How open science norms improve scientific practices

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Primena slobodnog softvera i otvorenog hardvera PSSOH

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Basic idea informing Open Science is that

all knowledge should be freely shared and disseminated.

What is the public value of science?

A source for credible and legitimate evaluations

CREDIBLE: the quality of being believable or trustworthy

LEGITIMATE: in accordance with accepted standards or principles

Replication crisis

Reproducibility: the amount of consistency in results when scientific studies are repeated

"Demarcation criterion between science and non science" (Braude, 1979)

How it should be…

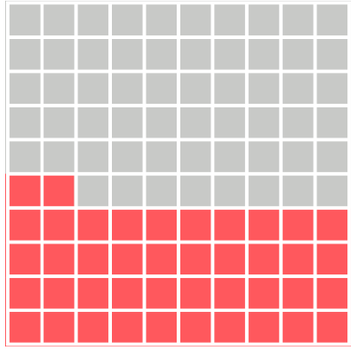
Important scientific findings are independently replicated, evidence of their robustness is accumulated.

If a finding is theoretically grounded, from a soundly designed study with enough statistical power, it will see the light of day.

Regardless of its status: positive or negative.

Science is self correcting: only replicable findings pass the test, their epistemological status becomes more sound.

However, in psychology…



Empirically analyzing empirical evidence

One of the central goals in any scientific endeavor is to understand causality. Experiments that seek to demonstrate a cause/effect relation most often manipulate the postulated causal factor. Aarts *et al.* describe the replication of 100 experiments reported in papers published in 2008 in three high-ranking psychology journals. Assessing whether the replication and the original experiment yielded the same result according to several criteria, they find that about one-third to one-half of the original findings were also observed in the replication study.

Physics

Pharmacy

- “In 2011, German researchers in the drug company Bayer found in an extensive survey that more than 75% of the published findings could not be validated.”

Medicine – cancer research

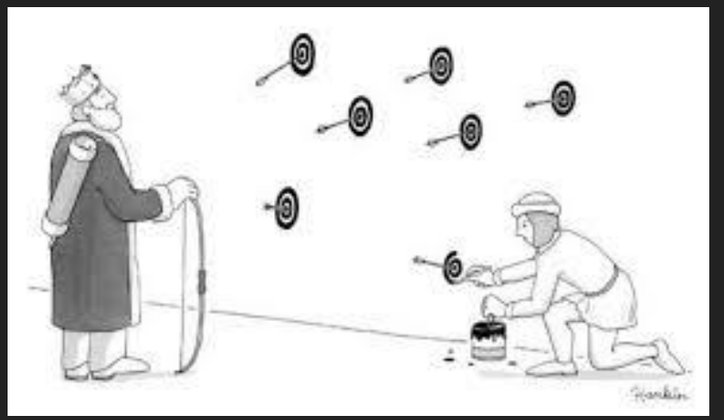
- “In 2012, scientists at the American drug company Amgen published the results of a study in which they selected 53 key papers deemed to be “landmark” studies and tried to reproduce them. Only 6 (11%) could be confirmed.”

Questionable research practices

Questionable Research Practices (QRP)

Anonymous survey- 6000 APA members:

- 74% **does not report on all DVs**, but only the ones that produce significant effects
- 71% **stops collecting data** when reach statistical significance
- 54% reports the unexpected results as if they were expected (tzv **HARK ing– Hypothesizing After Results are Known**)
- 50% **ommits negative findings** as pilot studies or states they are methodologicaly flawed, whilst **positive findings are excepted with no scrutiny**
- 1.7% admits to **fabricating data**



John, L. K., Loewenstein, G., & Prelec, D. (2012). Measuring the prevalence of questionable research practices with incentives for truth-telling. *Psychological Science, 23,* 524-532.

Questionable Research Practices (QRP)

- Searching for statistically significant results (p-hacking)
- Selective reporting of (dependent) variables
- Deciding whether to collect more data after looking to see whether the results will be significant
- Failing to disclose experimental conditions
- In a paper reporting selectively studies that worked - file-drawer effect
- Series of ”small" experiments low in statistical power---- illusion of robustness of the effect
- Continuing data collection over the planned sample size until statistical significance is reached ----ideo of increasing power

All QRPs more common in experimental then correlational studies.

Researchers are not solely responsible...

it was the system that rewarded flashy positive findings

and marginalized negative ones.

Where these patterns originate from?

Biases in publishing

Editorial: of 79 editors of high impact journals 94% claims they do not encourage replications (Madden, 1995)

Reviewer: 60% reviewers favour novel findings over replications – "waist of journal space" (Neuliep & Crandall, 1993)

Author: probability of submitting a positive finding 8 times higher than submitting a negative finding (Greenwald, 1975)

Where these patterns originate from?

Wrong incentives for science research

Competitiveness

Innovation favored over robustness of findings

”Null findings” devalued

Quantity favored over quality – “Publish or perish”

"You are completely free to carry out whatever research you want, so long as you come to these conclusions."

Good scientific practices

Three zones for change

Methods

Reporting and Dissemination

Incentives

Methods

Research transparency

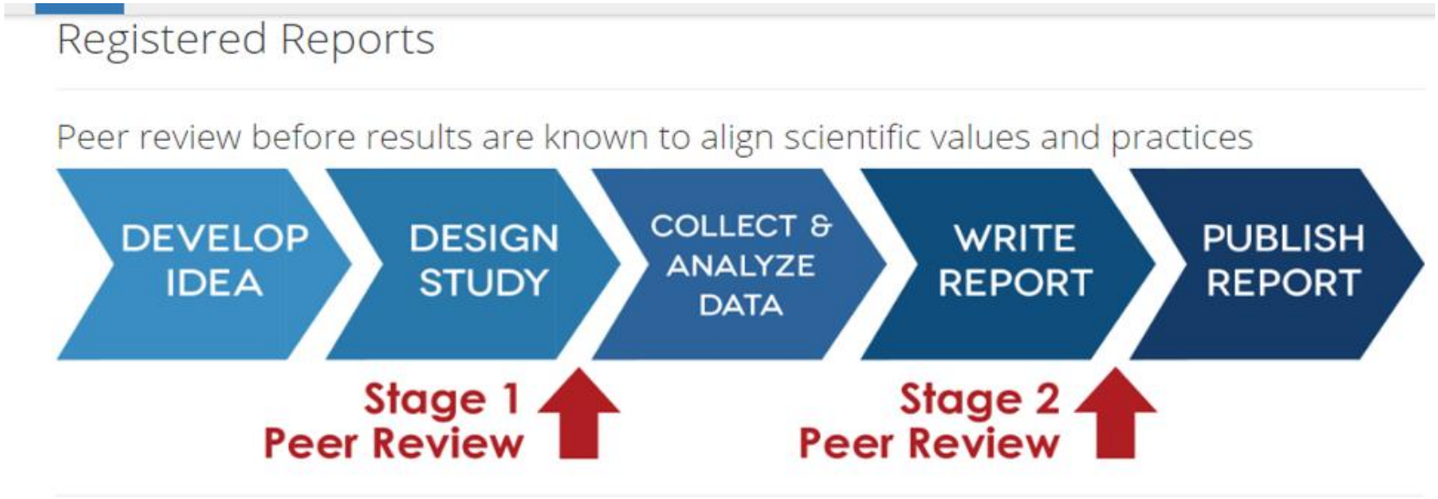
Production Transparency (Open design, Open materials)

Analytic Transparency (Open code)

Data sharing (Open data)

Research transparency

Pre-registration



Needs to be incentivized,

PREREGISTRATION CHALLENGE

If you have a project that is entering the planning or data collection phase, we'd like you to try out a preregistration. Through our **$1 Million Preregistration Challenge**, we're giving away $1,000 to 1,000 researchers who preregister their projects before they publish them. It's straightforward to complete and will really enhance your research output.

Research transparency

Open data

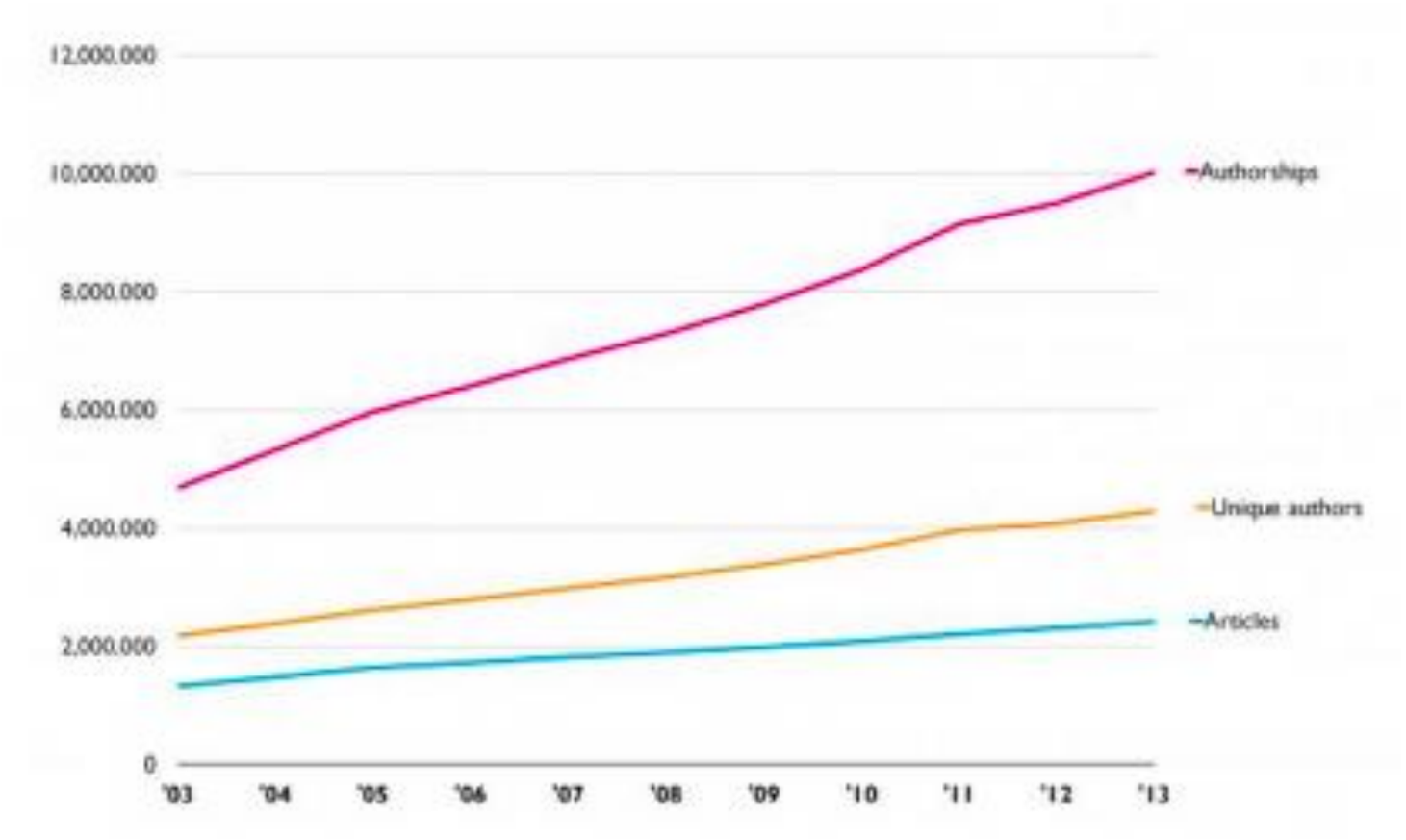
Publicly funded research, including the raw data, belongs to the public!

To the extent that researchers' evidence-based knowledge claims rely on data they themselves generated or collected, they should :

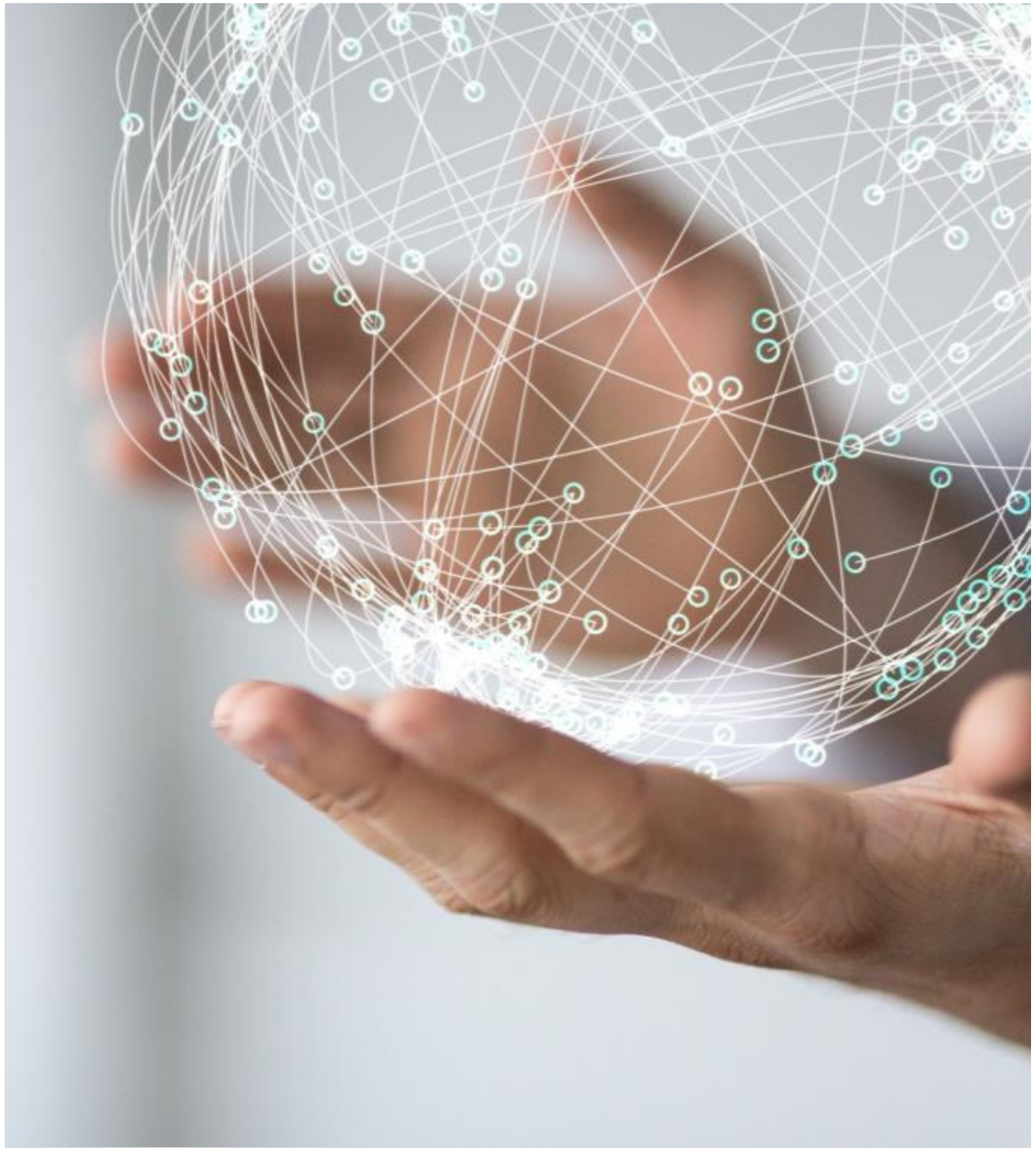
- provide access to those data
- or explain why they cannot.

Rise of collaborative research

Evolution of collaborative research



Source: Scopus database

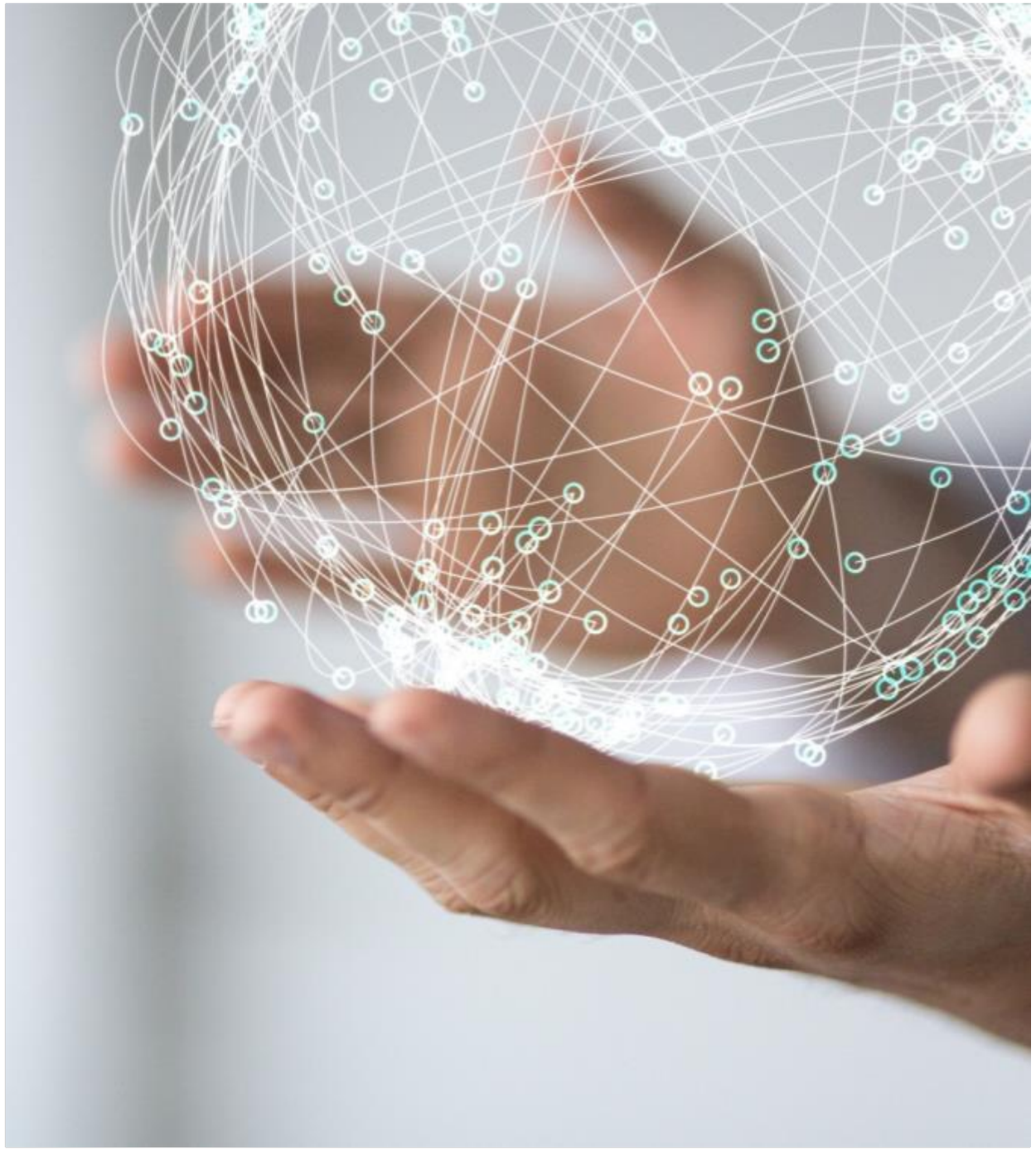


Best examples of collaborative research

CERN

CERN is the result of a collective effort of European countries to build the world's leading particle physics research center to address fundamental scientific questions about the structure of the Universe. CERN hosts the world's largest particle accelerator, a 27- kilometer long Hadron Collider that collides protons or lead ions at energies approaching the speed of light. CERN is one of Europe's first joint ventures, gathering 21 member states and over 600 institutes and universities around the world, which are presently using its facilities.

Around 10,000 visiting scientists from over 113 countries, which represent half of the world's particle physicists, come to CERN for their research. They represent 580 universities and over 85 nationalities. The construction and operation budget contributions are proportional to the GDP of each of the member states.

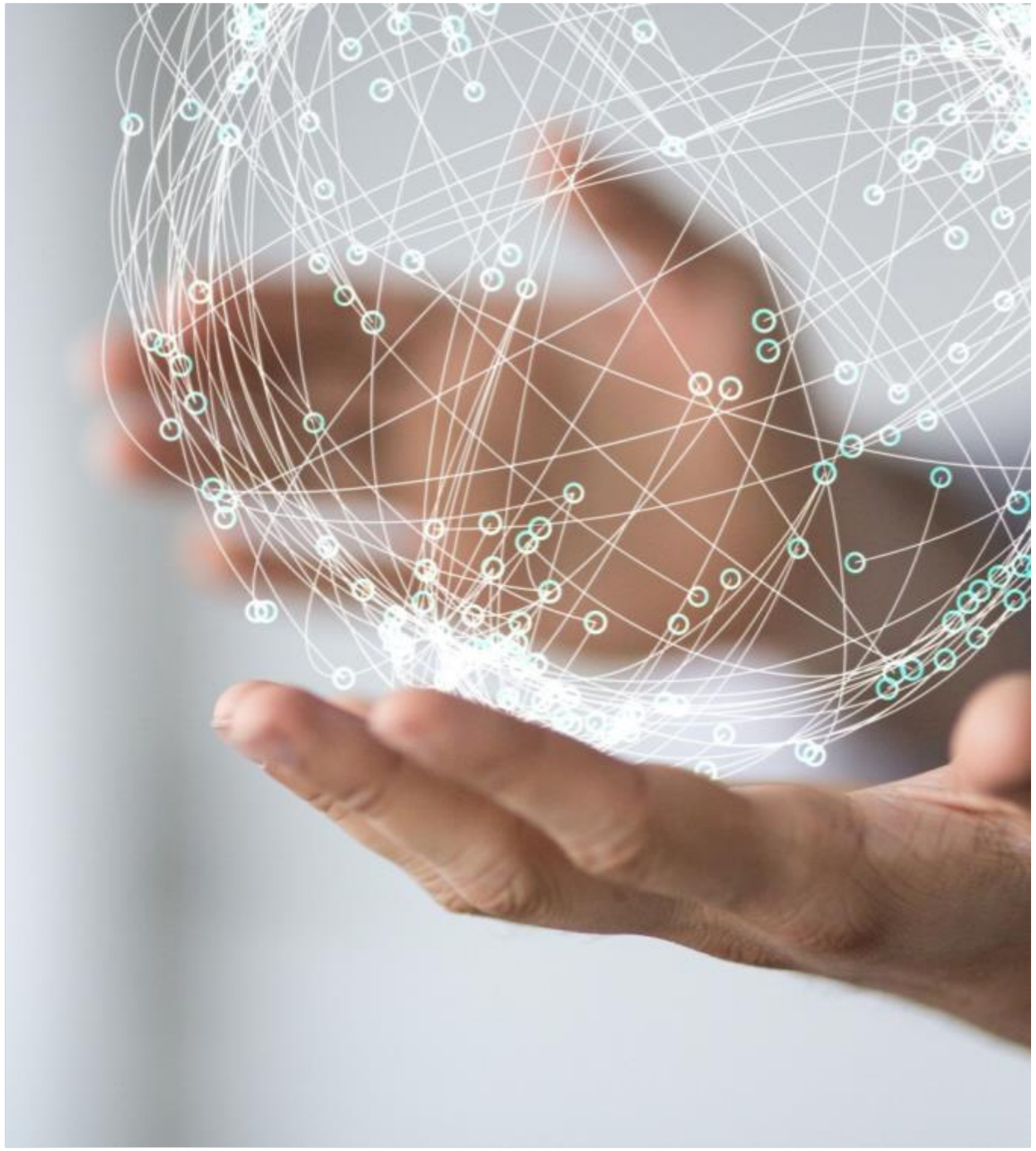


Best examples of collaborative research

HUMAN GENOME PROJECT

The efforts of several laboratories located in several countries to complete an initial sequencing of the human genome. Its goal is to determine the sequence of nucleotide base pairs that make up human DNA and to map all the genes of the human genome.

It remains the world's largest collaborative biological project. A large number of discoveries and publications have emerged from this project, due in part to the public availability of the data.



Best examples of collaborative research

Reproducibility project: Psychology

RESEARCH ARTICLE

PSYCHOLOGY

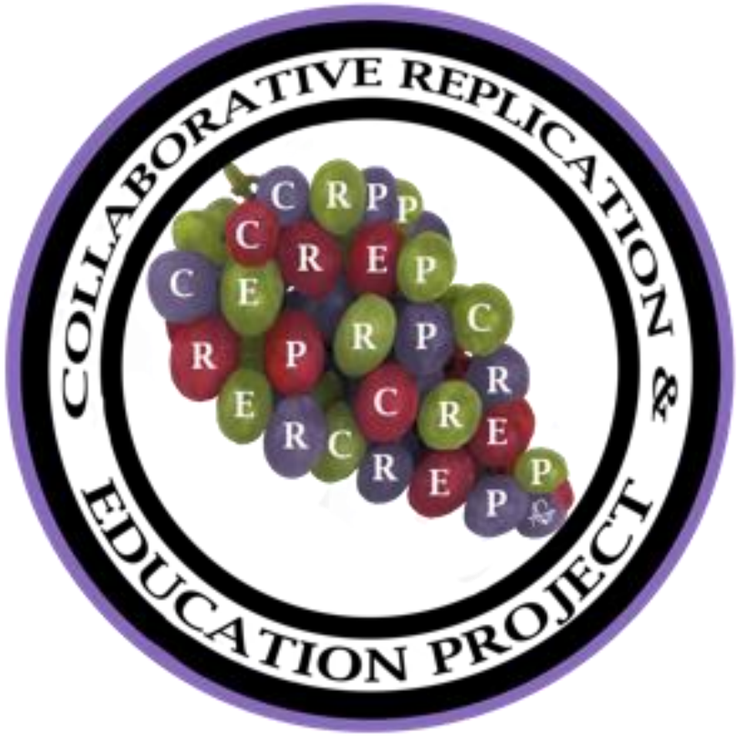
Estimating the reproducibility of psychological science

Open Science Collaboration*†

Reproducibility is a defining feature of science, but the extent to which it characterizes current research is unknown. We conducted replications of 100 experimental and correlational studies published in three psychology journals using high-powered designs and original materials when available. Replication effects were half the magnitude of original effects, representing a substantial decline. Ninety-seven percent of original studies had statistically significant results. Thirty-six percent of replications had statistically significant results; 47% of original effect sizes were in the 95% confidence interval of the replication effect size; 39% of effects were subjectively rated to have replicated the original result; and if no bias in original results is assumed, combining original and replication results left 68% with statistically significant effects. Correlational tests suggest that replication success was better predicted by the strength of original evidence than by characteristics of the original and replication teams.

More rigorous statistical and methodological training

- Collaborative Replications and Education Project - a crowdsourced replication project for undergraduate researchers.
- **Purpose:** Through student participation in large-scale replication efforts we aim to (1) facilitate student research training and (2) solidify research findings in psychological science.



The role of higher education institutions (HEIs)

To adopt and apply the open science and research principles of the OSR Initiative in their policies, operations and practices.

University level policies and guidelines need to address why openness of research is important and give instructions concerning open research methods and open access publishing.

At the same time, HEIs need to develop services and infrastructures to support open science, as well as to provide training for researchers related to data management planning and data preservation.

Open teaching resources (especially textbooks) present another challenge for OSR implementation. HEIs need to be supported by funding bodies and academic community to make this endeavor succesfull.

Reporting and Dissemination

Support for the movement

Under the EU research and innovation funding program Horizon 2020, open access to publications is now mandatory. The European Commission (EC) launched a pilot project to open up publicly funded research data available from 2013 onwards.

“We are moving into a world of open innovation and user innovation. Open Innovation, Open Science and Openness to the World are the three strategic priorities for EU research. “

Carlos Moedas (2015), Commissioner for Research, Science and Innovation at the EC

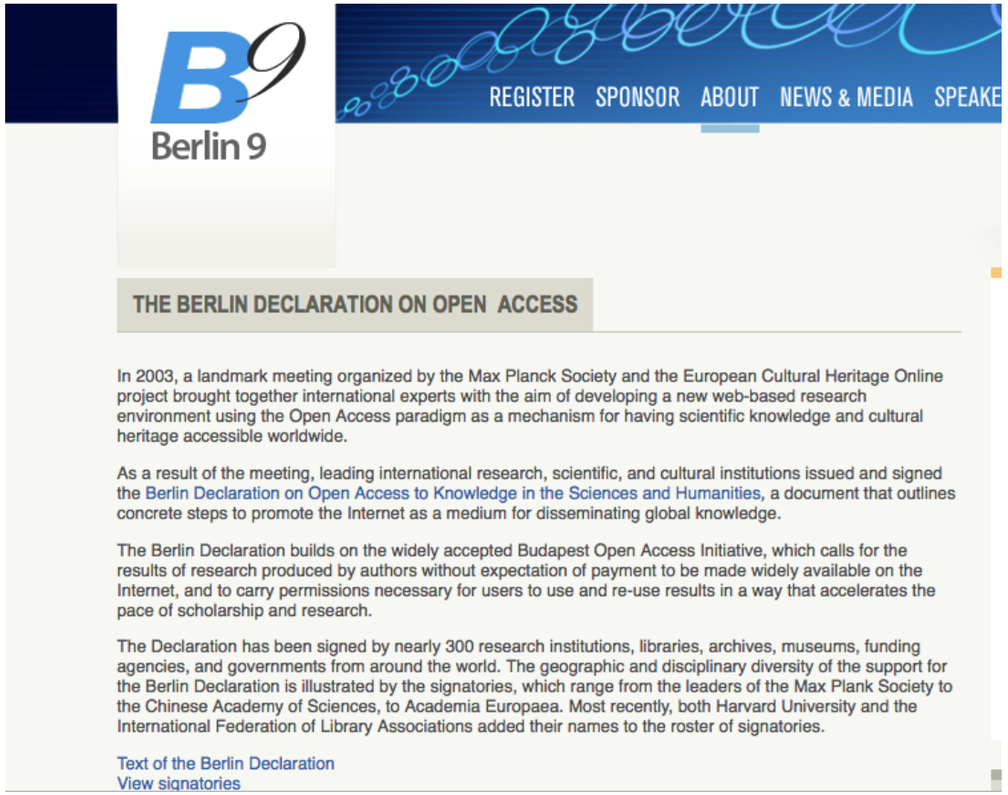
Initiatives for open science policies

Ten years on from the Budapest Open Access Initiative: setting the default to open

BOAI 10

Prologue: The Budapest Open Access Initiative after 10 years

http://www.budapestopenaccessinitiative.org/



http://www.berlin9.org/about/declaration/

SCIENTIFIC STANDARDS

Promoting an open research culture

Author guidelines for journals could help to promote transparency, openness, and reproducibility

By B. A. Nosek,* G. Alter, G. C. Banks, D. Borsboom, S. D. Bowman, S. J. Breckler, S. Buck, C. D. Chambers, G. Chin, G. Christensen, M. Contestabile, A. Dafoe, E. Eich, J. Freese, R. Glennerster, D. Goroff, D. P. Green, B. Hesse, M. Humphreys, J. Ishiyama, D. Karlan, A. Kraut, A. Lupia, P. Mabry, T. A. Madon, N. Malhotra, E. Mayo-Wilson, M. McNutt, E. Miguel, E. Levy Paluck, U. Simonsohn, C. Soderberg, B. A. Spellman, J. Turitto, G. VandenBos, S. Vazire, E. J. Wagenmakers, R. Wilson, T. Yarkoni

Transparency, openness, and reproducibility are readily recognized as

The role of academic journals

"Journals now understand that they have a strong role not only in the publication of science, but in determining what is said and how it's said."

Brian Nosek, 2016

The role of academic journals: TOP guidelines

Citation Standards Describes citation of data	**Data Transparency** Describes availability and sharing of data
Analytical Methods Transparency Describes analytical code accessibility	**Research Materials Transparency** Describes research materials accessibility
Design and Analysis Transparency Sets standards for research design disclosures	**Preregistration of Studies** Specification of study details before data collection
Preregistration of Analysis Plans Specification of analytical details before data collection	**Replication** Encourages publication of replication studies

ACROSS 3 TIERS

1 **DISCLOSURE:** the final research output must disclose if the work satisfies the standard

2 **REQUIREMENT:** the final research output must satisfy the standard

3 **VERIFICATION:** third party must verify that the standard is being met

The role of academic journals: TOP guidelines

OVER 5,000 JOURNAL SIGNATORIES

Center for Open Science announces Elsevier as new signatory to TOP Guideline

Elsevier develops and implements comprehensive new journal data guidelines

Science Home News Journals Topics Careers

SHARE

35K

832

910

The Competitiveness Council meeting in Brussels this week. EU Competitiveness Council

In dramatic statement, European leaders call for 'immediate' open access to all scientific papers by 2020

By Martin Enserink | May. 27, 2016 , 2:30 PM

In what European science chief Carlos Moedas calls a "life-changing" move, E.U. member states today agreed on an ambitious new open-access (OA) target. All scientific papers should be freely available by 2020, the Competitiveness Council—a gathering of ministers of science, innovation, trade, and industry—**concluded after a 2-day meeting in Brussels**. But some observers are warning that the goal will be difficult to achieve.

Stand up for Science

Paywall and what to do about it

- Once published, research more often than not resides behind the "paywall"
- Individual strategies
  - Pirating/hacking (Sci Hub)
  - Directly contacting the researchers or online academic networks (Research Gate, Academia)
- Change in policies
  - Cover authors' fees for open access journals
  - Fund double open access journals (free for both authors and readers)

Incentives

Badges to Acknowledge Open Pracices

PLOS | BIOLOGY

META-RESEARCH ARTICLE

Badges to Acknowledge Open Practices: A Simple, Low-Cost, Effective Method for Increasing Transparency

Mallory C. Kidwell[1]*, Ljiljana B. Lazarević[2], Erica Baranski[3], Tom E. Hardwicke[4], Sarah Piechowski[5], Lina-Sophia Falkenberg[5], Curtis Kennett[6], Agnieszka Slowik[7], Carina Sonnleitner[7], Chelsey Hess-Holden[6], Timothy M. Errington[1], Susann Fiedler[5], Brian A. Nosek[1,8]

1 Center for Open Science, Charlottesville, Virginia, United States of America, **2** University of Belgrade, Belgrade, Serbia, **3** University of California, Riverside, Riverside, California, United States of America, **4** University College London, London, United Kingdom, **5** Max Planck Institute for Research on Collective Goods, Bonn, Germany, **6** Mississippi State University, Starkville, Mississippi, United States of America, **7** University of Vienna, Vienna, Austria, **8** University of Virginia, Charlottesville, Virginia, United States of America

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OPEN ACCESS

Citation: Kidwell MC, Lazarević LB, Baranski E, Hardwicke TE, Piechowski S, Falkenberg L-S, et al. (2016) Badges to Acknowledge Open Practices: A Simple, Low-Cost, Effective Method for Increasing Transparency. PLoS Biol 14(5): e1002456.

Abstract

Beginning January 2014, *Psychological Science* gave authors the opportunity to signal open data and materials if they qualified for badges that accompanied published articles. Before badges, less than 3% of *Psychological Science* articles reported open data. After

Employment policies

German Psychological Society fully embraces open data, gives detailed recommendations

February 15, 2017

tl;dr: The German Psychological Society developed and adopted new recommendations for data sharing that fully embrace openness, transparency and scientific integrity. Key message is that raw data are an essential part of an empirical publication and must be openly shared. The recommendations also give very practical advice on how to implement these values, such as "When should data providers be asked to be co-authors in a data reuse project?" and "How to deal with participant privacy?".

In the last year, the discussion in our field moved from "Do we have a replication crisis?" towards "Yes, we have a problem, and what can and should we change? How can be implement it?". I think that we need both top-down changes on an institutional level, combined with bottom-up approaches, such as local Open Science Initiatives. Here, I want to present one big institutional change concerning open

The Department of Psychology at the Faculty of Human Sciences of the University of Cologne (UoC) seeks to appoint a

FULL PROFESSOR OF SOCIAL PSYCHOLOGY (W3-tenured)

The successful candidate is expected to have a record of excellence in social cognition, and/or related areas such as cognitive psychology or motivation science. The candidate is also expected to strongly contribute to the UoC's Center for Social and Economic Behavior and the Social Cognition Center Cologne of the Department of Psychology. Both structures are part of UoC's Key Profile Area II, „Behavioral Economic Engineering and Social Cognition".

For further information please visit http://c-seb.uni-koeln.de and http://soccco.uni-koeln.de or contact Christian Unkelbach (mailto:christian.unkelbach@uni-koeln.de).

The ideal candidate's track record should show an excellent fit with these interrelated structures and a strong interest to bridge the fields of social cognition and behavioral economics.

We strongly encourage *international* applicants. Salaries and working conditions at the UoC - one of the German Universities of Excellence – meet international standards. Candidates are expected to be willing to learn the German language. The Faculties offer Bachelor, Master, and doctoral degrees. Courses are taught either in English or German.

The Department of Psychology aims for transparent and reproducible research (including Open Data, Open Materials, and Preregistrations). Applicants are asked to illustrate how they have pursued these goals in the past and/or how they plan to do so in the future.

Enablers of open science

How to procede

To promote truth over publishability:

- Large scale collaborative replication efforts
- **More open practices** in research
- **Changing the incentives and enabling the infrastructure for sharing**

nature human behaviour

PERSPECTIVE

PUBLISHED: 10 JANUARY 2017 | VOLUME: 1 | ARTICLE NUMBER: 0021

OPEN

A manifesto for reproducible science

Marcus R. Munafò[1,2*], Brian A. Nosek[3,4], Dorothy V. M. Bishop[5], Katherine S. Button[6], Christopher D. Chambers[7], Nathalie Percie du Sert[8], Uri Simonsohn[9], Eric-Jan Wagenmakers[10], Jennifer J. Ware[11] and John P. A. Ioannidis[12,13,14]

Improving the reliability and efficiency of scientific research will increase the credibility of the published scientific literature and accelerate discovery. Here we argue for the adoption of measures to optimize key elements of the scientific process: methods, reporting and dissemination, reproducibility, evaluation and incentives. There is some evidence from both simulations and empirical studies supporting the likely effectiveness of these measures, but their broad adoption by researchers, institutions, funders and journals will require iterative evaluation and improvement. We discuss the goals of these measures, and how they can be implemented, in the hope that this will facilitate action toward improving the transparency, reproducibility and efficiency of scientific research.

What proportion of published research is likely to be false? Low sample size, small effect sizes, data dredging (also known as *P* hacking), conflicts of interest, large numbers of scientists working competitively in silos without combining their efforts, and so on, may conspire to dramatically increase the probability that a published finding is incorrect[1]. The field of metascience — the scientific study of science itself — is flourishing and has generated substantial empirical evidence for the existence and prevalence of threats to efficiency in knowledge accumulation (refs 2–7; Fig. 1).

Data from many fields suggests reproducibility is lower than is desirable[8–11]; one analysis estimates that 85% of biomedical research efforts are wasted[14], while 90% of respondents to a recent survey in *Nature* agreed that there is a 'reproducibility crisis'[15]. Whether 'crisis' is the appropriate term to describe the current state or trajectory of science is debatable, but accumulated evidence indicates that there is substantial room for improvement with regard to research practices to maximize the efficiency of the research community's use of the public's financial investment in research.

Here we propose a series of measures that we believe will improve research efficiency and robustness of scientific findings by directly targeting specific threats to reproducible science. We argue for the adoption, evaluation and ongoing improvement of these measures to optimize the pace and efficiency of knowledge accumulation. The measures are organized into the following categories[16]: methods, reporting and dissemination, reproducibility, evaluation and incentives. They are not intended to be exhaustive, but provide a broad, practical and evidence-based set of actions that can be implemented by researchers, institutions, journals and funders. The measures and their current implementation are summarized in Table 1.

The problem

A hallmark of scientific creativity is the ability to see novel and unexpected patterns in data. John Snow's identification of links between cholera and water supply[17], Paul Broca's work on language lateralization[18] and Jocelyn Bell Burnell's discovery of pulsars[19] are examples of breakthroughs achieved by interpreting observations in a new way. However, a major challenge for scientists is to be open to new and important insights while simultaneously avoiding being misled by our tendency to see structure in randomness. The combination of apophenia (the tendency to see patterns in random data), confirmation bias (the tendency to focus on evidence that is in line with our expectations or favoured explanation) and hindsight bias (the tendency to see an event as having been predictable only after it has occurred) can easily lead us to false conclusions[20]. Thomas Levenson documents the example of astronomers who became convinced they had seen the fictitious planet Vulcan because their contemporary theories predicted its existence[21]. Experimenter effects are an example of this kind of bias[22].

Over-interpretation of noise is facilitated by the extent to which data analysis is rapid, flexible and automated[23]. In a high-dimensional dataset, there may be hundreds or thousands of reasonable alternative approaches to analysing the same data[24,25]. For example, in a systematic review of functional magnetic resonance imaging (fMRI) studies, Carp showed that there were almost as many unique analytical pipelines as there were studies[26]. If several thousand potential analytical pipelines can be applied to high dimensional data, the generation of false-positive findings is highly likely. For example, applying almost 7,000 analytical pipelines to a single fMRI dataset resulted in over 90% of brain voxels showing significant activation in at least one analysis[25].

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How to proceed

Activities fostered within OSR

Open and collaborative working culture.

Developing knowledge, skills and expertise related to OSR.

Clear guidelines for publishing research results, licensing and immaterial property rights (IPR) questions .

Clear descriptions of the liabilities and rights of a researcher regarding openness.

Supporting the utilization of shared service infrastructures and sharing resources.

Who gets to incentivize open science practices?

The agents which promote standards for good science

Journal editors (publishing policies)

Academic institutions (employment and advancement policies)

Funding bodies (resource allocation policies)

Final words

Open science describes the transformations in the way research is being performed: researchers collaborate and knowledge is shared so that everybody can contribute to scientific advancements through a more effective use of research results.

Open science represents a systemic change in the modus operandi of science: open science shifts research from the “publish or perish” mantra to a knowledge-sharing ideal.

However, it shouldn’t be portrayed as an utopist movement that doesn’t provide clear benefits for the actor involved.

Benefits of different actors

Sharing resources from publicly funded research (opposed to reinventing the wheel every time) – economically wiser.

Facilitating access to research data encourages its re-use outside academia – to the interested public, but also by businesses.

Faster exchange of information serves innovation and growth.

Better communication with the public leads to more responsiveness to public needs.

Thank you!

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Our papers available at the website of the Lab for the study of individual dfferences https://lira.f.bg.ac.rs/en/

Dropbox folder with all the materials