack of training
- Peer review of 'grant' / research
- Pressure to publish & 'positive' results bias
- *Incentives* to share all results & (relevant) outputs
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- Variable editorial policies & practices at publishers

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REFLECTIONS:

- ***discoverability is key – are we uncovering tip of the iceberg? (legacy vs new issues)***
- ***are we addressing the root causes or currently intervening where it is expedient ?***
- ***all the above require system-wide thinking***

Need for research on causes of (ir) reproducibility

PLOS | BIOLOGY

RESEARCH MATTERS

Meta-research: Why research on research matters

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Abstract

Meta-research is the study of research itself: its methods, reporting, reproducibility, evaluation, and incentives. Given that science is the key driver of human progress, improving the efficiency of scientific investigation and yielding more credible and more useful research results can translate to major benefits. The research enterprise grows very fast. Both new opportunities for knowledge and innovation and new threats to validity and scientific integrity emerge. Old biases abound, and new ones continuously appear as novel disciplines emerge with different standards and challenges. Meta-research uses an interdisciplinary approach to study, promote, and defend robust science. Major disruptions are likely to happen in the way we pursue scientific investigation, and it is important to ensure that these disruptions are evidence based.

Check for updates

OPEN ACCESS

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Published: March 13, 2018

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Competing interests: The authors have declared that no competing interests exist.

Abbreviations: NIH, National Institutes of Health; R&D, Research and Development; STEM, Science, Technology, Engineering, and Math.

Provenance: Commissioned; not externally peer reviewed

Science, like all human endeavors, is prone to biases. Yet science can assess its own methods, reporting, reproducibility, evaluation, and incentives [1]. A relatively new discipline, called meta-research, covers a wide range of theoretical, observational, and experimental investigations designed to study research itself and its practices. The objective is to understand and improve how we perform, communicate, verify, evaluate, and reward research [1].

Before elaborating on a discipline that studies biases, I should disclose some of my own. First, all scientists are meta-researchers to some extent, though most usually work on focused subject matter disciplines. And though the advice of my early lab mentors—"focus, focus, focus"—still rings in my ears, the piles on my desk and the files in my computers can be notoriously unfocused. I don't have attention-deficit disorder, but plain unconstrained curiosity. What attracted me to science was its vastness and diversity. In my early training years, I enjoyed roaming in libraries in Athens and Boston, discovering scientific journals with fancy names, encountering intriguing articles, drifting from my initial search. Without yet realizing it, I was interested primarily in research itself apparently, much as others were interested primarily in *Caenorhabditis elegans*, volcanic eruptions, or automata.

Science and its literature is a marvelous maze of data, arguments, biases, errors, and the greatest achievements of humans. What can be more rewarding to study scientifically? Thirty

https://doi.org/10.1371/journal.pbio.2005468

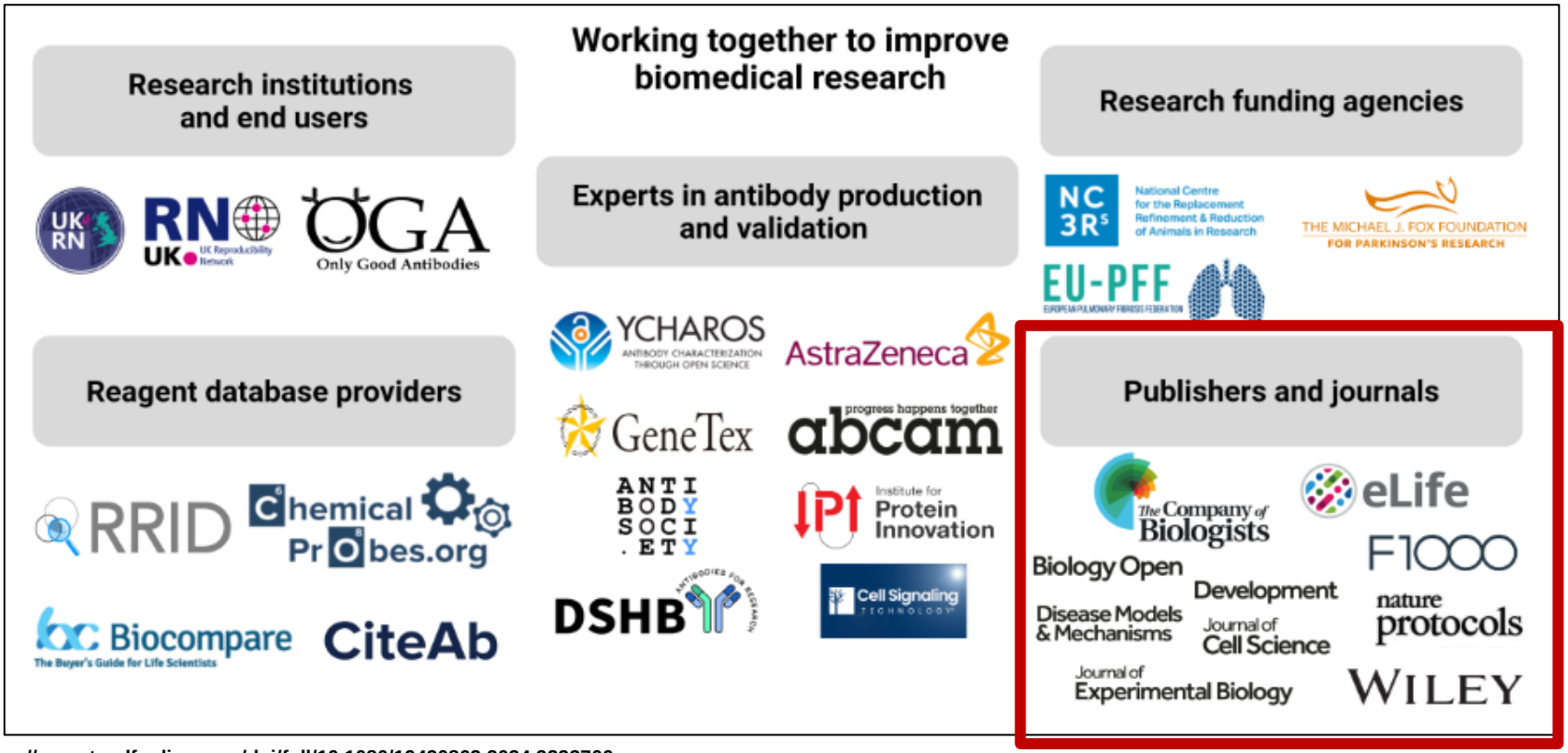
"Science remains the key driver of human progress, yet we have little evidence on how to best fund science and incentivize high-quality work."

John Ioannidis (2018)

RoRI RESEARCH ON RESEARCH INSTITUTE

Cross sector collaboration needed:

OGA
Only Good Antibodies



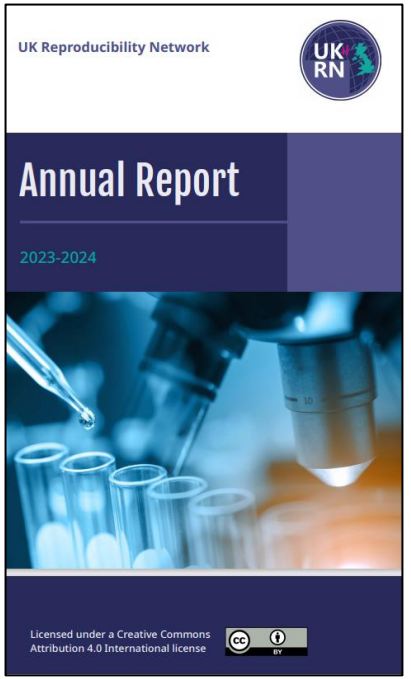
https://www.tandfonline.com/doi/full/10.1080/19420862.2024.2323706
https://www.responsibleresearchinpractice.co.uk/2023/12/13/guide-to-antibodies-and-research-reproducibility/

Cross sector collaboration needed:

Purpose:

*"to enable **researchers, institutions, and other stakeholders** working in the UK to **collaborate**, so they are better able to conduct and promote rigorous, reproducible, and transparent research."*

- **Cross-sector involvement**
- **RNs established across the world**
- **Focus on training, learning & effective policy**
- ***Focus on more positive narrative around 'doing good science'***



https://www.ukrn.org/open-research-resources/

https://www.ukrn.org/files/2024/04/UK-Reproducibility-Network-Annual-report-2023-24-85d30001026a18f7.pdf

What I will cover

1. Some reflections on research reproducibility

2. **Where can publishers make a difference?**

Where can *(do we think)* publishers make a difference?

- Provide venues for sound science
- Enable publication of important components of research
- Encouraging sharing of data & code
- Enable discoverability via metadata etc
- Transparency & openness
- Build in trust-markers
- Make it simple for authors (& editors)
- Working cross sector & in collaboration

What I will cover

1. Some reflections on research reproducibility
2. Where can publishers make a difference?
3. **Introducing the TIER2 project publisher pilots**

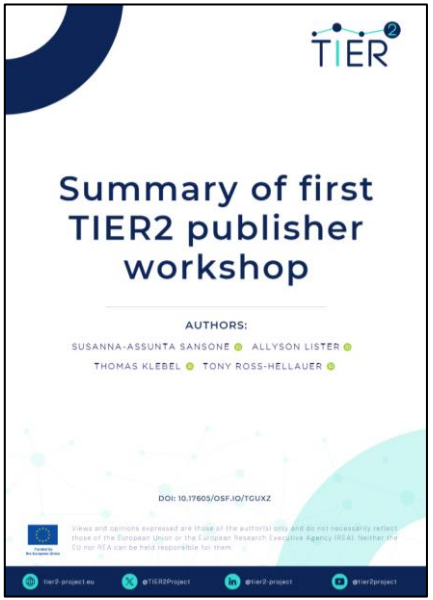
Cross sector collaboration needed:

TIER2 project (a reminder):

- Focus on co-creating approaches & tools
- Recognising diversity of perspectives
- Publishers affiliated with the project

May 2023 – first publisher workshop

- Representatives of 20 publishers (big, small, nfp, Society)
- Workshop aims:
  - share existing initiatives in place +/or planned to increase reproducibility
  - identify & prioritise areas for development
  - develop pilots that could be done in collaboration with TIER2



https://osf.io/6gbcv

Publisher collaboration in TIER2

Q: *what are the main challenges that you face to assure the reproducibility of research you publish?*

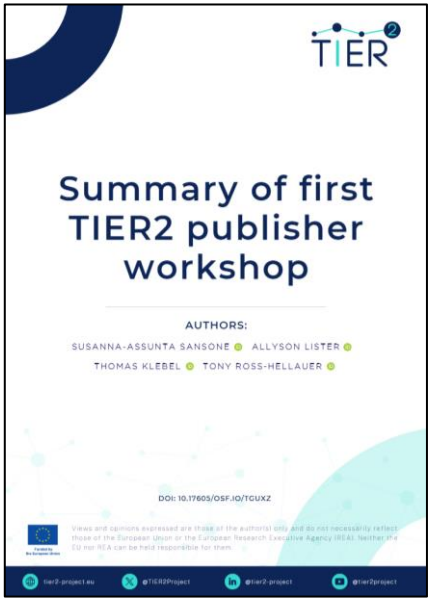
- **Limits of supporting infrastructure (& costs)**
- **Capacity for Editorial checks to assure FAIR etc**
- **Need for variation:** *one-size doesn't fit all*

- **Knowledge & awareness of requirements & best practice/s**
- **Absence of system-wide agreed standards & check-lists**

- **Limited demand from authors** *(esp in pay-to-publish model?)*
- **Desire to avoid extra peer review burden**

REFLECTION:

- ***what are the incentives for all concerned?***



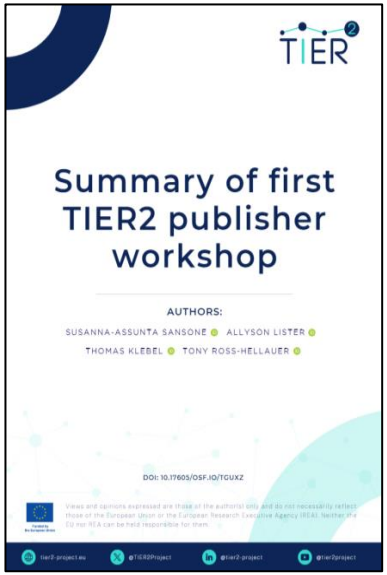
https://osf.io/6gbcv

Q: *what would boost the reproductivity of published research?*

- **Reform of incentives -** *focus on good rather than 'flashy' science*
- **Stronger policies & requirements of researchers**

- **Joined-up approaches & collaboration**
- **Standards & interoperability (to aid discoverability)**

- **Training & awareness building**
- **Monitoring & measuring impact**



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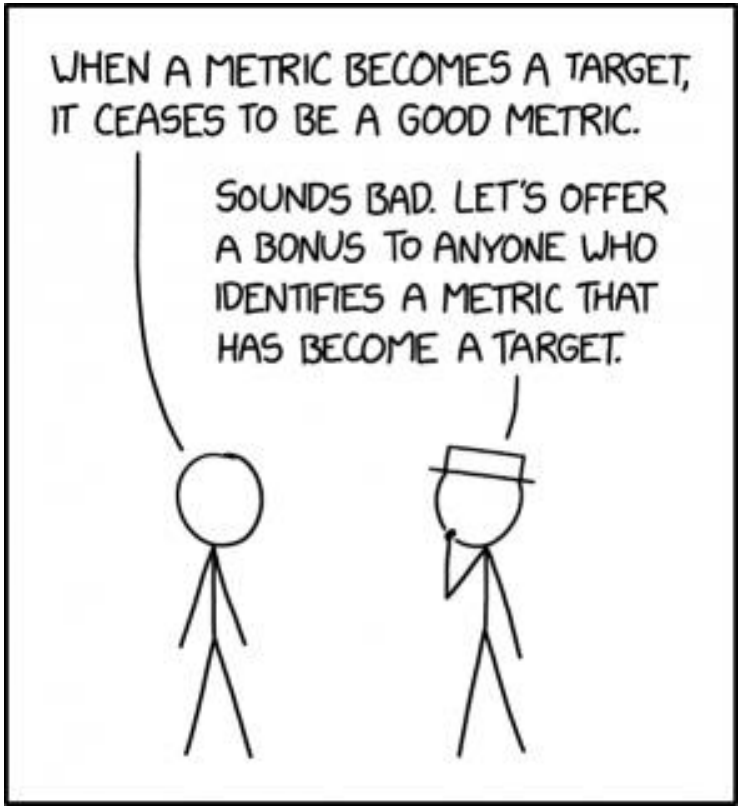
REFLECTIONS - proceed with caution:

- ***one size doesn't fit all***
- ***beware imposing 'global north standards'***
- ***beware 'metricisation' & Goodhart's law***
- ***… and do we know what the root causes are? Can publishers make a real difference?***

In encouraging behaviour change beware Goodhart's Law!



https://imgs.xkcd.com/comics/goodharts_law.png

"When a metric becomes a target, it ceases to be a good metric."

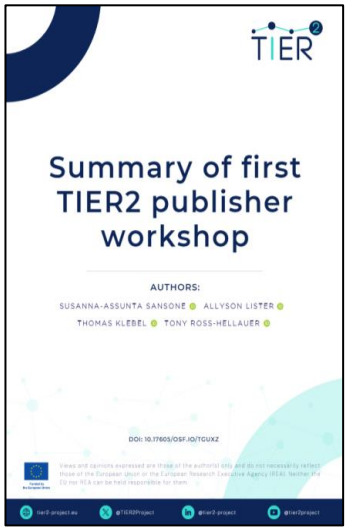
Charles Goodhart
(born 1936 -)
Economist

Two publisher focused pilots:

- Focus on topics ***where we think it will make a difference (FAIR, data availability & for reuse)***
- Aim to **keep it simple** for authors & publishers
- Monitoring & learning to inform potential scale up **(or not!)**
- **Timescale: Jan 2024- Sept 2025**

1. Data Availability Statements (DAS)

to provide editors with simple first line route to improve DAS – *statements, descriptors & links to data*



https://osf.io/6gbcv

Enforcing data sharing is challenging

www.nature.com/scientificdata

scientific data

OPEN

ANALYSIS

Data sharing practices and data availability upon request differ across scientific disciplines

Leho Tedersoo[1,2✉], Rainer Küngas[1], Ester Oras[1,3,4], Kajar Köster[1,4], Helen Eenmaa[1,5], Äli Leijen[1,2], Margus Pedaste[1], Marju Raju[1,6], Anastasiya Astapova[1,7], Heli Lukner[1,8], Karin Kogermann[1,4] & Tuul Sepp[1,9]

Data sharing is one of the cornerstones of modern science that enables large-scale analyses and reproducibility. We evaluated data availability in research articles across nine disciplines in *Nature* and *Science* magazines and recorded corresponding authors' concerns, requests and reasons for declining data sharing. Although data sharing has improved in the last decade and particularly in recent years, data availability and willingness to share data still differ greatly among disciplines. We observed that statements of data availability upon (reasonable) request are inefficient and should not be allowed by journals. To improve data sharing at the time of manuscript acceptance, researchers should be better motivated to release their data with real benefits such as recognition, or bonus points in grant and job applications. We recommend that data management costs should be covered by funding agencies; publicly available research data ought to be included in the evaluation of applications; and surveillance of data sharing should be enforced by both academic publishers and funders. These cross-discipline survey data are available from the plutoF repository.

Introduction

Technological advances and accumulation of case studies have led many research fields into the era of 'big data' - the possibility to integrate data from various sources for secondary analysis, e.g. meta-studies and meta-analyses[1,2]. Nearly half of the researchers commonly use data generated by other scientists[3]. Data sharing is a scientific norm and an important part of research ethics in all disciplines, also increasingly endorsed by publishers, funders and the scientific community[4–6]. Despite decades of argumentation[7], much of the published data is still essentially unavailable for integration into secondary data analysis and evaluation of reproducibility, a proxy for reliability[8–10]. Furthermore, the deposited data may also be incomplete, sometimes intentionally[11–14], e.g. in cases these exhibit mismatching sample codes or lack information about important metadata such as sex and age of studied organisms in biological and social sciences.

Although the vast majority of researchers prefer data sharing[15,16], scientists tend to be concerned about losing their priority in future publishing and potential commercial use of their work without their consent or participation[17,18,17]. Researchers working on human subjects may be bound by legal agreements not to reveal sensitive data[18,19]. Across research fields, papers indicating available data are cited on average 25% more[19]. In research using microarrays, papers with access to raw data accumulate on average 69% more citations compared with other articles[20]. Unfortunately, higher citation rate has not motivated many researchers enough to release their data, although referees and funding agencies account for bibliometrics when evaluating researchers and their

[1]Estonian Young Academy of Sciences, Kohtu 6, 10130, Tallinn, Estonia. [2]Mycology and Microbiology Center, University of Tartu, Ravila 14a, 50411, Tartu, Estonia. [3]Institute of Chemistry, University of Tartu, Ravila 14a, 50411, Tartu, Estonia. [4]Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005, Tartu, Estonia. [5]Department of Forest Sciences, University of Helsinki, PO Box 27 (Latokartanonkaari 7), Helsinki, FI-00014, Finland. [6]School of Law, University of Tartu, Näituse 20, 50409, Tartu, Estonia. [7]Institute of Education, University of Tartu, Salme 1a, 50103, Tartu, Estonia. [8]Department of Musicology, Music Pedagogy and Cultural Management, Estonian Academy of Music and Theatre, Tatari 13, 10126, Tallinn, Estonia. [9]Institute for Cultural Research and Fine Arts, University of Tartu, Ülikooli 16, 51003, Tartu, Estonia. [10]Institute of Physics, University of Tartu, W. Ostwaldi 1, 50411, Tartu, Estonia. [11]Institute of Pharmacy, University of Tartu, Nooruse 1, 50411, Tartu, Estonia. [12]Institute of Ecology and Earth Sciences, University of Tartu, Vanemuise 46, 51003, Tartu, Estonia. ✉e-mail: leho.tedersoo@ut.ee

- Study of data availability across articles (n=875) in Nature & Science 2009-2019
- Despite stringent data availability policies among publishers (inc DAS), data were *partially* available (& upon request) in c30% of articles

Recommendations (cross sector):

- data sharing/management costs *covered* by funders
- data sharing practices *incentivised* by institutions
- data sharing *enforced* by both publishers & funders

Tedersoo, L., Küngas, R., Oras, E. *et al.* Data sharing practices and data availability upon request differ across scientific disciplines. *Sci Data* 8, 192 (2021). https://doi.org/10.1038/s41597-021-00981-0

Reasons for not sharing data upon request


scientific data

OPEN ANALYSIS

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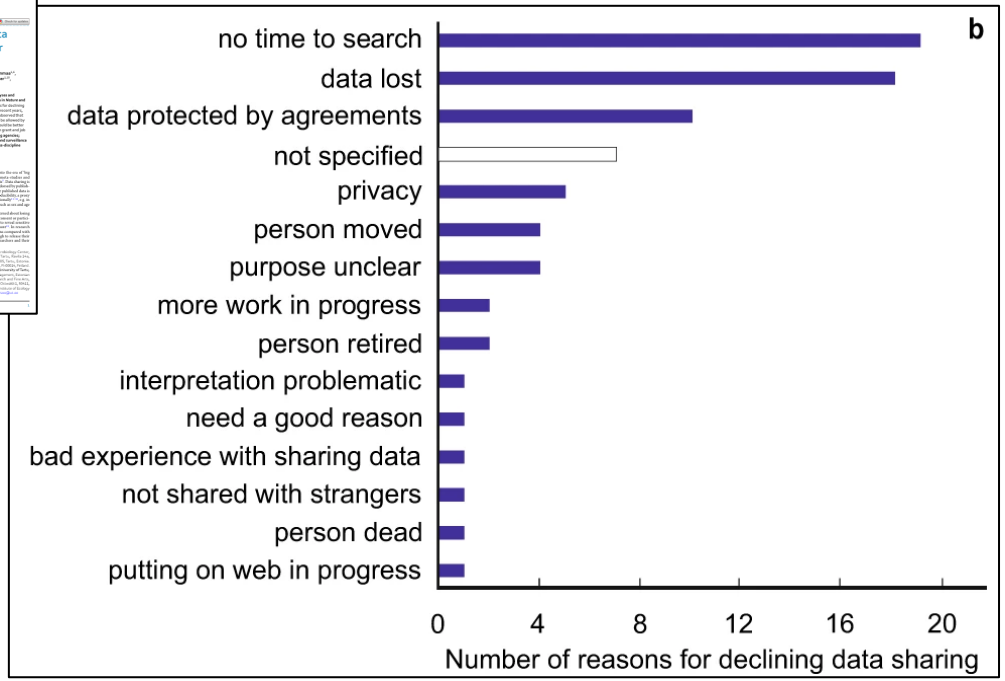


Base: n=67 authors who declined to share data upon contact

"While the majority of data are eventually available, it is alarming that less than a half of the data clearly stated to be available upon request could be effectively obtained from the authors."

Tedersoo, L., Küngas, R., Oras, E. *et al.* Data sharing practices and data availability upon request differ across scientific disciplines. *Sci Data* 8, 192 (2021). https://doi.org/10.1038/s41597-021-00981-0

Publisher workflow intervention:

to provide editors with simple first line route to improve DAS – statements, descriptors & links to data

Pilot 7 - Editorial Workflows to Increase Data Sharing

This Pilot is aimed at increasing data sharing in published work. Data sharing is an important building block for increased reproducibility & transparency, but current rates of sharing are low.

Stakeholders: Publishers

Timeline: January 2024 - September 2025

Objectives: The pilot will improve our knowledge on data sharing with two activities:
- A randomised controlled trial of an intervention targeting data availability statements with the aim to increase deposition of data in trusted repositories.
- A Delphi-study to gather consensus on the most pressing issues and best paths to improve sharing of research data underlying publications.

Contact info: Tony Ross-Hellauer (Know-Center GmbH) Thomas Klebel (Know-Center GmbH)

Find out more

https://tier2-project.eu/pilots

Two publisher focused pilots:

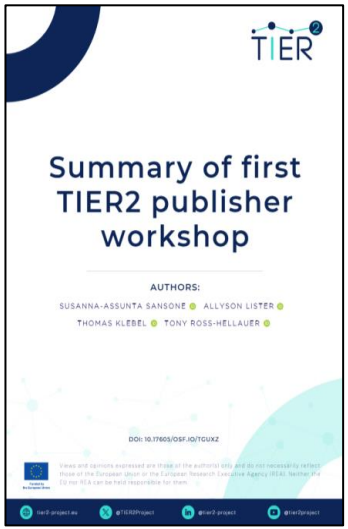
- Focus on topics *where we think it will make a difference (FAIR, data availability & for reuse)*
- Aim to **keep it simple** for authors & publishers
- Monitoring & learning to inform potential scale up
- Timescales: Jan 2024- Sept 2025

1. Data Availability Statements (DAS)

to provide editors with simple first line route to improve DAS – *statements, descriptors & links to data*

2. Editorial reference 'handbook'

focused on FAIRness (esp of data) to operationalise and harmonise editorial checks



https://osf.io/6gbcv

Publisher workflow intervention:

*to create a **Handbook for FAIRness** operationalise and harmonise editorial checks*

Pilot 8 - An Editorial Reference Handbook for Reproducibility and FAIRness

This Pilot will co-create and test an Editorial Reference Handbook that contributes towards a common understanding and what is required to assist reproducibility and FAIRness. The Handbook, identified as a priority in a workshop with publishers, will include two components. A structured section will include educational and practical set of checks, defined by reviewing existing material, harmonising and operationalising them. Some journals have internal checks, but the type, richness and stringency vary, and there is little/no consensus among publishers. A narrative component with a general framework will help improve internal processes, defined by describing an ideal process where checks should be applied. There are a variety of internal processes, and how, when and by whom these checks are done vary, and this can also affect the results.

The Pilot includes representatives of Cambridge University Press, Cell Press, EMBO Press, F1000 (Taylor & Francis), GigaScience Press, Lancet, Oxford University Press, PLOS, Springer Nature, Wiley.

Stakeholders: Publishers

Timeline: January 2024 - September 2025

Objectives: The Handbook is set to help put the requirements of the journal data policy in action:

- journals that already have their own internal guidance will be able to use the handbook to validate and refine their existing methodology;
- journals that do not yet have their own internal guidance should use it as an opportunity to define their own process.

The planned intervention will target in-house editorial staff managing the manuscripts, but also benefit reviewers, authors on what compliance to the journal data policy may require, as well as developers to drive their service provisions to publishers.

Contact all leads:

Allyson Lister (University of Oxford), Susanna-Assunta Sansone (University of Oxford), Rebecca Taylor-Grant (Taylor and Francis), Matthew Cannon (Taylor and Francis), Christopher Osborne (University of Oxford), Liz Allen (Taylor & Francis & F1000)

Find out more

https://tier2-project.eu/pilots

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Summary & more reflections

1. **Important to understand the root causes of the 'problem';** *to avoid developing wasted interventions & unintended consequences*
2. **Cross sector collaboration is essential**; *publisher initiatives to improve reproducibility work best as part of system-wide initiatives & actions*
3. **Practical steps (small) can make a difference;** *given the complexity of issues, it is important to pilot interventions & keep simple & pragmatic*
4. **Importance of incentives;** *effective change (in workflows, systems, behaviour) needs buy-in & evidence of benefits*
5. **Interventions should be evidence-based***; this is the 'Science of science' in action!*

Thank you !

Comments & questions welcome ☺

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