

Reproducibility for greater impact

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Open Science



“Open science is an approach based on open cooperative work and systematic sharing of knowledge and tools as early and widely as possible in the process”

European Commission

Open Access to publications

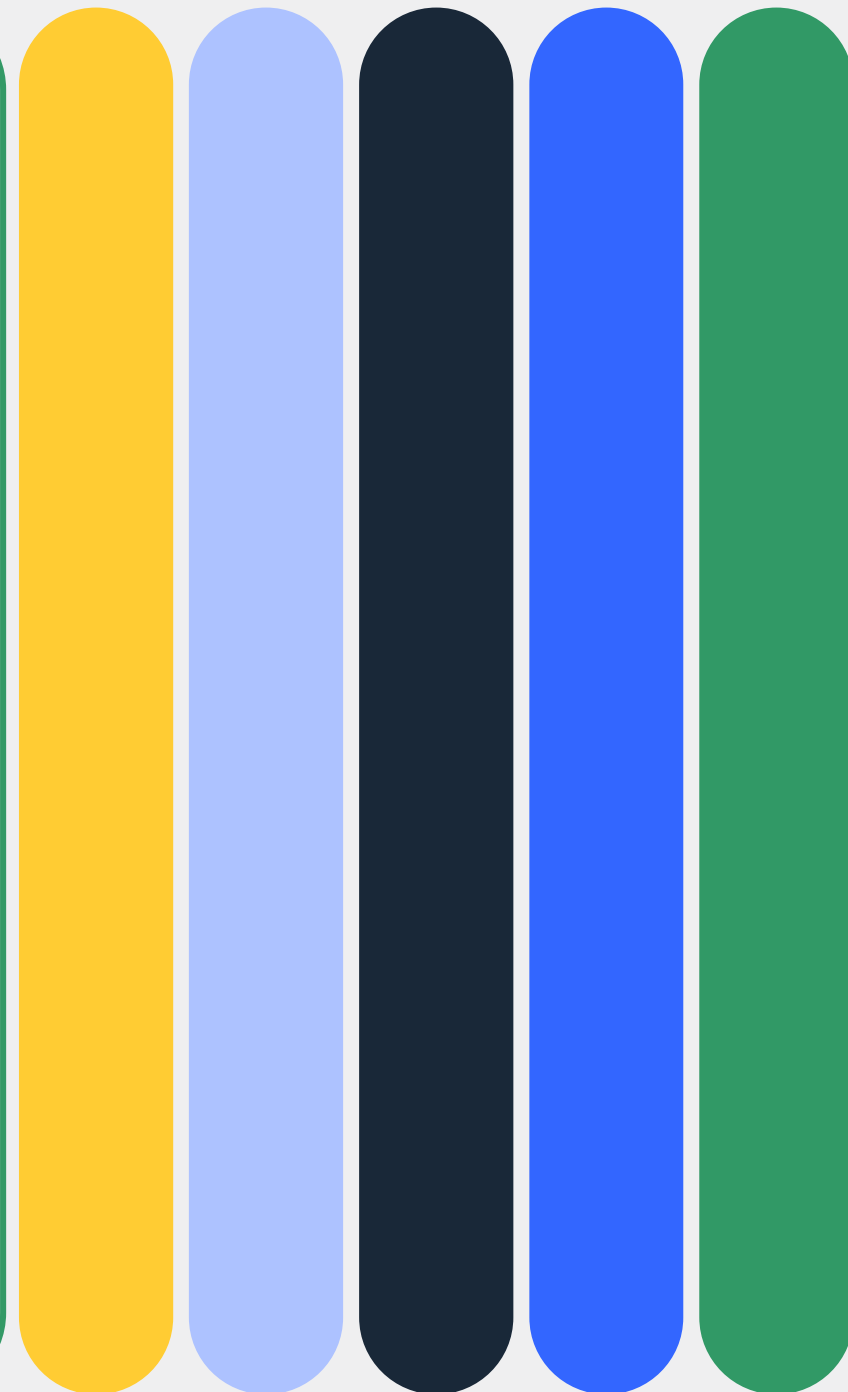
Responsible management of data (FAIR principles)

Open access to data 'as open as possible, as closed as necessary'

Information about outputs / tools / instruments to validate/re-use results and data

Digital /physical access of results to validate the conclusions

Reproducibility is a cornerstone of Horizon Europe's commitment to Open Science, aiming to ensure that the research results are reliable, transparent, and verifiable.



Findable

- Persistent identifier (e.g. DOI)
- Rich metadata
- Searchable and discoverable online

Accessible

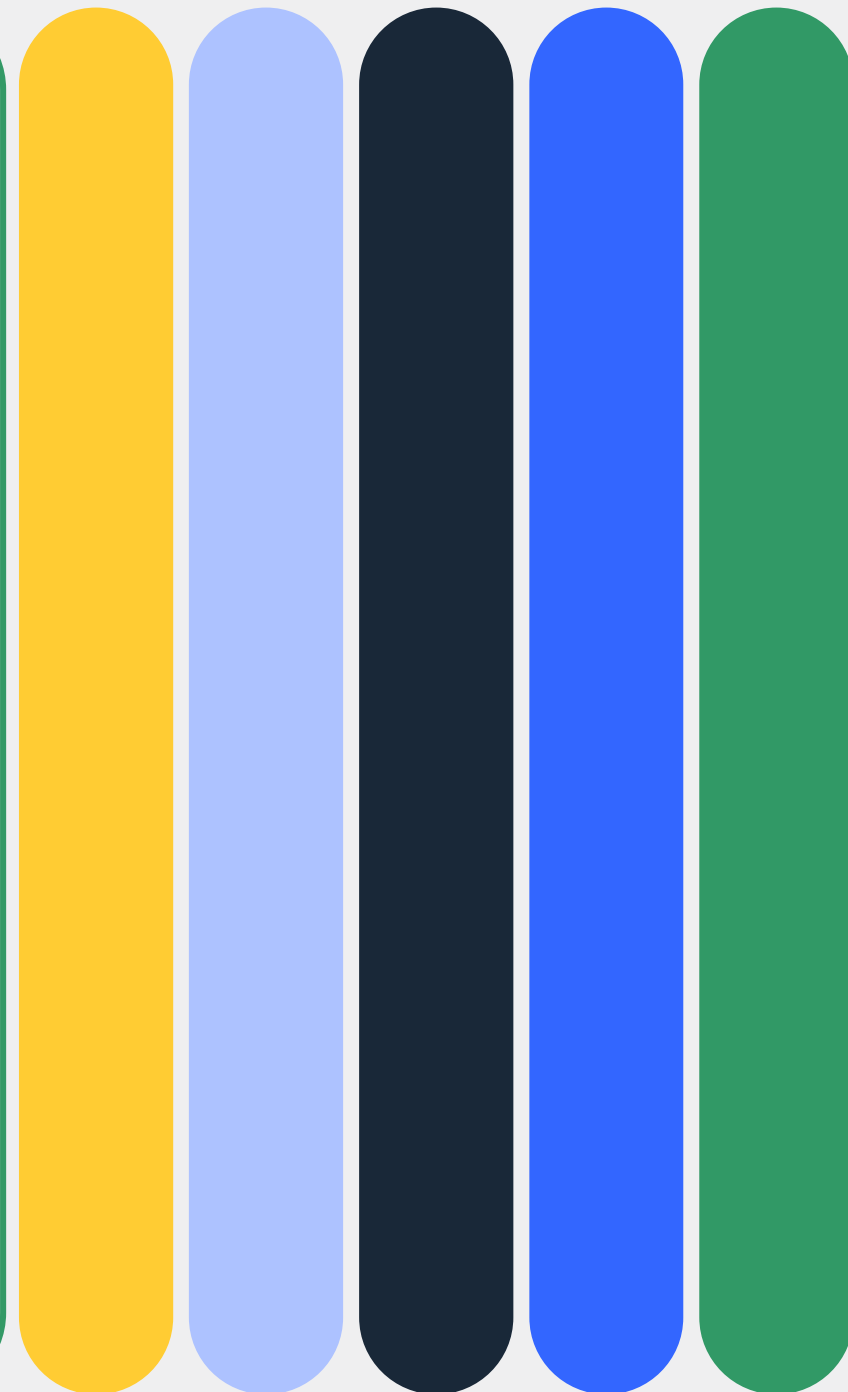
- Deposited on a trusted repository (e.g. Zenodo)
- Data can be restricted and still FAIR – “as open as possible, as closed as necessary”

Reusable

- Well documented (e.g. README files), including provenance and tools/instruments needed to reproduce the results
- Clear licence (e.g. CC BY 4.0, CC0)

Interoperable

- Open and/or standardised file formats

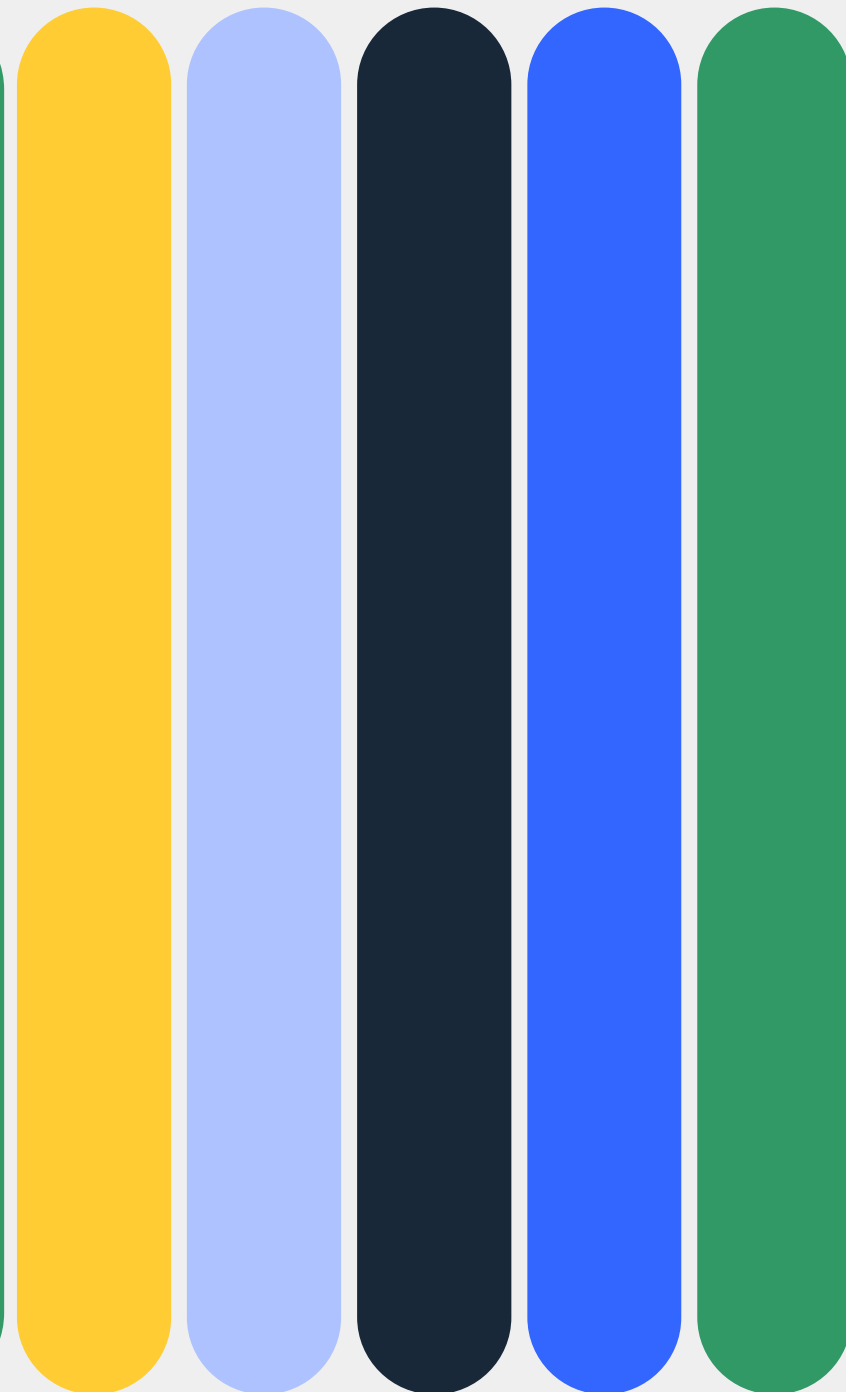


Key Aspects of Reproducibility in HORIZON EUROPE



- Open Science
- Funded Initiatives - **TIER2** building capacity, offering training, establishing national networks across Europe. **iRISE** – to improve the reproducibility – better methodologies
- The EU focuses on a "**continuum**" of reproducibility, including reproduction (using original data/code) and replication (using new data).
- Focus Areas - [Reproducibility Promotion Plans](#) -for funders (train and monitor the quality of research)
- **Research Integrity** – looking for causes of irreproducibility

These efforts, part of the [Horizon WIDERA work programme](#) and others, foster a culture of transparency and trust in scientific results.

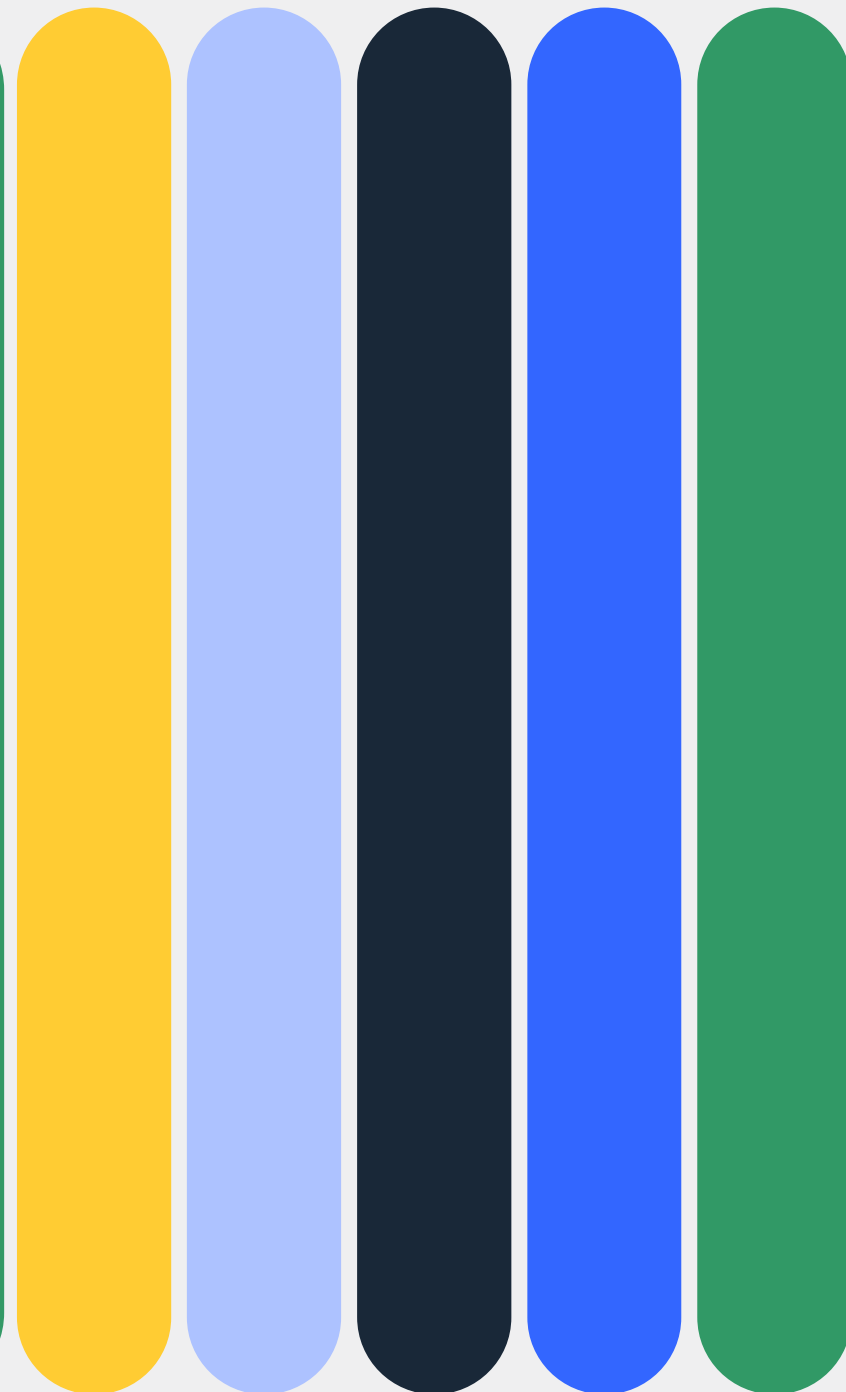


OS enables good science - instead of just more science
OS boosts trust in science, rather than undermining it



Without reproducibility, science turns into a collection of interesting stories.
With it, science becomes a dependable way of understanding how the world actually works.

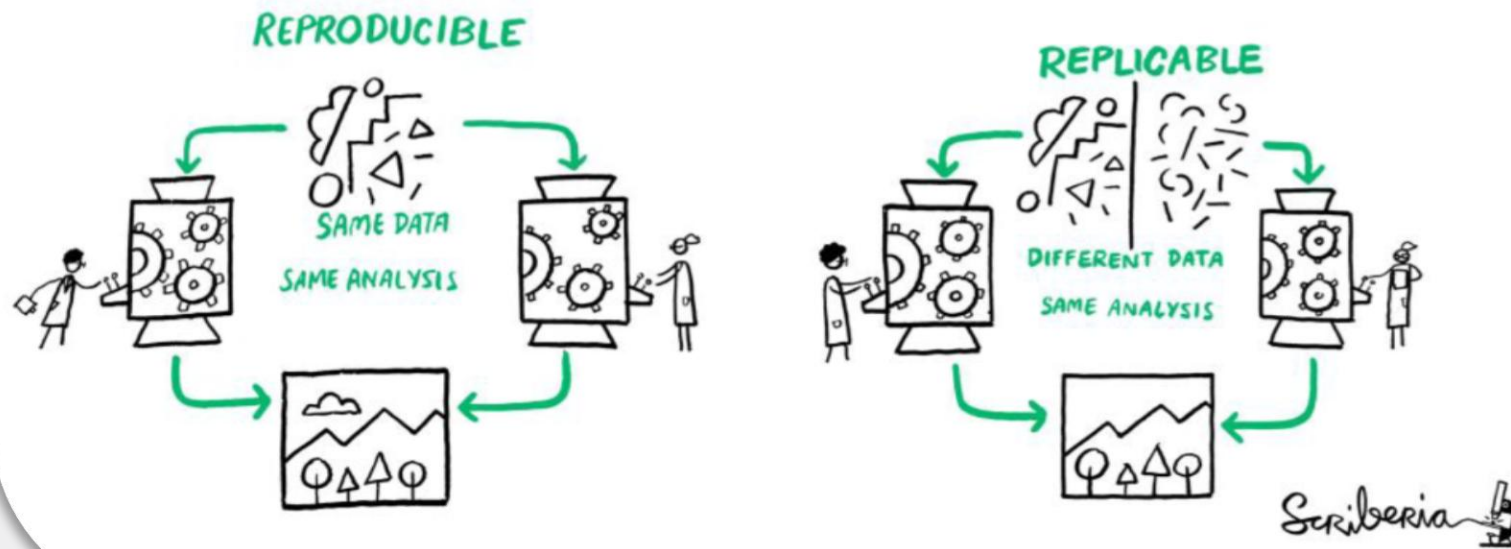
The reproducibility of results has value both as a mechanism to ensure good science based on truthful claims and as a driver of further discovery and innovation.



DEFINITIONS

Reproducibility refers to the possibility for the scientific community to obtain the same results as the originators of some specific scientific findings

Reproducibility as a continuum based on three main research processes:
reproduction, replication, and re-use.





REUSE

Re-use the results beyond the original research context, both within and outside the original scientific discipline (e.g., for innovation, transfer, and transdisciplinary research).

It depends directly on the practical availability of the data and the methods and protocols developed in the original research.

Reuse of data created by others offers:

- significant benefits for research
- economic growth (return on investment)
- increased transparency
- **enhanced integrity** and reproducibility
- greater socio-economic efficiency in science.

To avoid useless and costly repetition, to maximise return on investment in R&D&I, to prevent the propagation of mistakes, and to facilitate the translation of results into innovations



Research integrity is closely related to reproducibility

Research integrity (RI) refers to the application of good research management practices, the truthfulness of results (including reproducibility), the behaviour of individual scientists, and the ethical principles of science and society.

Why is reproducibility important for RI:

- It safeguards research integrity by promoting **transparency**, accountability, and accuracy
- It verifies the reliability of findings, discourages **QRP**
- scientific claims are **based on robust evidence rather than novelty or prestige**
- It reinforces **trust** - science as a self-correcting and ethically responsible enterprise.



in ensuring the quality of research, reflected in the design, the methodology, the analysis and the use of resources.

Reliability

Respect

for colleagues, research participants, society, ecosystems, cultural heritage and the environment.

Four Core Principles

of Research Integrity

in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, full and unbiased way.

Honesty

Accountability

for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts.

TRANSPARENCY

(Full documentation of the research process increases reproducibility)

To increase reproducibility, the following elements are of specific importance:

- the integrity of datasets;
- the availability of data and the transparency of data collection methods (what was not reported, what was not used, negative results, why);
- the coherence of the approach (pre-registration of method/protocol);
- the analysis plan, the methodology, and the tools of analysis;
- and verification (both to validate and to check for mistakes in data, methods, code, and results)

Transparency reduces the need for trust

QRP

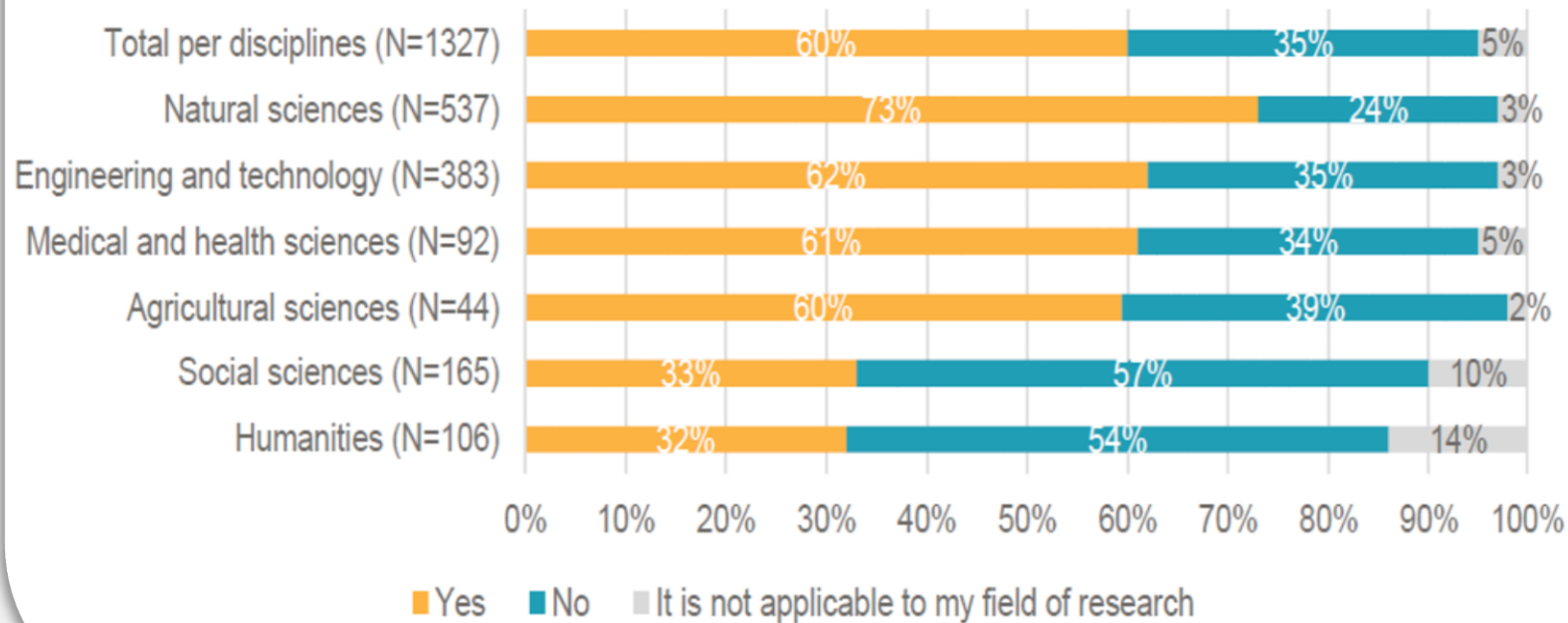
Barriers to reproducibility

- Selective and incomplete reporting of results, outcomes and data
- Protocols, computer code, or reagent information are insufficient or not available from the original lab
- Raw data is unavailable
- **Pressure to publish immature research**
- **Insufficient peer review** of published research, **no peer review** of data
- Lack of recognition for data-related work (data manipulation, data stewardship, data software skills)
- **Lack of time and motivation to replicate in 'competitive science.'**
- **Col** - financial, political, and other interests in the results (biasing or directly interfering with the research process)
- the lack of training to learn how to implement reproducibility practices

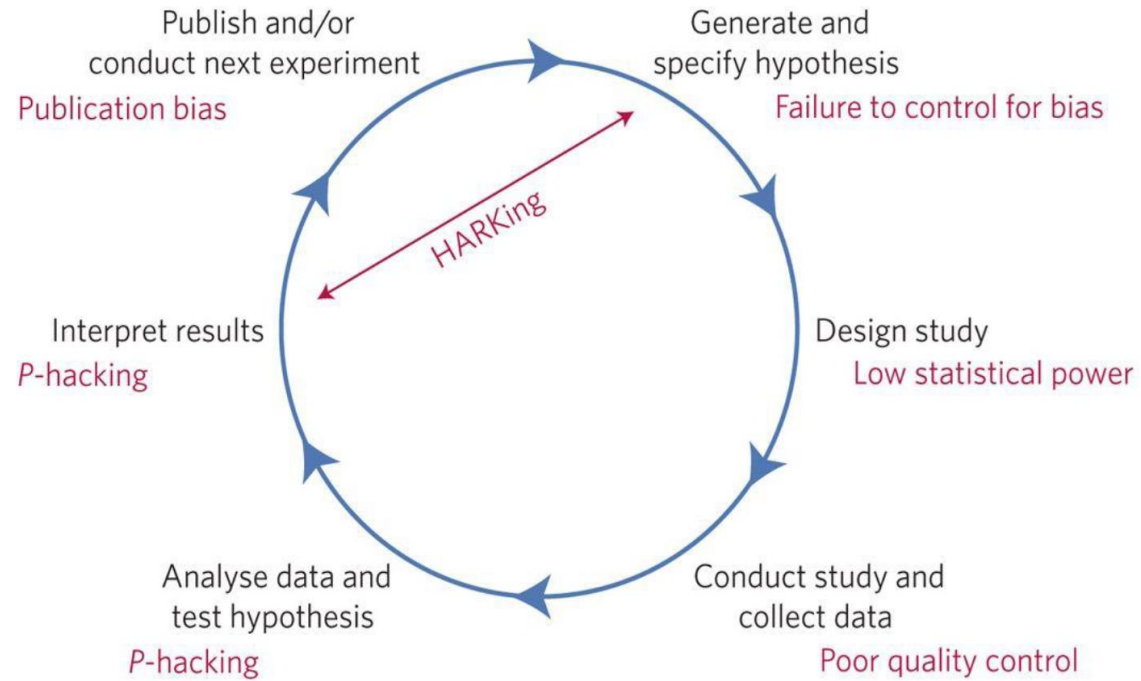
Funding and publishing replication studies acts as a **behavioral safeguard**, encouraging honest methods, careful statistics, and full reporting from the start.

H2020

Attempts to reproduce/replicate the research of others by researchers in the last five years



Reproducibility concerns the full spectrum of the research process:
the design, the methods, the results, the interpretation of results and their dissemination



HARKing = Hypothesizing After the Results are Known

P-hacking = manipulating data analysis until statistically significant results

Replication verifies truth, not prestige.

When replication is valued, findings stand because they are *correct*, not because they were published in a high-impact journal or produced by a famous lab.

Low reproducibility affects the validity of scientific findings,
hinders innovation and reduces trust in science.



Funding practices and policies

- Set specific **grant requirements**;
- Set clear guidelines to **encourage data sharing**;
- Expand the perception of integrity (methodology - to avoid cognitive biases);
- Set up schemes for certification of data reproducibility
- **Provide dedicated funding for the reproduction/replication of studies**;

Career and promotion

- Make rewards less focused on the number of high-impact publications, and more focused on methodological rigour, sharing of results, quality of reports, and impact of research;
- In the researcher's assessment, **valorise data re-use**;
- Create career incentives (credit and recognition) for data-management.

Training and careers

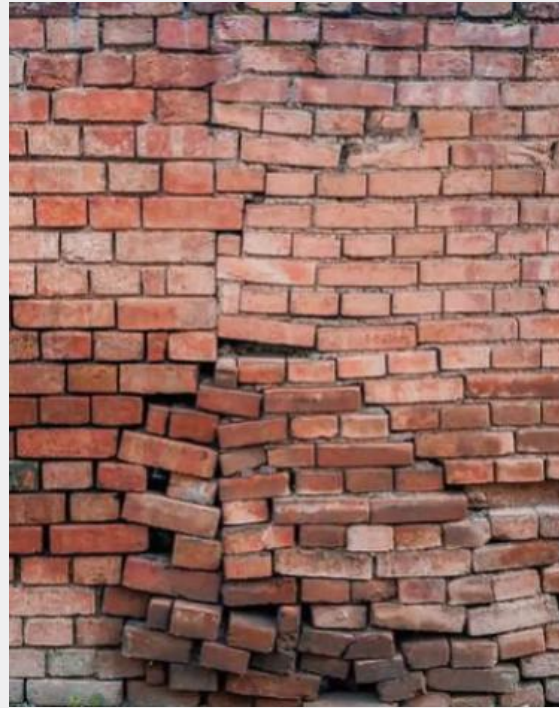
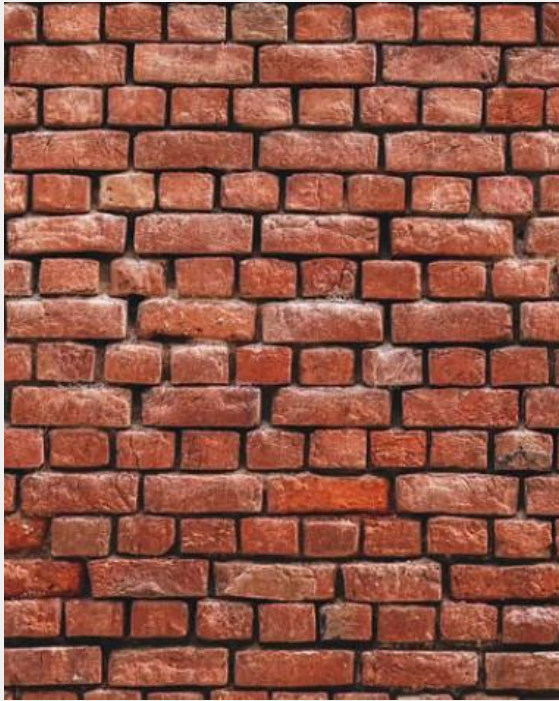
- Provide accredited training on integrity, basic statistics principles/methods, publication process, reproducibility culture, etc.;
- Provide training for peer-review panel chairs;

Publication

- **Support full OA publication;**
- Publishing checklists and guidelines by publishers
- More opportunities and mechanisms to present/publish negative results;
- Provide a publishing platform for all experimental outputs;
- Establish a quality assurance system for Open Access journals, **to avoid predatory journals** and non-peer-reviewed / low-quality journals.

Open data

- Enable liberal and fair re-use of project data;
- Encourage peer-review of data;
- **Extend the concept of 'open':** open data, open protocols, open software, open research tools, open computational workflows, ...;



Foster a reproducibility culture by providing incentives and rewards, and invest in research integrity.

RESEARCH

INNOVATION

COLLABORATION

Thank you for **your attention**

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