TIER2 Enhancing Trust, Integrity and Efficiency in Research through next-level Reproducibility

BIH QUEST Center for Responsible Research

Enhancing Trust, Integrity and Efficiency in Research through next-level Reproducibility – the TIER2 project

Alexandra Bannach-Brown, PhD

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Funded by the European Union.
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TIER2 in a nutshell

TIER2: enhancing Trust, Integrity And Efficiency In Research through next-level Reproducibility

- Investigate reproducibility in social, life, computer sciences, plus funder and publisher contexts
- Co-creative approach to creating and evaluating new reproducibility tools and practices
- 2 million Euros from EC Horizon Europe and UKRI
- January 2023 to December 2025

http://tier2-project.eu/

TIER2

Organisation	Principal investigator
Know-Center GmbH, Austria	Tony Ross-Hellauer (m)
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Stichting Vumc, Netherlands	Joeri Tijdink (m)
Aarhus University, Denmark	Jesper Schneider (m)
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GESIS, Germany	Hajira Jabeen (f)
OpenAIRE, EU	Natalia Manola (f)
Charite, Germany	Alexandra Bannach-Brown (f)
University of Oxford, UK	Susanna-Assunta Sansone (f)
Biomedical Sciences Research Center Alexander Fleming, Greece	Martin Reczko (m)

Why should we care? – Quest for Tru

Image: Neil Webb, “Nothing in the Rulebook”

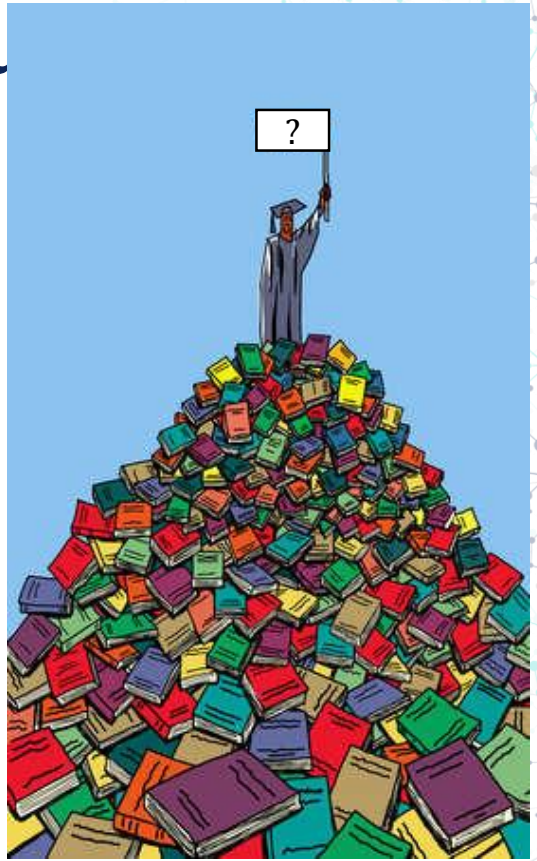
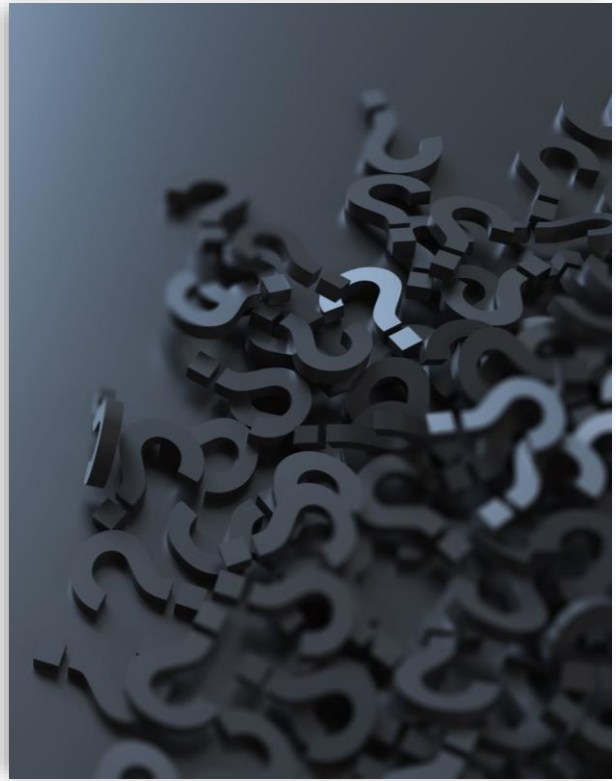


Image: Anthony Bari 520758

What is reproducibility?

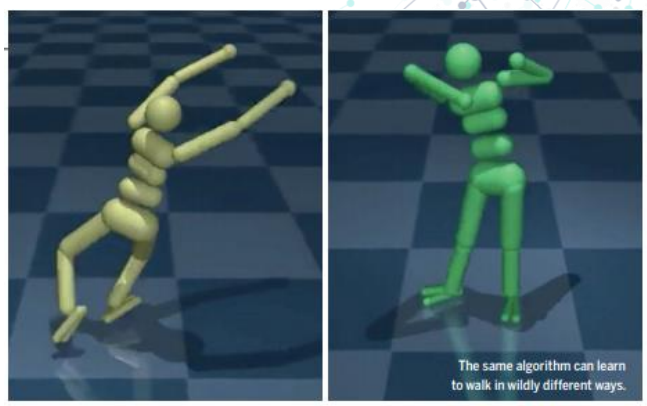
- Definitions vary (a lot)
  - Using the same words for different things (reproducibility / replication)
  - Taxonomies for the different aspects of research that can be made reproducible/replicable
- Key distinction between:
  - *Methods reproducibility:* - “reproducible in principle”, sufficient documentation and sharing of methods, protocols, data, code, etc. to enable the work to be reproduced.
  - *Results reproducibility:* - successful reproduction/replication when a study is repeated, i.e., the results are sufficiently similar across both studies
- At its highest level, just obtaining consistent results when repeating experiments and analyses



Reliability of findings are in question

Why Most Published Research Findings Are False

John P. A. Ioannidis



COMPUTER SCIENCE

Artificial intelligence faces reproducibility crisis

Unpublished code and sensitivity to training conditions make many claims hard to verify

nature REVIEWS DRUG DISCOVERY

Believe it or not: how much can we rely on published data on potential drug targets?

Florian Prinz, Thomas Schlange & Khusru Asadullah

BMJ

BMJ 2014;348:g3725 doi: 10.1136/bmj.g3725 (Published 13 June 2014)

Evidence based medicine: a movement in crisis?

Trisha Greenhalgh and colleagues argue that, although evidence based medicine has had many benefits, it has also had some negative unintended consequences. They offer a preliminary agenda for the movement's renaissance, refocusing on providing useable evidence that can be combined with context and professional expertise so that individual patients get optimal treatment

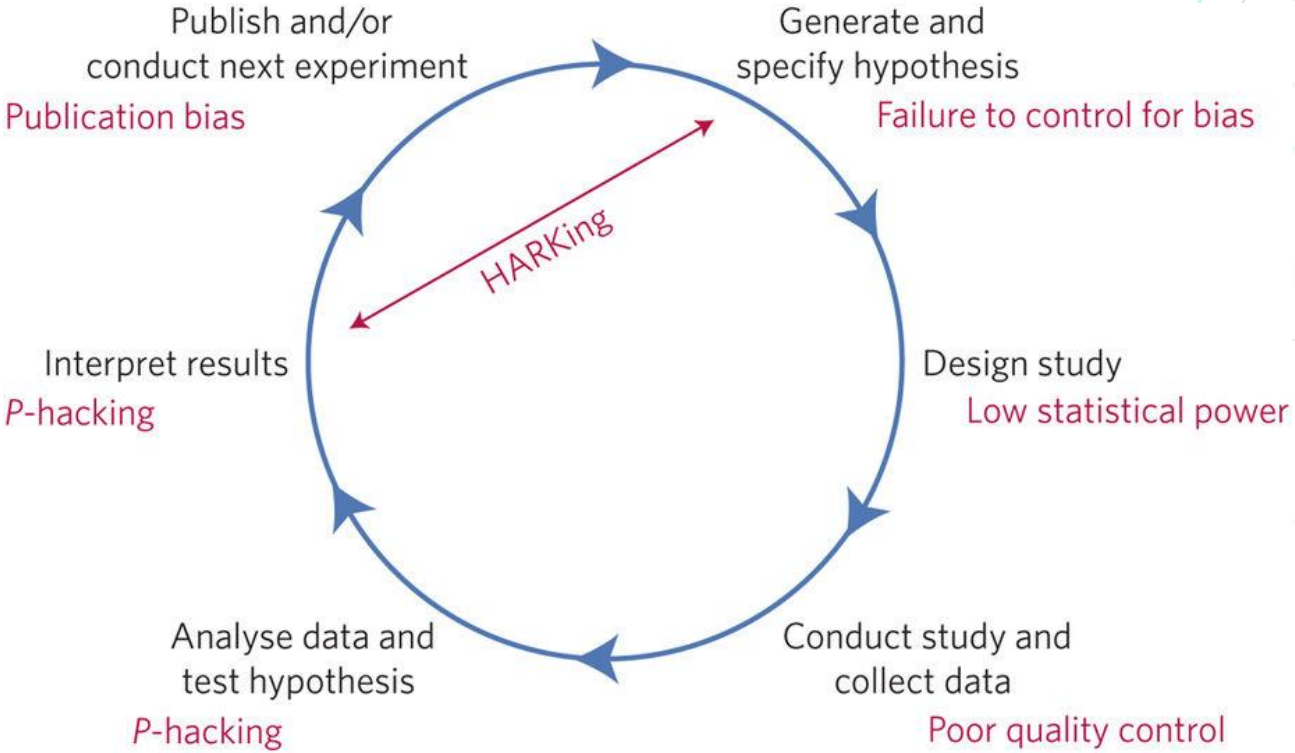
Power failure: why small sample size undermines the reliability of neuroscience

Katherine S. Button[1,2], John P. A. Ioannidis[3], Claire Mokrysz[1], Brian A. Nosek[4], Jonathan Flint[5], Emma S. J. Robinson[6] and Marcus R. Munafò[1]

Causes

- Lack of transparency
- Poor reporting of methods
- Lack of sharing of data/code
- Lack of reproduction/replication studies
- Publication bias towards reporting of positive results
- Questionable research practices

Threats to reproducible science



"Manifesto for Reproducible Science", Munafo et al., 2017

Funders are taking note

2020 European Commission Scoping Report* recommended dedicated **funding lines**, testing and scaling of **interventions**, **capacity-building**, alignment of **policies**

- 2022 EC Horizon Europe call for Research and Innovation Projects on the theme "**Increasing the reproducibility of scientific results**"
  - **3 projects** funded for total **~6m Euros** from EC and UKRI

siris TIER2 iRISE

TIER2

* European Commission, Directorate-General for Research and Innovation, Baker, L., Cristea, I., Errington, T., et al., *Reproducibility of scientific results in the EU : scoping report*, Lusoli, W. (editor), Publications Office, 2020, **https://data.europa.eu/doi/10.2777/341654**

Strategic priorities: The TIER2 approach

Research Ideas and Outcomes 8: e98457
doi: 10.3897/rio.8.e98457

OPEN ACCESS

Grant Proposal

TIER2: enhancing Trust, Integrity and Efficiency in Research through next-level Reproducibility

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Reviewable v 1

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Ross-Hellauer T et al. (2022) TIER2: enhancing Trust, Integrity and Efficiency in Research through next-level Reproducibility. Research Ideas and Outcomes 8: e98457. https://doi.org/10.3897/rio.8.e98457

5 key principles

1. Reproducibility is an opportunity, not a crisis;
2. Epistemic diversity (variation across modes of knowledge production and socio-technical contexts) must be centred;
3. Evidence must be systematised for informed policy across contexts;
4. Action must be targeted holistically to boost capacity at all levels.
5. Emphasize inclusion to minimize unintended consequences and maximize equitable transition

The solution: How will TIER2 increase reproducibility?

Create conceptual frameworks for assessing the state of reproducibility across scientific domains and contexts

Co-create reproducibility-related tools and interventions for different disciplinary contexts.

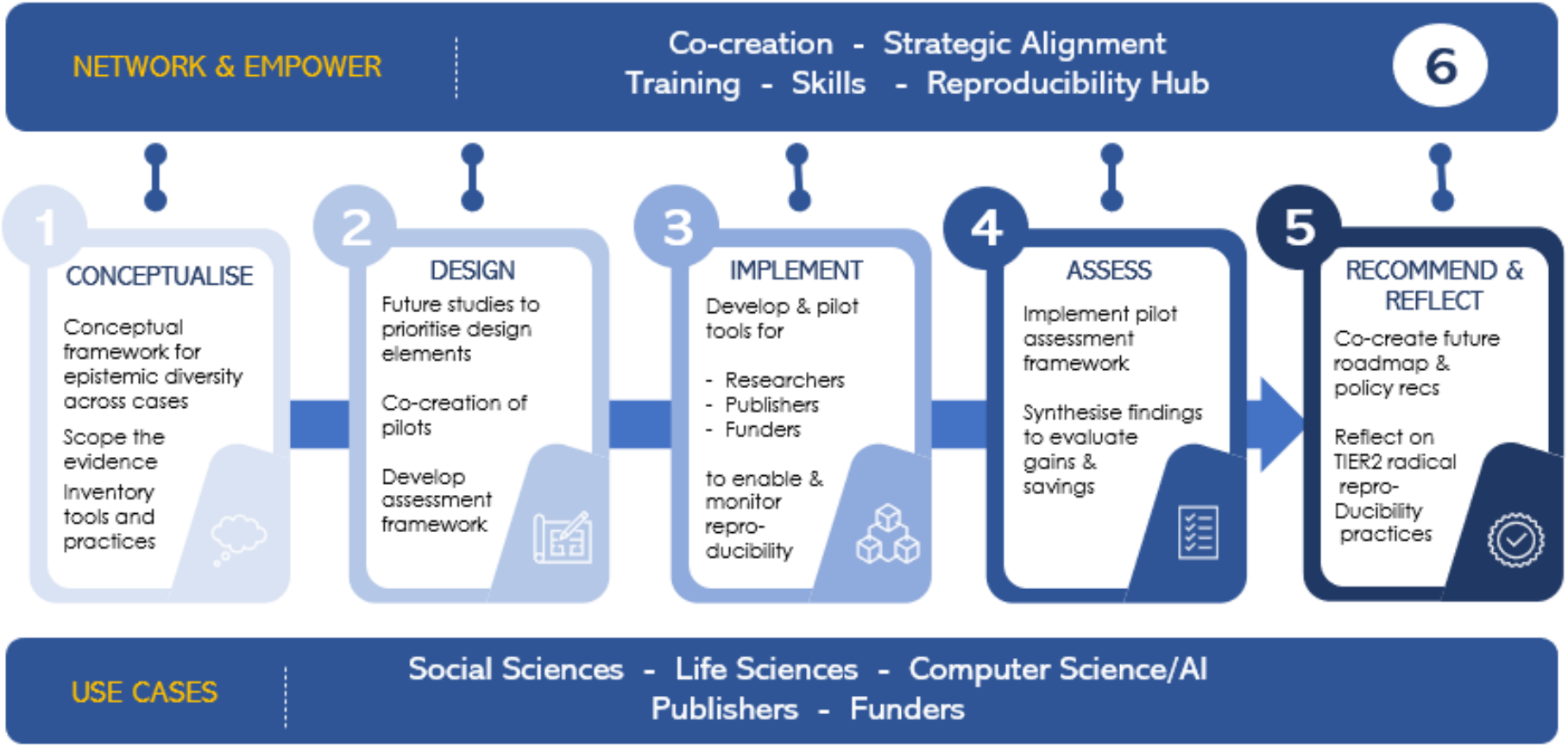
Build capacity to tackle reproducibility issues by linking and empowering individuals and networks.

Co-create a policy roadmap on relevant priorities for improvement of future reproducibility and science integrity.

TIER2 Partners

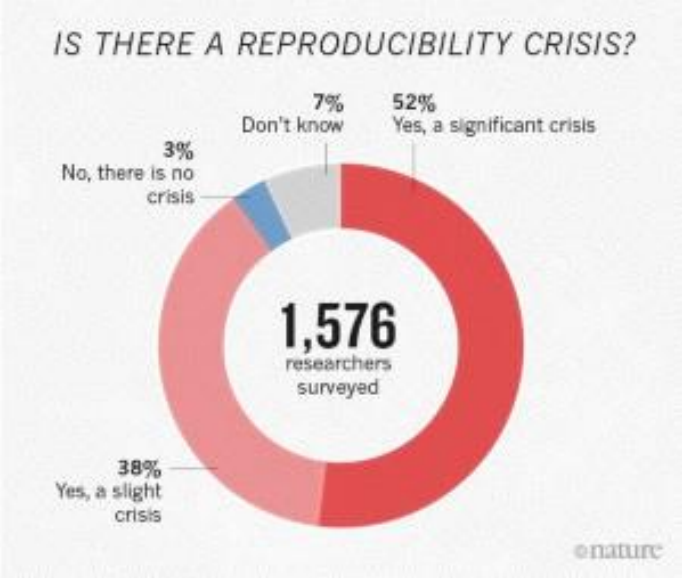
- Know-Center GmbH – Project Coordinator
- Athena Research Center
- Biomedical Research Center Fleming
- Stichting VUmc Amsterdam
- Aarhus University
- Pensoft Publishers
- Gesis Leibniz Institute for Social Sciences
- OpenAIRE
- Charité - Universitätsmedizin Berlin
- University of Oxford

TIER2 methodological steps

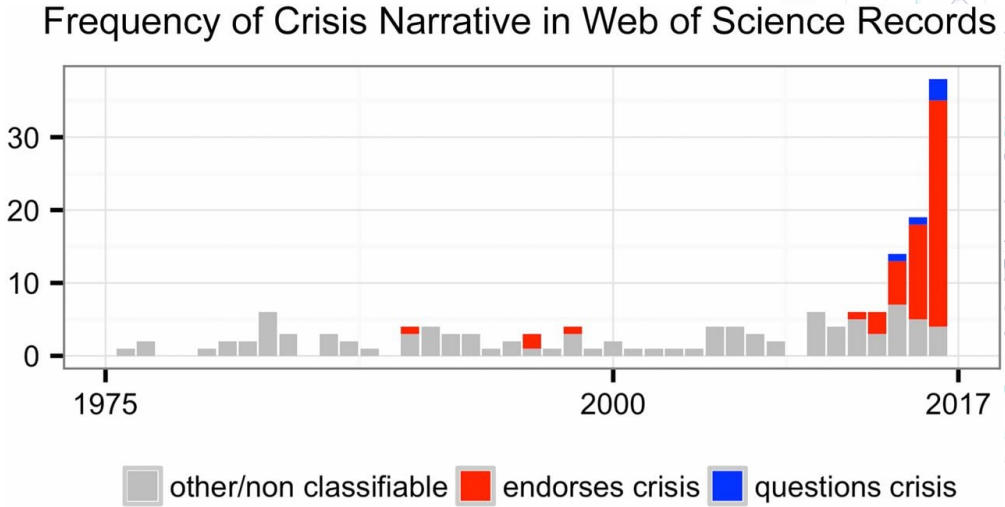


1. Frame reproducibility as a reformation, not a crisis

Research in crisis?

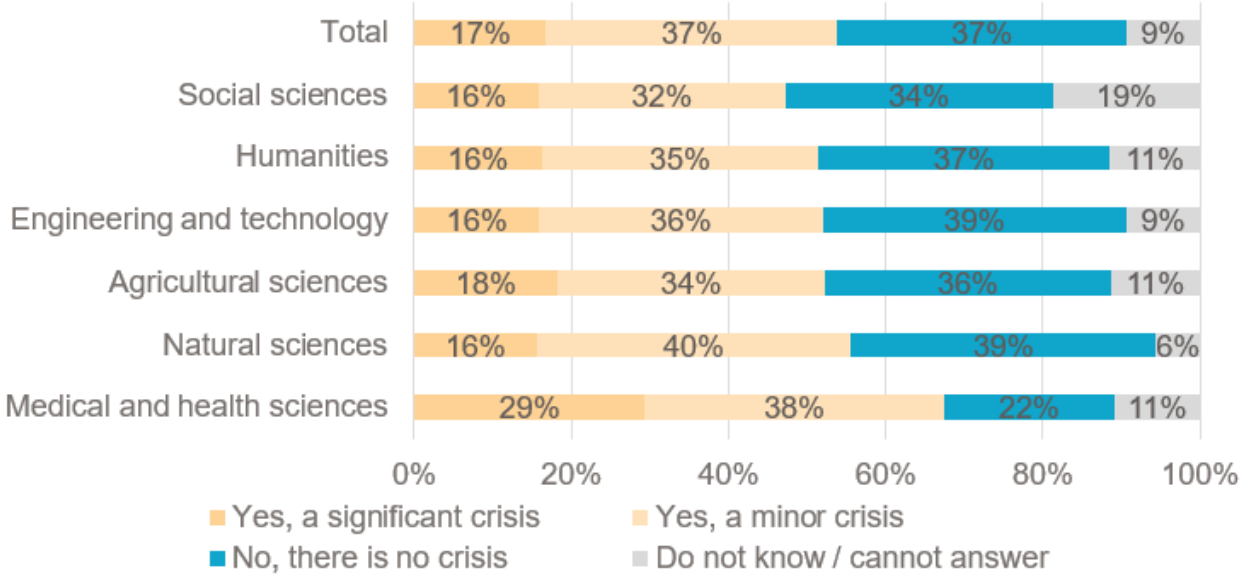


Baker, M. 1,500 scientists lift the lid on reproducibility. Nature 533, 452–454 (2016). https://doi.org/10.1038/533452a



Fanelli D. Is science really facing a reproducibility crisis, and do we need it to? Proc Natl Acad Sci USA. 2018;115(11):2628–2631. pmid:29531051

2022 – Less so?



European Commission, Directorate-General for Research and Innovation. 2022. Assessing the reproducibility of research results in EU Framework Programmes for Research final report. https://data.europa.eu/doi/10.2777/186782

An opportunity not a crisis?

“Rather than viewing the current debate around the reproducibility and replicability of research findings as a “crisis”, it is more constructive in our view to frame it as an opportunity to reflect on which aspects of relevant working practices continue to be effective, which can be improved, and which new ways of working can beneficially be introduced to the research ecosystem.”

Munafò, M.R., Chambers, C., Collins, A. et al. The reproducibility debate is an opportunity, not a crisis. BMC Res Notes 15, 43 (2022). https://doi.org/10.1186/s13104-022-05942-3

2. Centre epistemic diversity.

Forms of reproducibility across research contexts

- Discussion on reproducibility led by specific disciplines like medicine & psychology
- Yet, per Leonelli: “Reproducibility for data-intensive research comes in a variety of forms geared to specific features of the research environment”, e.g.,:
  - Assumed degree of control over research conditions
  - Dependence on statistics as inferential tool
  - Precision of the research goals
  - Dependence on researchers’ judgement”
- And what of non-data intensive research? (Open question)

Leonelli, S. (2018), "Rethinking Reproducibility as a Criterion for Research Quality", https://doi.org/10.1108/S0743-41542018000036B009

Leonelli - Sources of epistemic diversity relevant to Open Science*

MATERIAL
- Target objects
- Materials

CONCEPTUAL

METHODOLOGICAL
- Standards
- Methods

INFRASTRACTURAL (capacity res. environment)
- Funding
- Infrastructures
- ICT and other technologies
- Mobility and transports

SOCIO-CULTURAL
- System of research assessment (locally and nationally)
- Legal and ethical accountability
- Geo-political location
- Language
- Values and goals
- Characteristics of researchers (gender, class, ethnicity, age, physical ability..)

INSTITUTIONAL
- Career stage and power dynamics
- Institutional and administrative support
- Field of study and related norms / venues for publishing and exchange
- Intellectual property regimes

Leonelli S. 2021. Open Science and Epistemic Diversity: Friends or Foes? DOI: 10.1017/psa.2022.45

In TIER2 …

- Investigation of relevance and feasibility of reproducibility across modes of knowledge production
  - Theoretical investigation led by Jesper Schneider, Aarhus University
  - *Ulpts, S., & Schneider, J. W. (2023). Knowledge Production Modes: The Relevance and Feasibility of 'Reproducibility'.* https://doi.org/10.31222/osf.io/ujnd9
  - "Future studies" investigations with researchers, publishers and funders to investigate views of what is necessary to increase reproducibility
- Pilots of new tools in various contexts (social, life, computer sciences + funders and publishers)

3. Systematize evidence for informed policy across contexts

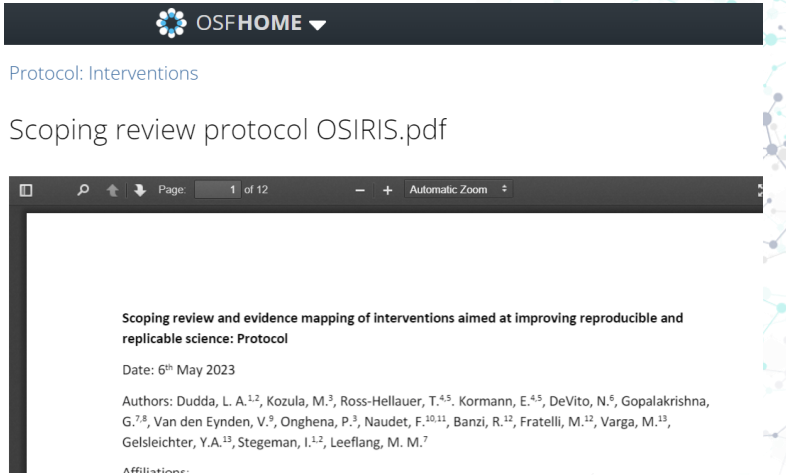
Q. How do reproducibility interventions affect outcomes across contexts?

- Currently, much of the debate and evidence comes from a relatively narrow slice of the research spectrum
- Need to acknowledge that across contexts (e.g., disciplinary, geographic, demographic), communities face different problems and are at different levels of readiness
- Even within research areas, not all interventions equally effective
  - E.g., Vazire (2018) suggests that although increased reproducibility may raise productivity in general, productivity may be reduced in some subfields
- What generalities can we find in common issues across disciplines, and what specificities?

Vazire, S. 2018. “Implications of the Credibility Revolution for Productivity, Creativity, & Progress.” Perspectives on Psychological Science 13 (4): 411–17. https://doi.org/10.1177/1745691617751884.

Scoping the evidence in TIER2

- Scoping review and evidence mapping of interventions aimed at improving reproducible and replicable science
- All disciplines and contexts (incl. publishing, funding)
- Study underway (collaboration with OSIRIS project)
- Currently reviewing >25,000 records
- Protocol online: https://osf.io/rhe9k



TIER2 pilots on new tools and interventions *(under development!)

Researchers

- **Reproducibility hub** (resources for awareness, training, checklists hosted via Embassy of Good Science)
- **Reproducible workflow tools**
  - "Schema" extension for Life Science
  - Methods Hub for computational social science
  - Tools for transparency in qualitative research

Funders

- **Reproducibility promotion plans** for funder policy development
- Reproducibility **monitoring dashboard** – indicators of levels of Open Science and reproducibility practices
- **Reproducibility management planning tool** (extension of Data Management Plan concept)

Publishers

- **Data Availability Statements** (intervention to improve clarity/efficacy of Data Availability Statements)
- Training/education on **workflows for editorial checks on data**

4. Work together to boost capacity at all levels

Elements of research culture change (from Nosek, 2019)

- Treat reproducibility as a “full stack” problem
- Joined-up approaches for coordinated change at all levels
- Building on the great strides already made
  - Reproducibility Networks
  - **Open** infras, e.g., OSF, EOSC
  - Research assessment reform (COARA)

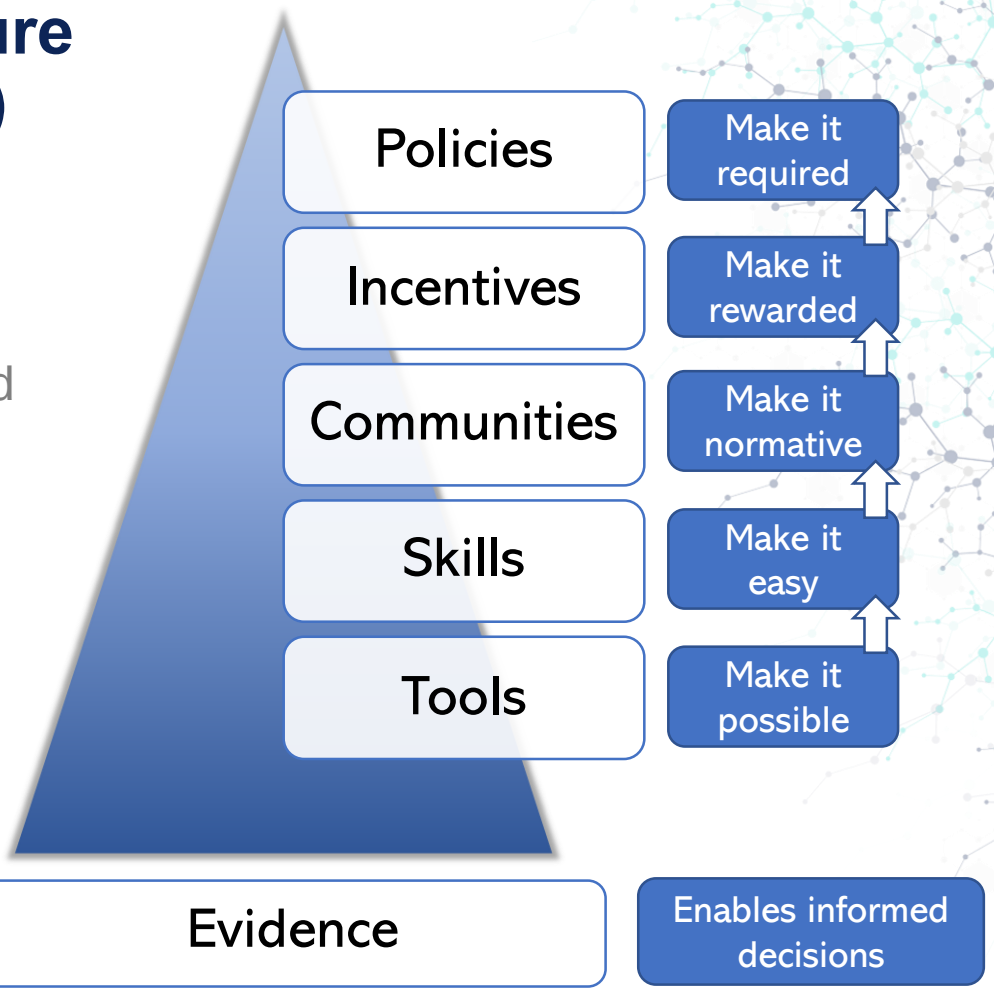


Figure adapted from CC BY figure in: Nosek, B. 2019. “Strategy for Culture Change.” 2019. https://www.cos.io/blog/strategy-for-culture-change.

TIER2 is well linked to, and empowers, other networks

Including:

- Reproducibility Networks
  - via several National RNs, incl UKRN, German Reproducibility Network
- Research Data Alliance (RDA)
  - via the FAIRsharing WG, OpenAIRE
- EOSC and other European Research Infrastructures
  - via OpenAIRE and FAIRsharing
- Center for Open Science (COS)
  - we share members between COS Board of Directors and TIER2 Advisory Board
- Publisher and Funder networks
- Fellow EC reproducibility projects iRISE & OSIRIS

RN

RDA

RESEARCH DATA ALLIANCE

eosc

COS

CENTER FOR OPEN SCIENCE

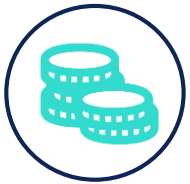
TIER2

Collaboration with sister projects

- Evidence scoping (interventions, outcomes)
- Assessment/monitoring indicators
- Events, community-building
- Self-reflection on own practices
- Investigation of new interventions

The TIER2 Award for establishing a Reproducibility Network

- The aim is to foster the creation of three new Reproducibility Networks (RNs) in “Widening participation” countries.

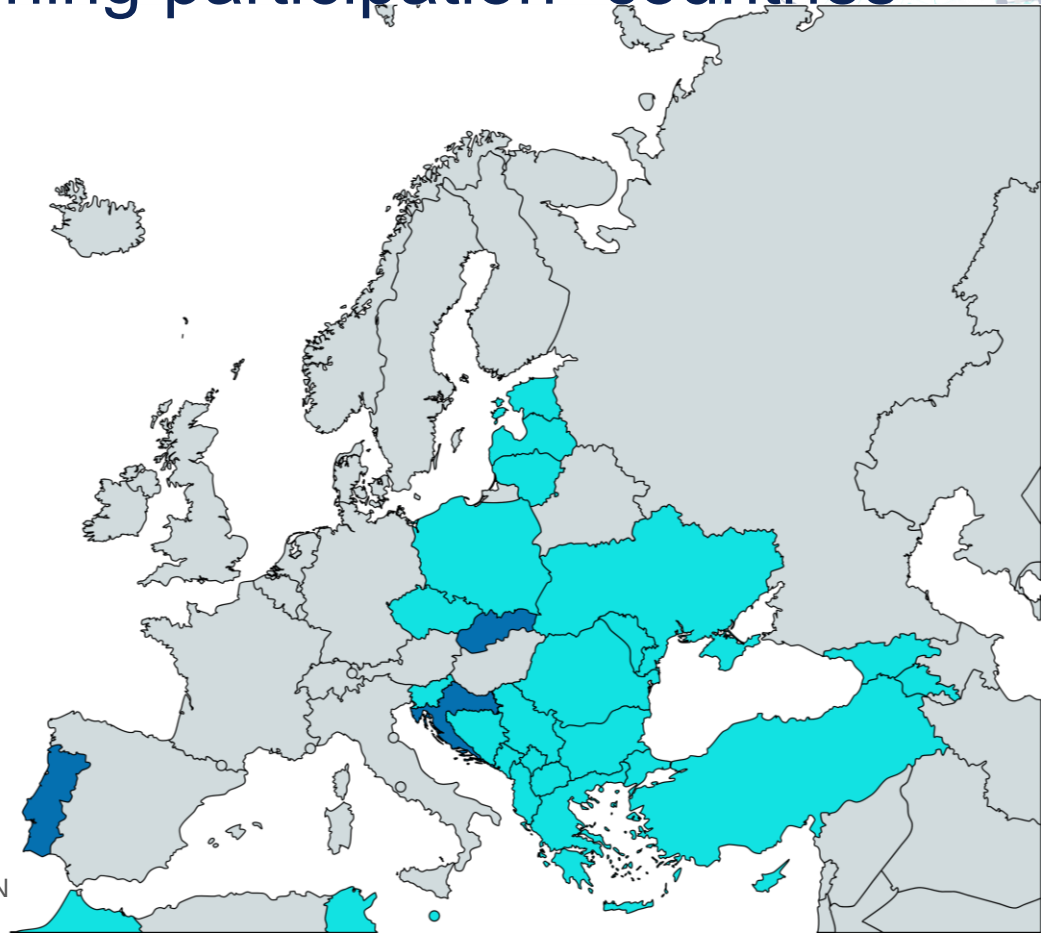


- Three selected consortia will receive an award of €5000 each to organize an initial establishment meeting

The TIER2 Award - “Widening participation” countries

“Widening participation” countries

- EU member states
- Associated countries

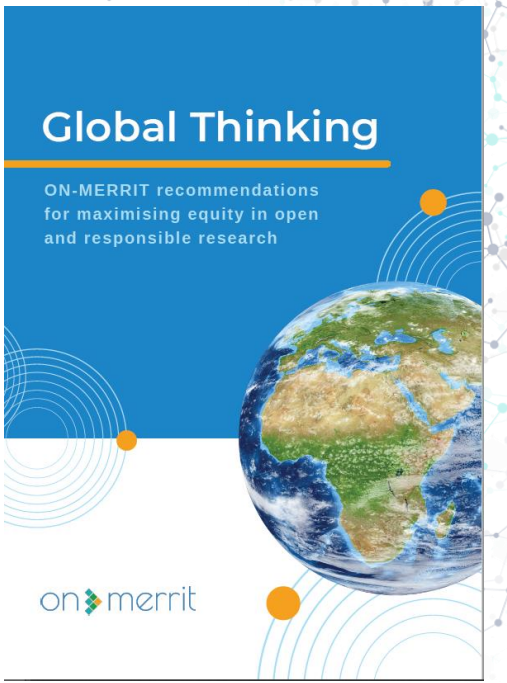



TIER2
Meet the Awardees
TIER2 Reproducibility Network Award Winners
Ukraine Consortium
Institute for Open Science & Innovation (INOSI)
OPTIMA Project Consortium
Lviv Polytechnic National University
Georgia Consortium
Tbilisi State Medical University
Tbilisi State University
Caucasus International University
Read more at: tier2-project.eu/news

5. Emphasize inclusion to minimize unintended consequences and maximize equitable transition

Avoiding unintended consequences

- Not all impacts will be positive, and trade-offs and unintended consequences are to be expected
- Need special attention on ways that variance in epistemic diversity alters what is desirable in terms of reproducibility
- Respect differences in levels of advancement in dealing with these issues across these contexts
- Ensure that policies reflect this diversity, and harness openness of infrastructures, tools, services, and training to move as a global community



Cole, Reichmann, Ross-Hellauer. (2022). Global Thinking. ON-MERRIT recommendations for maximising equity in open and responsible research. https://doi.org/10.5281/zenodo.6276753

In TIER2 …

- Developing open, collaborative solutions
- Collaborative Working Group across sister projects on DEI
- Working with newly established RNs in widening participation countries to address and minimise unintended consequences

Priorities for Reproducibility Reform

1. Frame reproducibility as a reformation

Ditch the 'crisis' narrative and reframe debate to emphasize the opportunities possible through a broad holistic movement towards reproducibility reformation

2. Centre epistemic diversity

Better understand the meanings, implications and conditions of/for reproducibility across disciplinary, methodological, geographic and stakeholder contexts

3. Systematize the evidence

Foster (systematic) experimentation across, between and within contexts to generate comparative findings, inform/cross-pollinate interventions, identify trade-offs

4. Collaborate to boost capacity

Network existing initiatives across dimensions of research to build capacities and harness network effects, especially by empowering the Reproducibility Networks

5. Minimize unintended consequences

Be alert to possible negative impacts and trade-offs, and work to maximize equitable transition, especially through global dialogue and open infrastructures/services

TIER

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Acknowledgements

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Slides from Tony Ross Hellauer & TIER2 Project

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Thank you!

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TIER2 Project

https://tier2-project.eu/