Towards open, reliable & transparent science: an introduction

Alfredo Sánchez-Tójar

AEET Conference 2023

16th October 2023

evolutionary biology

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- Evolutionary Ecologist

@ASanchez_Tojar

UNIVERSITÄT BIELEFELD

- Evolutionary Ecologist
- Ornithologist by training

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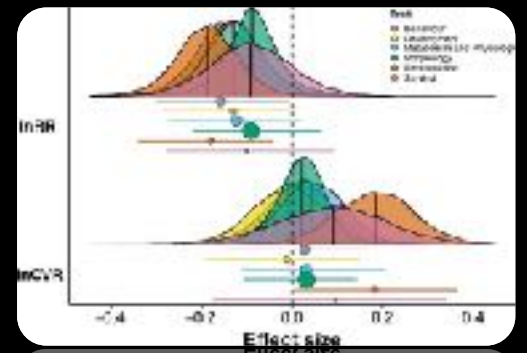
UNIVERSITÄT BIELEFELD

- Evolutionary Ecologist
- Ornithologist by training
- Reconverted into:

  ➢ Evidence synthesist



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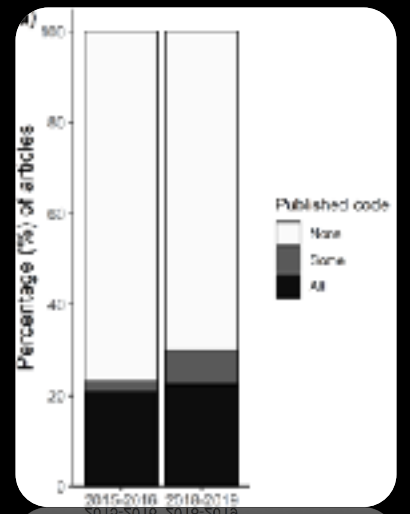
  - ➢ Meta-researcher



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- Evolutionary Ecologist
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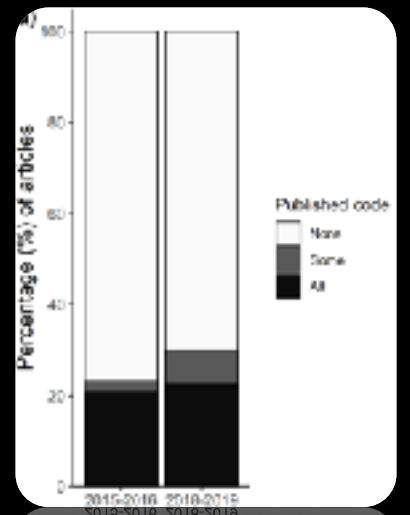
  - ➢ Evidence synthesist
  - ➢ Meta-researcher
- Board of Directors: SORTEE



SORTEE
Society for Open, Reliable, and Transparent Ecology and Evolutionary Biology

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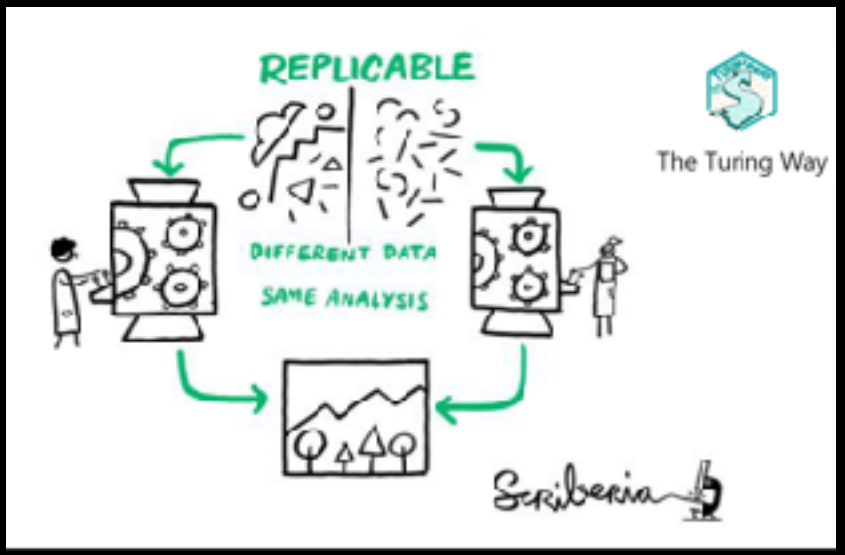
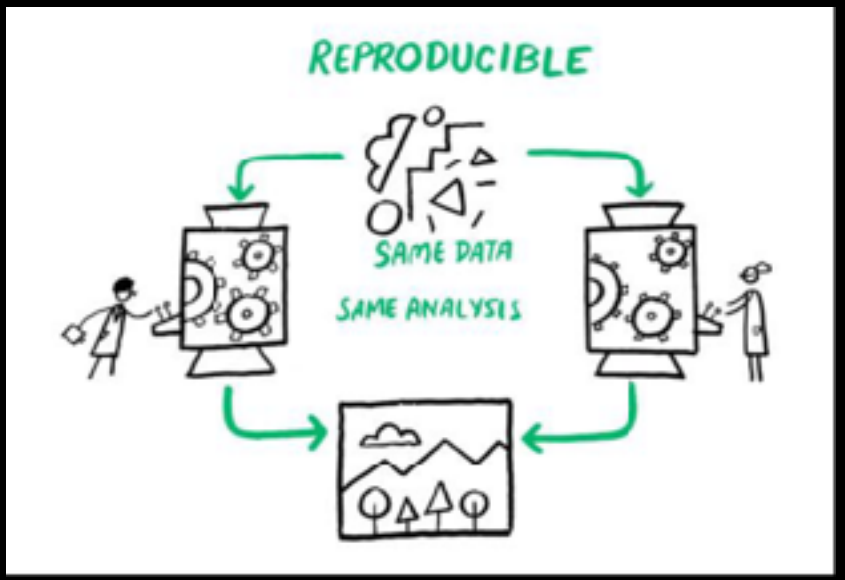
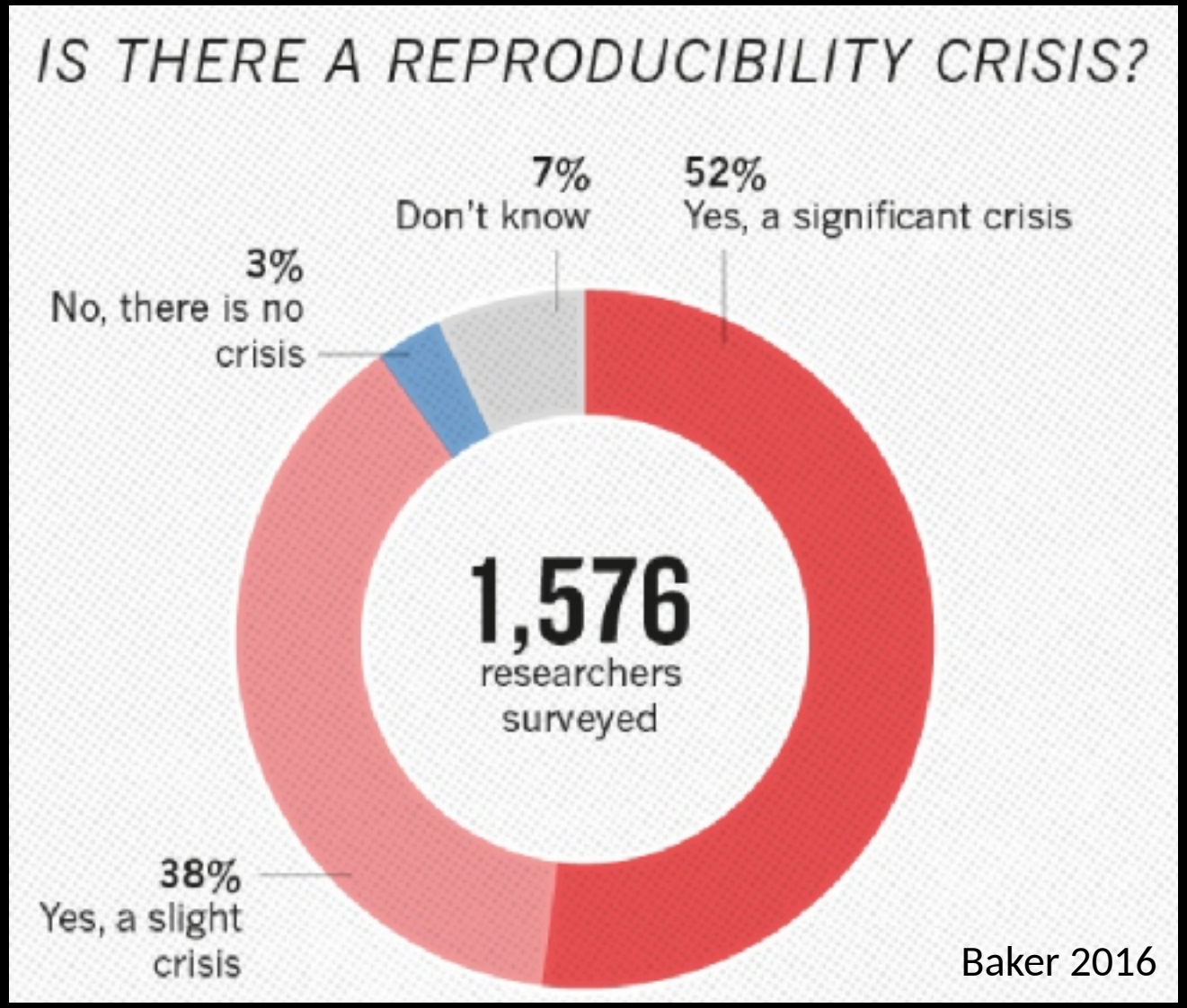
Replicability and Reproducibility

Replicability and Reproducibility

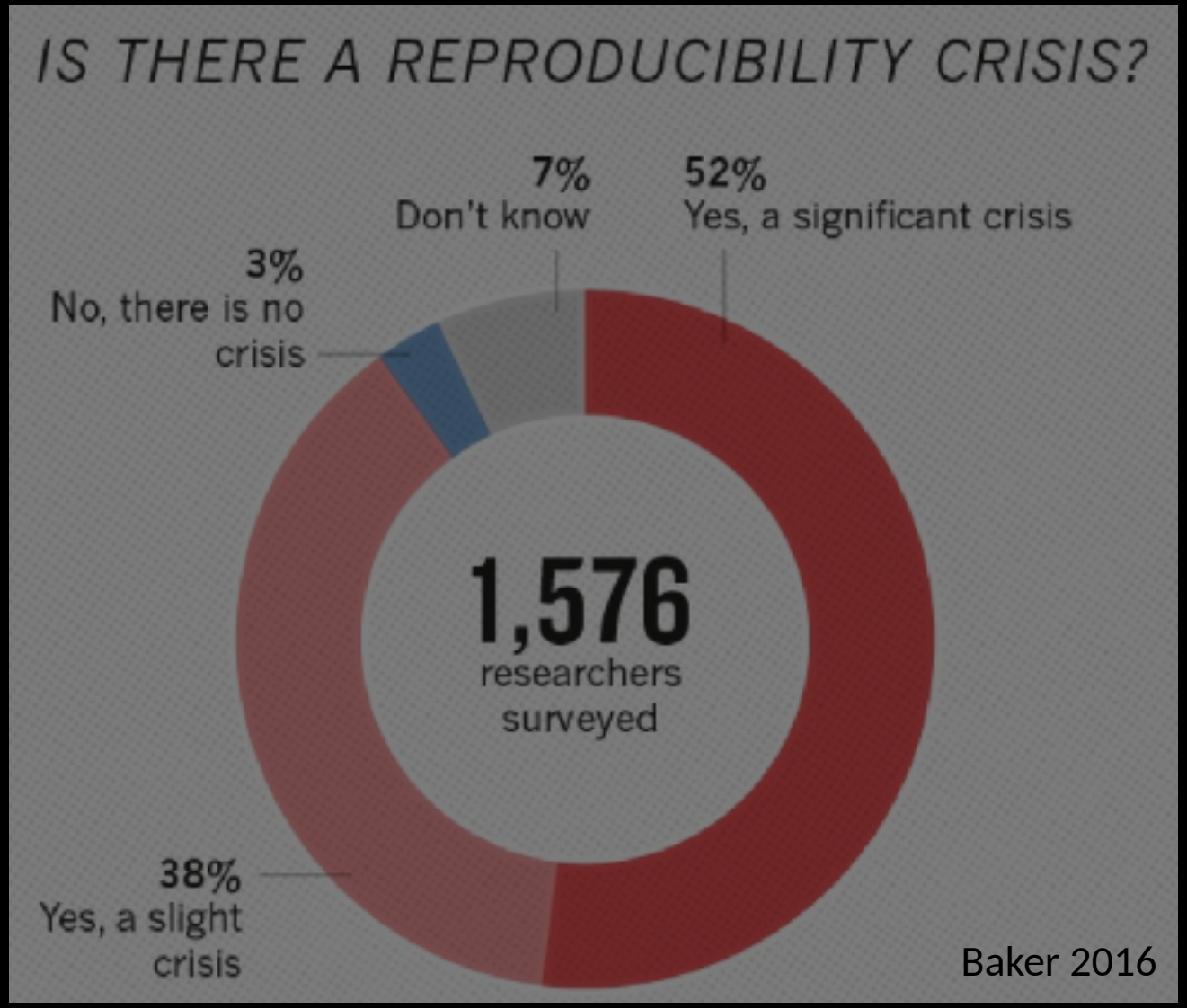
- Replicability: same/similar methods, different data
- Reproducibility: same methods, same data






IS THERE A REPRODUCIBILITY CRISIS?
7%
Don't know
52%
Yes, a significant crisis
3%
No, there is no crisis
1,576
researchers surveyed
38%
Yes, a slight crisis

Baker 2016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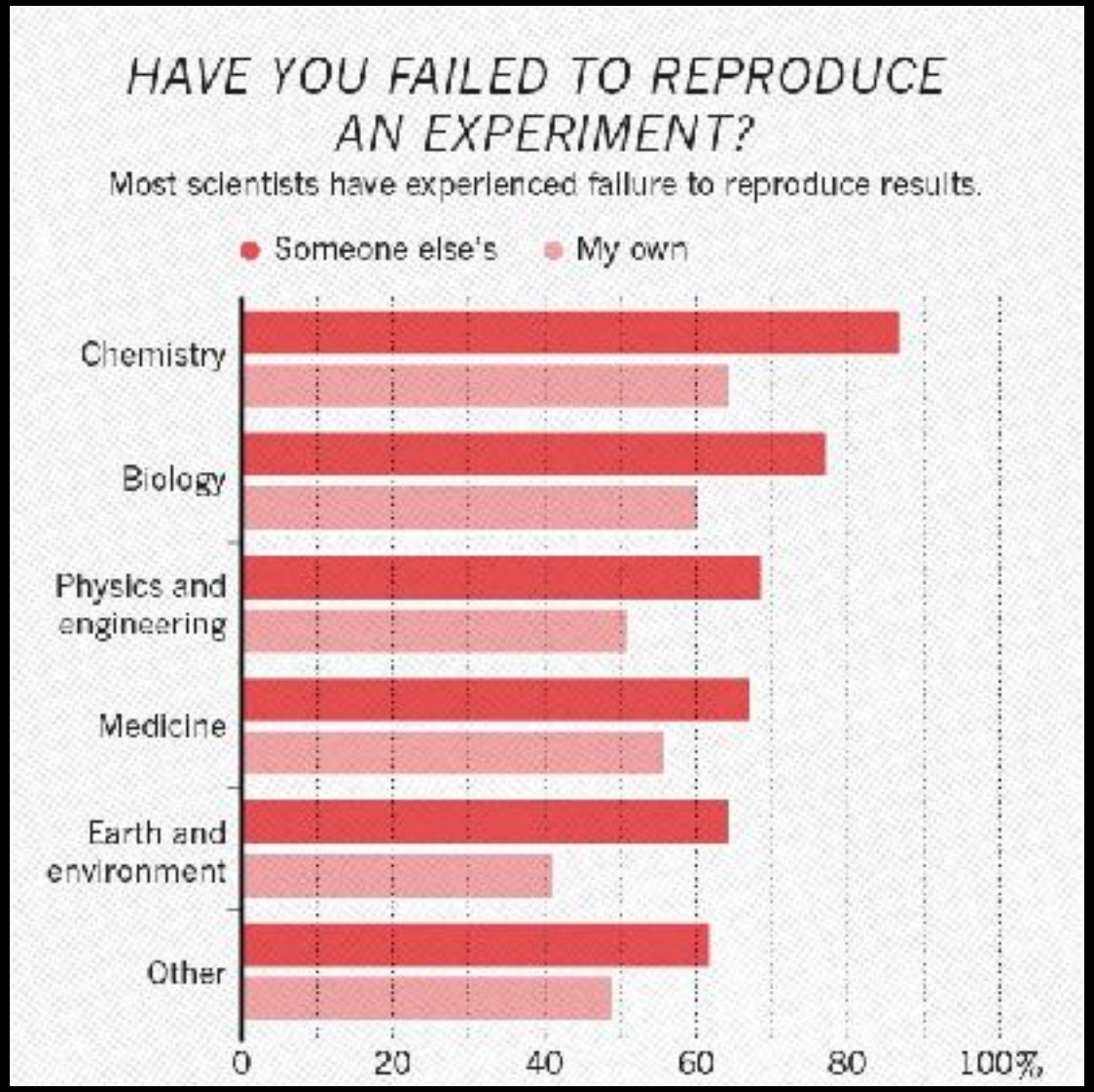

HAVE YOU FAILED TO REPRODUCE AN EXPERIMENT?
Most scientists have experienced failure to reproduce results.
Someone else's
My own
Chemistry
Biology
Physics and engineering
Medicine
Earth and environment
Other
0
20
40
60
80
100%

+ 269 collaborators!

Brian Nosek

The Reproducibility Project: Psychology

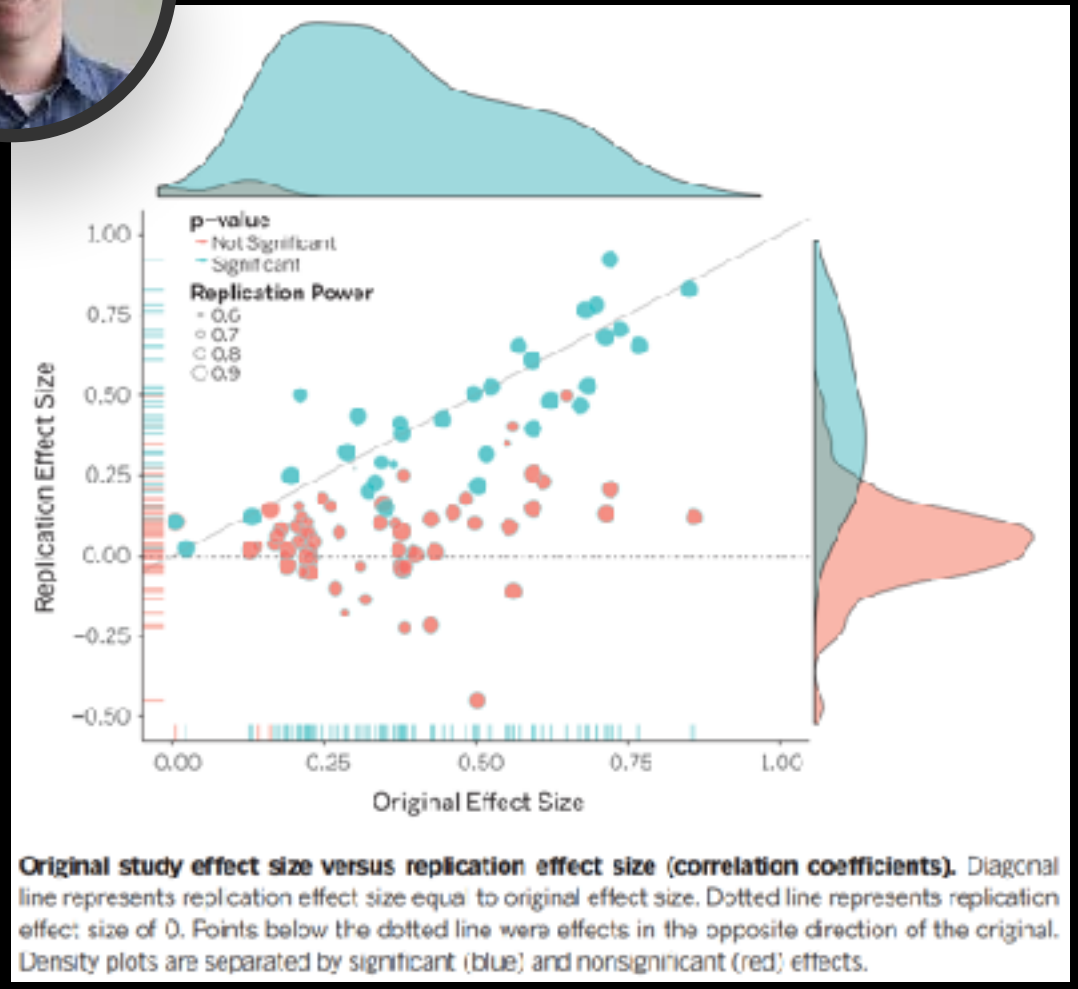
https://osf.io/ezcuj/

Open Science Collaboration 2015

+ 269 collaborators!

The Reproducibility Project: Psychology

https://osf.io/ezcuj/



Original study effect size versus replication effect size (correlation coefficients). Diagonal line represents replication effect size equal to original effect size. Dotted line represents replication effect size of 0. Points below the dotted line were effects in the opposite direction of the original. Density plots are separated by significant (blue) and nonsignificant (red) effects.

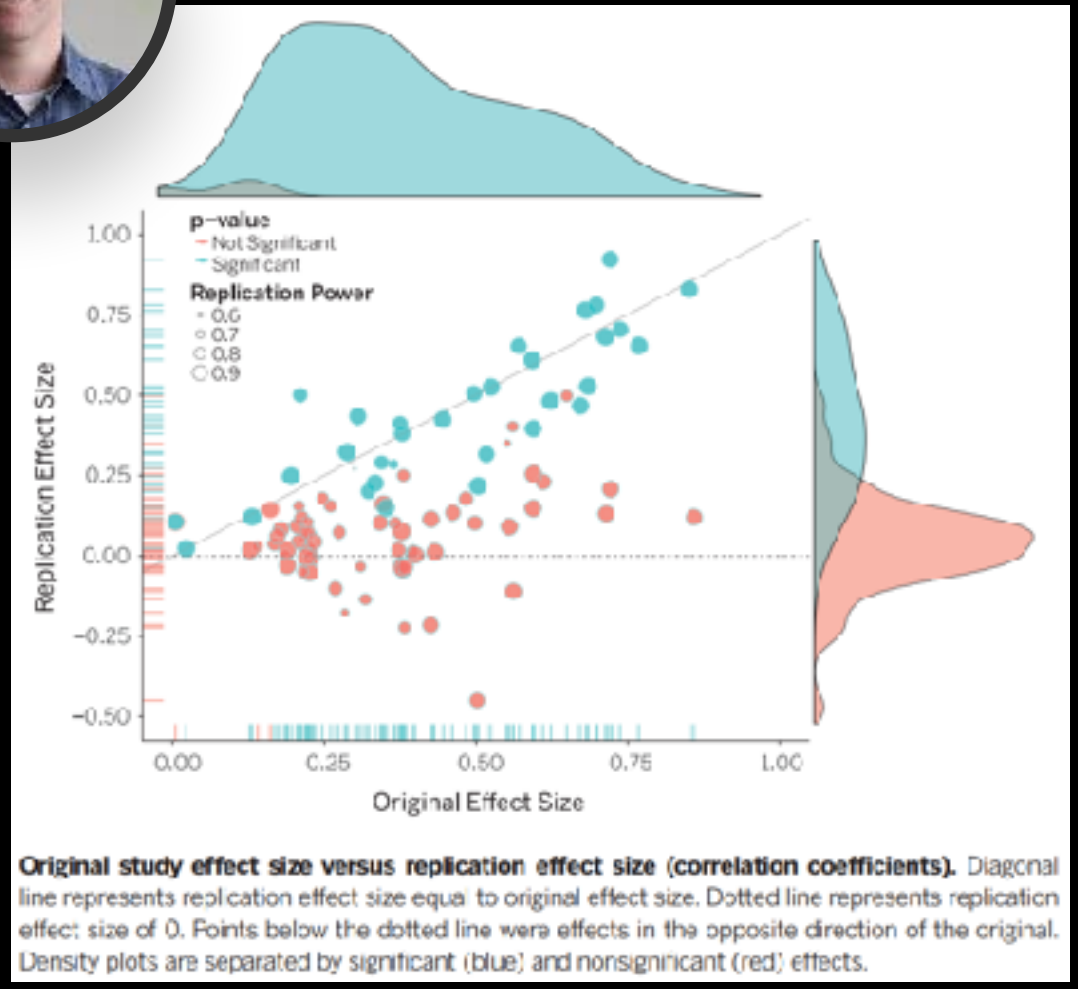
- 100 findings

Open Science Collaboration 2015

+ 269 collaborators!

The Reproducibility Project: Psychology

https://osf.io/ezcuj/



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- 100 findings
- Effect size = ½ original

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The Reproducibility Project: Psychology

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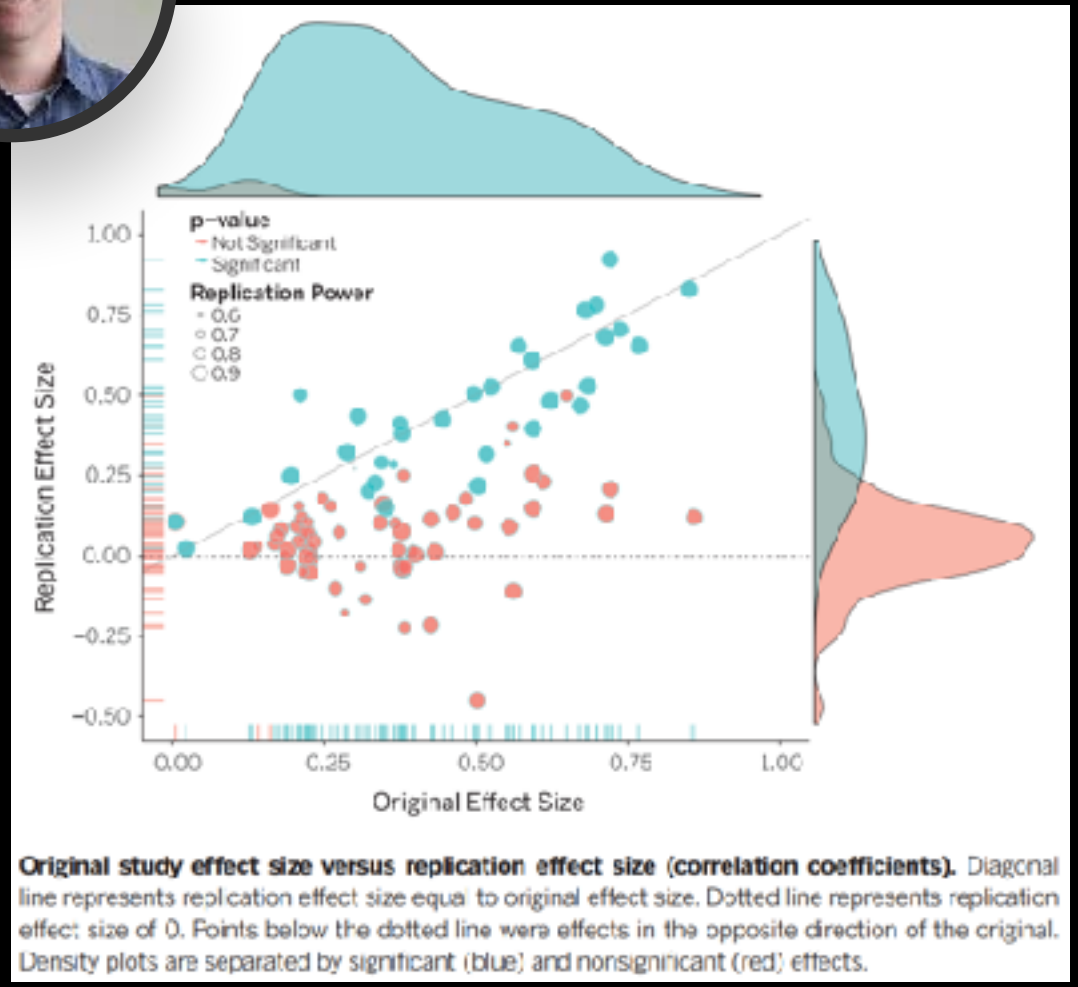

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- 100 findings
- Effect size = ½ original
- Replicability = 47%
- Statistical significance = 97% vs. 36%

Open Science Collaboration 2015

The Reproducibility Project: Psychology

+ 269 collaborators!

https://osf.io/ezcuj/

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After 10 Years, 'Many Labs' Comes to an End – But Its Success Is Replicable

By Eric Williamson, williamson@virginia.edu • May 23, 2022

Density plots are separated by significant (blue) and nonsignificant (red) effects.

Open Science Collaboration 2015

evolutionary biology

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Tim Errington

+ many collaborators!

The Reproducibility Project: Cancer Biology

https://www.cos.io/rpcb

Errington et al. 2021

+ many collaborators!

The Reproducibility Project: Cancer Biology

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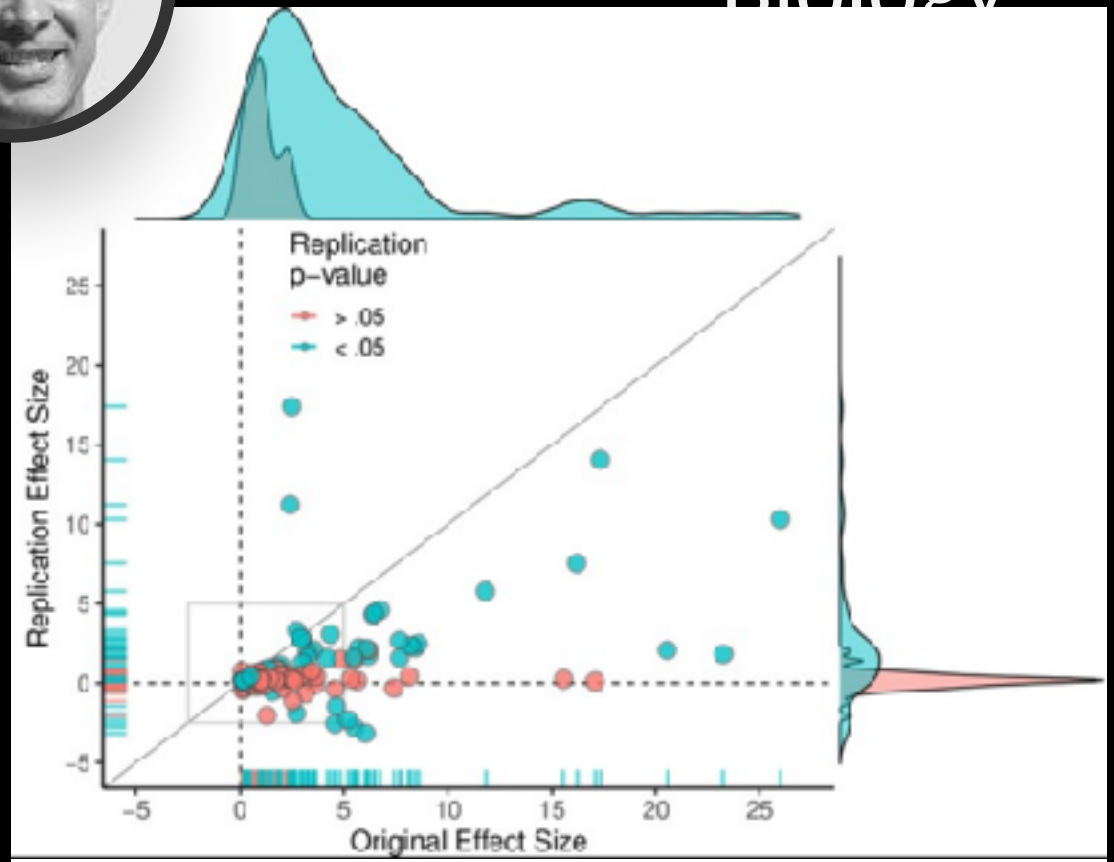

Replication effect sizes compared with original effect sizes.

(A) Graph in which each circle represents an effect for which an SMD effect size could be computed for both the original effect and the replication (n = 110). Blue circles indicate effects for which p < 0.05 in the replication, and red circles indicate p > 0.05. Two effects for which the original effects size was >80 are not shown. The median effect size in the replications was 85% smaller than the median effect size in the original experiments, and 97% of replication effect sizes were smaller than original effect sizes (below the gray diagonal

- Testable: 23/53 studies (50/193 experiments)

Errington et al. 2021

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+ many collaborators!

The Reproducibility Project: Cancer Biology

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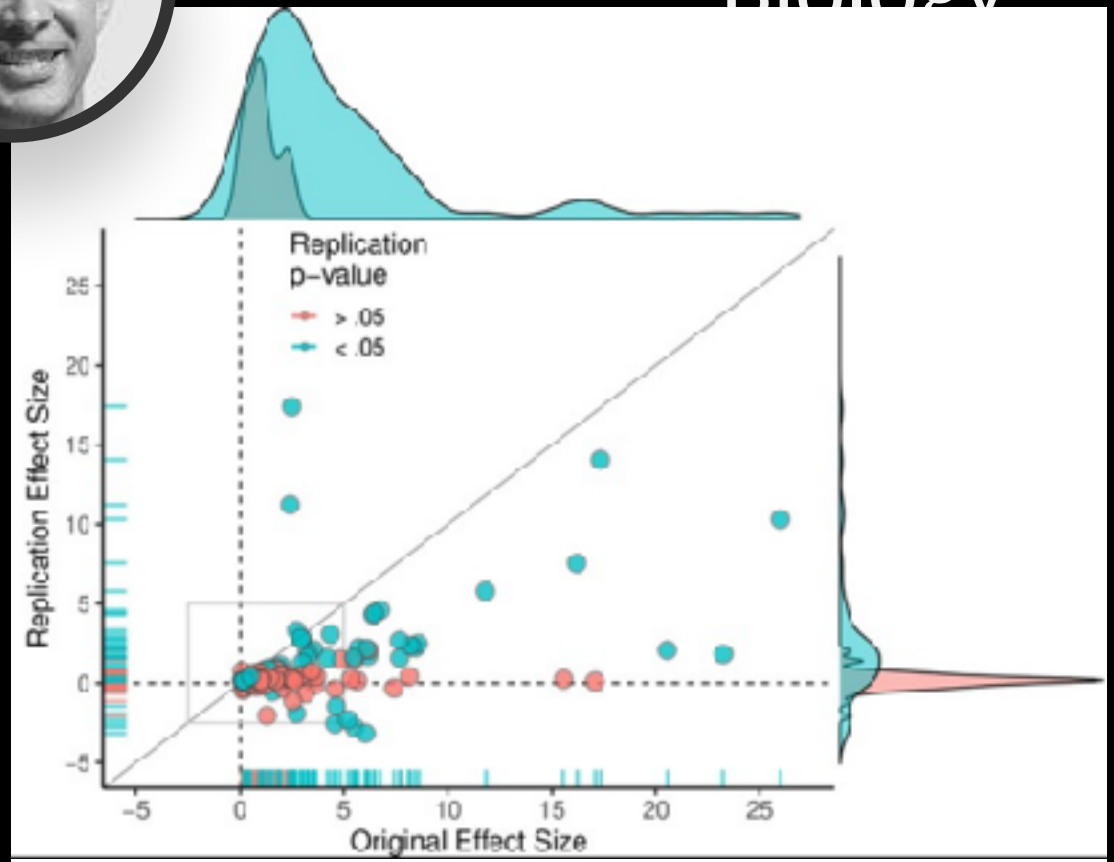

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- Testable: 23/53 studies (50/193 experiments)
- Effect size = 85% original

Errington et al. 2021

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+ many collaborators!

The Reproducibility Project: Cancer Biology

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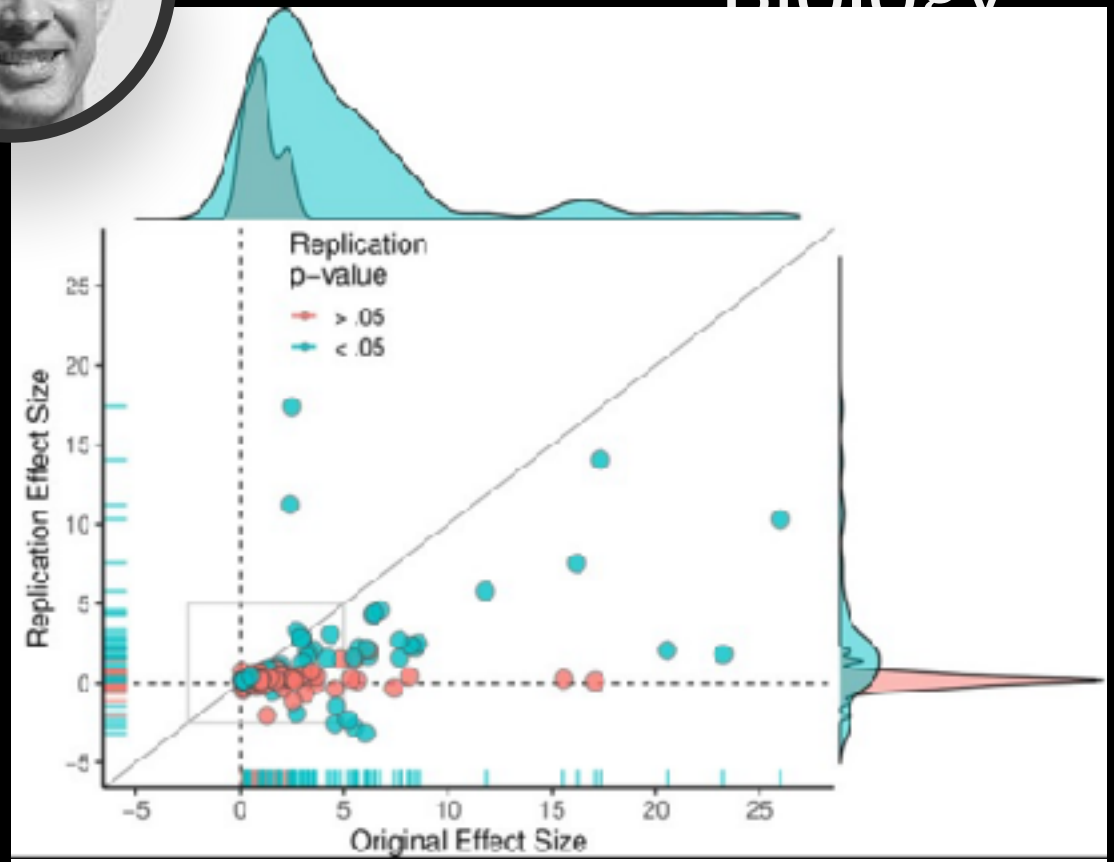

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- Testable: 23/53 studies (50/193 experiments)
- Effect size = 85% original
- Replicability = 46%

Errington et al. 2021

+ many collaborators!

The Reproducibility Project: Cancer Biology

https://www.cos.io/rpcb

eLife

HOME MAGAZINE COMMUNITY INNOVATION

Edited by

Roger J Davis et al.

Reproducibility Project: Cancer Biology

Investigating reproducibility in preclinical cancer research.

Collection • Dec 10, 2014

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Errington et al. 2021

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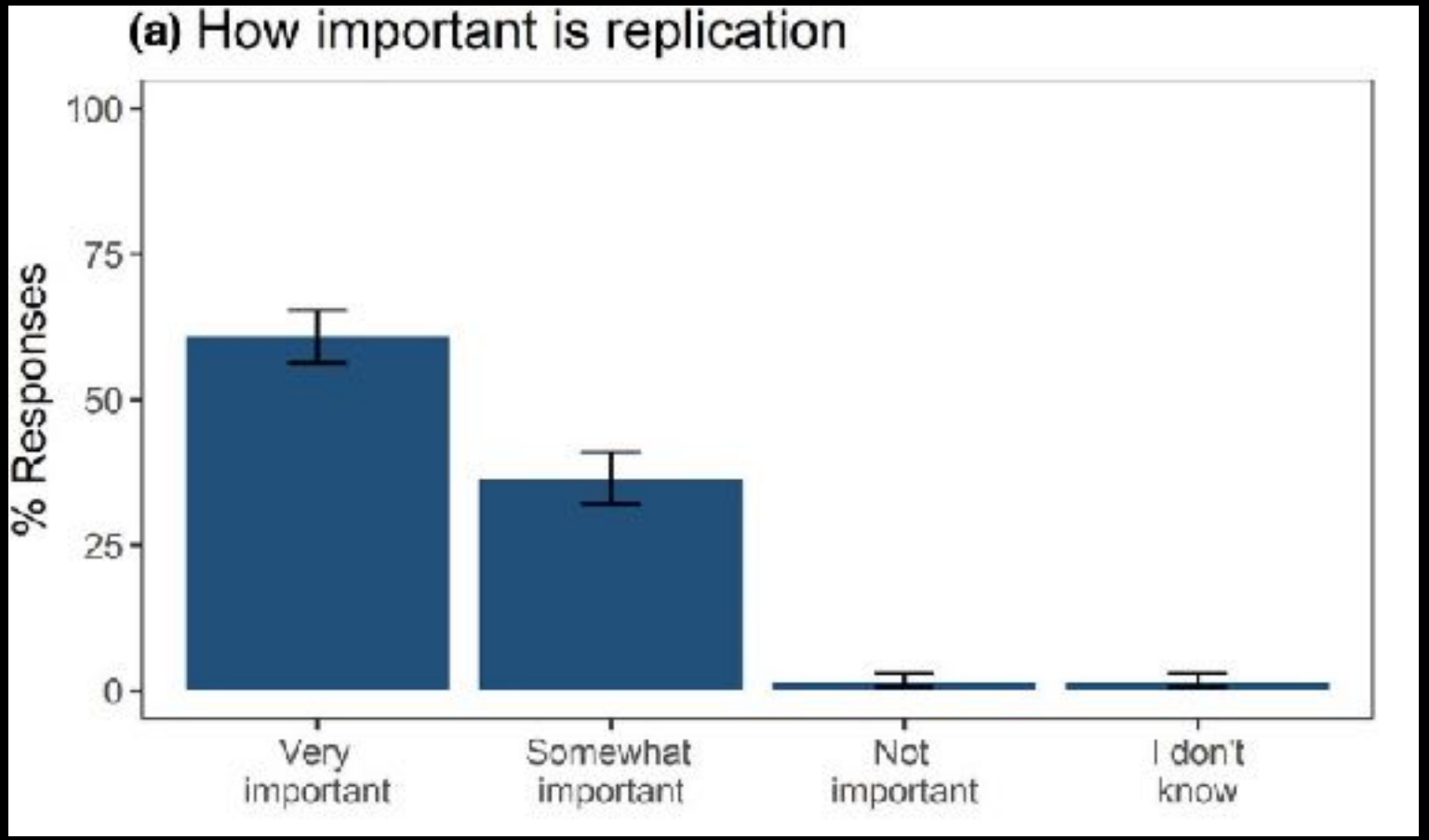
What about Ecology and Evolutionary Biology?

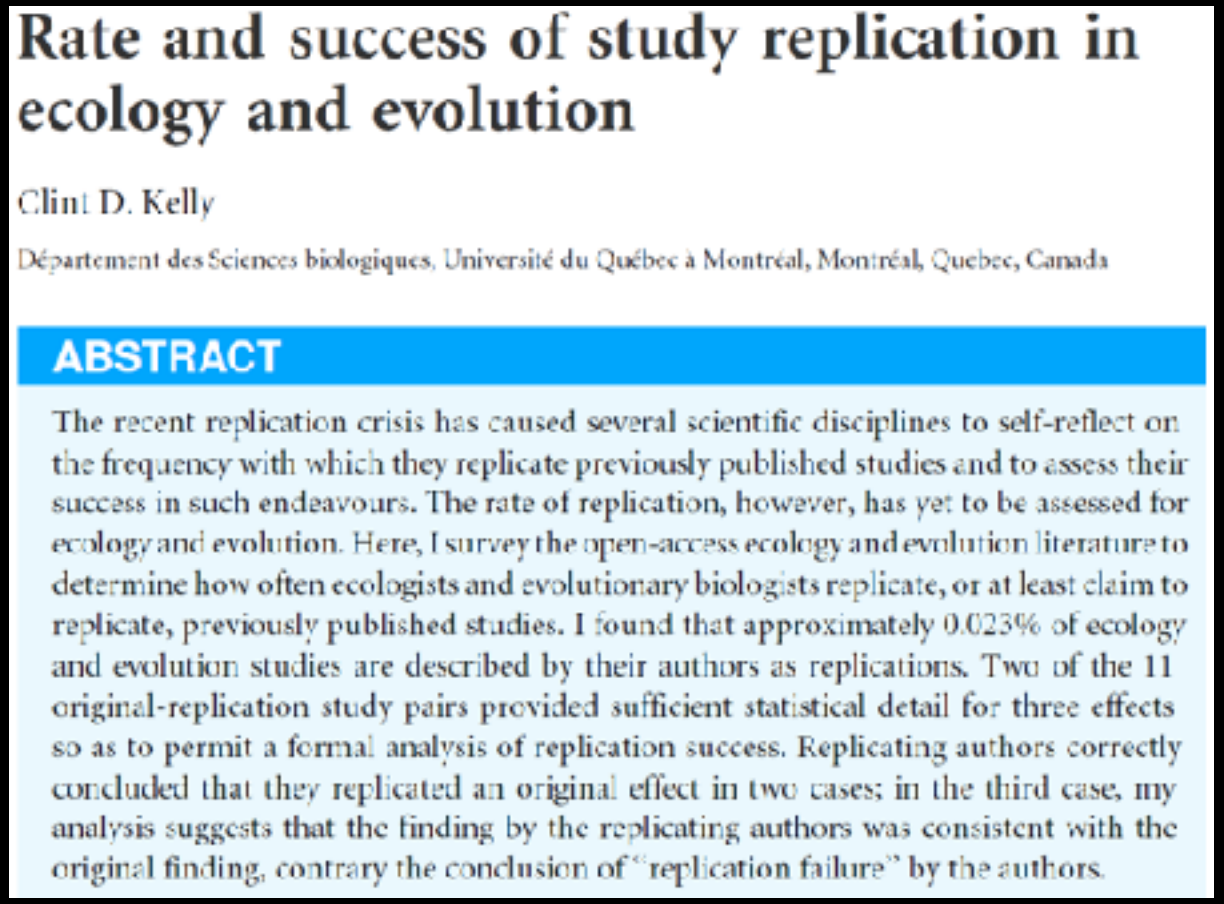
What about Eco & Evo?



- Survey: 437 Ecologists
- 97% important

Fraser et al. 2019

Replicability



Rate and success of study replication in ecology and evolution

Clint D. Kelly

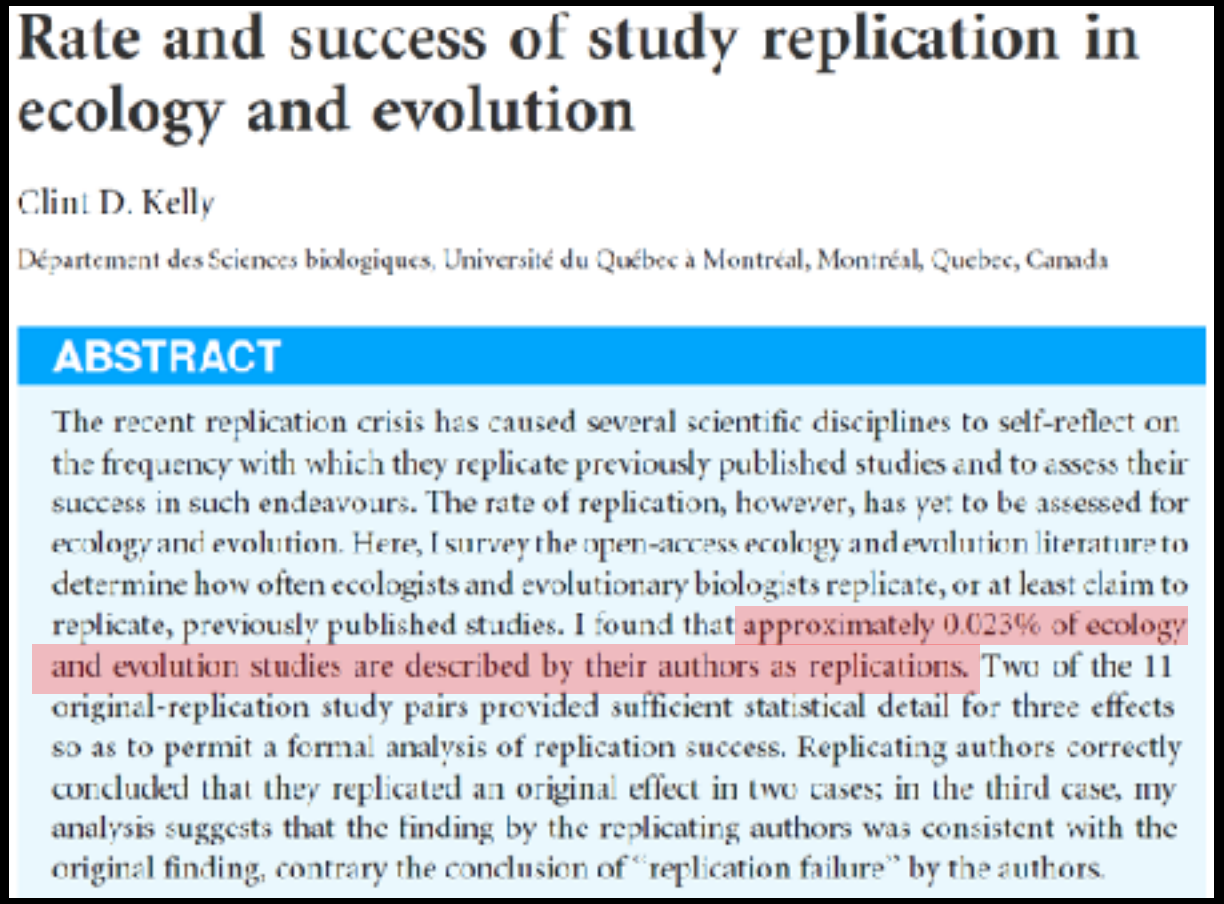
Département des Sciences biologiques, Université du Québec à Montréal, Montréal, Quebec, Canada

ABSTRACT

The recent replication crisis has caused several scientific disciplines to self-reflect on the frequency with which they replicate previously published studies and to assess their success in such endeavours. The rate of replication, however, has yet to be assessed for ecology and evolution. Here, I survey the open-access ecology and evolution literature to determine how often ecologists and evolutionary biologists replicate, or at least claim to replicate, previously published studies. I found that approximately 0.023% of ecology and evolution studies are described by their authors as replications. Two of the 11 original-replication study pairs provided sufficient statistical detail for three effects so as to permit a formal analysis of replication success. Replicating authors correctly concluded that they replicated an original effect in two cases; in the third case, my analysis suggests that the finding by the replicating authors was consistent with the original finding, contrary the conclusion of "replication failure" by the authors.

- Ecology, Evolution, Behavior, and Systematics

Replicability



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- Ecology, Evolution, Behavior, and Systematics
- 0.023% (9/38730): claimed replications

Replicability

Received: 12 January 2021 | Accepted: 24 May 2021

DOI: 10.1111/2041-210X.13657

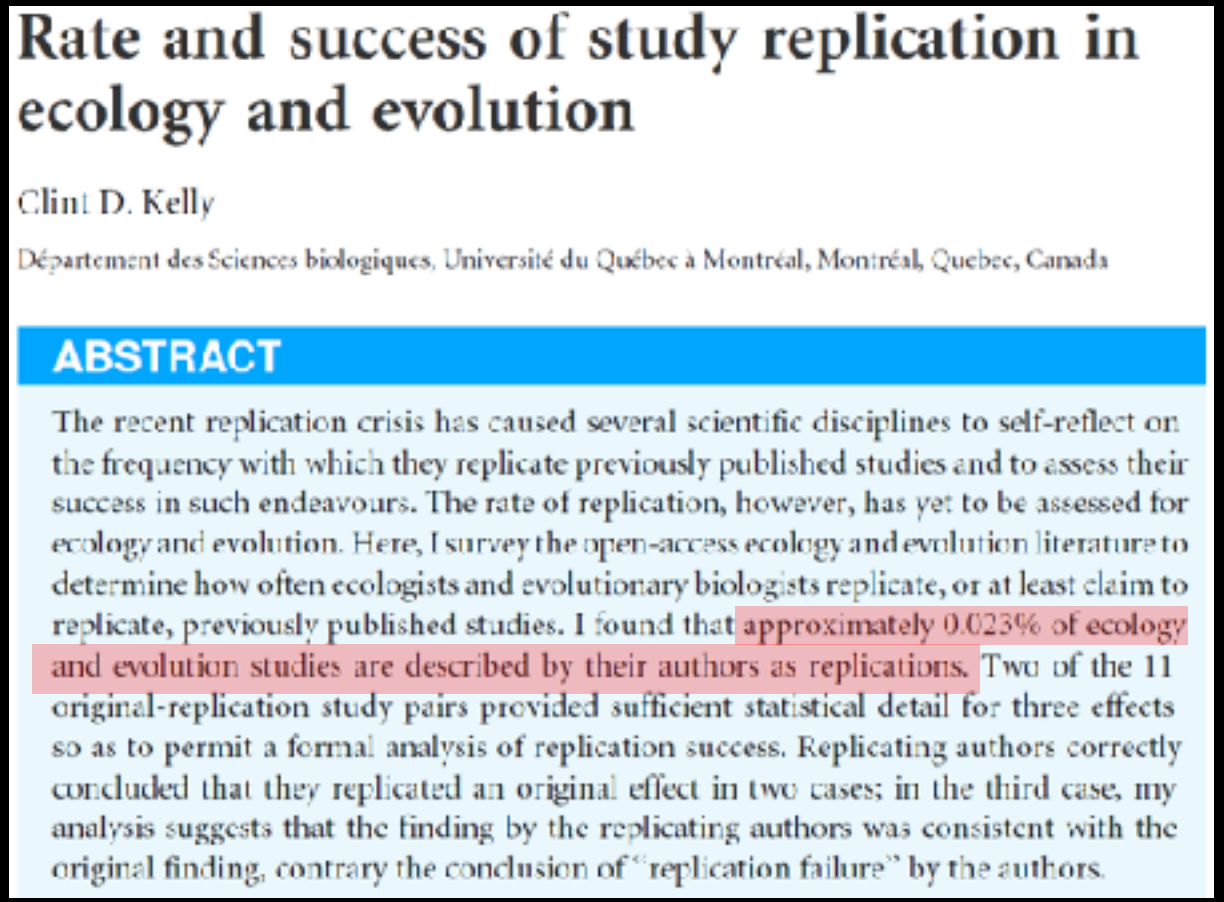
COMMENTARY

Methods in Ecology and Evolution | BRITISH ECOLOGICAL SOCIETY

Replication in field ecology: Identifying challenges and proposing solutions

Alessandro Filazzola[1,2] | James F. Cahill Jr[1]

Replicability



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Language: 0% (Marsden et al. 2018)

Linguistics: 0.06% (Kobrock & Roettger 2022)

Economics: 0.1% (Mueller-Langer et al. 2019)

Education: 0.13% (Makel et al. 2014)

Special Education: 0.5% (Makel et al. 2016)

Social Sciences: 1% (Hardwicke et al. 2021)

Psychology: 1% (Makel et al. 2012); 5% (Hardwicke et al. 2021)

Criminology: 2% (McNeely & Warner 2014)

Behavioural Ecology: 25-34% (n = 300; conceptual) (Kelly 2006)

Ecology and Evolution: 0.02% (n = 38730) (Kelly 2019)

Replicability

That is, the NIH and NSF should be required to spend 0.1% of their funding each year on replication studies. By comparison, the Center for Medicare and Medicaid Services spends around 0.17% of its yearly budget on the Center for Program Integrity.

https://goodscience.substack.com/p/why-we-need-more-quality-control

Revolutionary?

What about Reproducibility in Ecology and Evolutionary Biology?

evolutionary biology

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Replicability and Reproducibility

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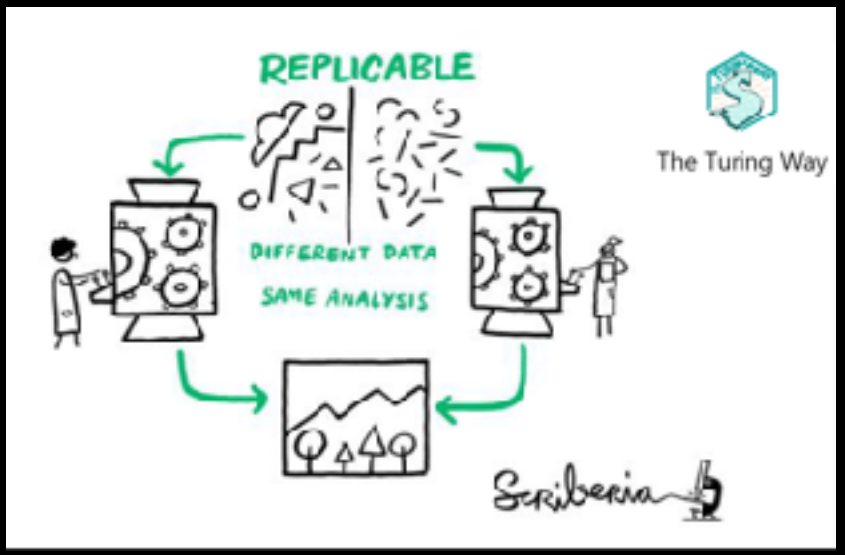
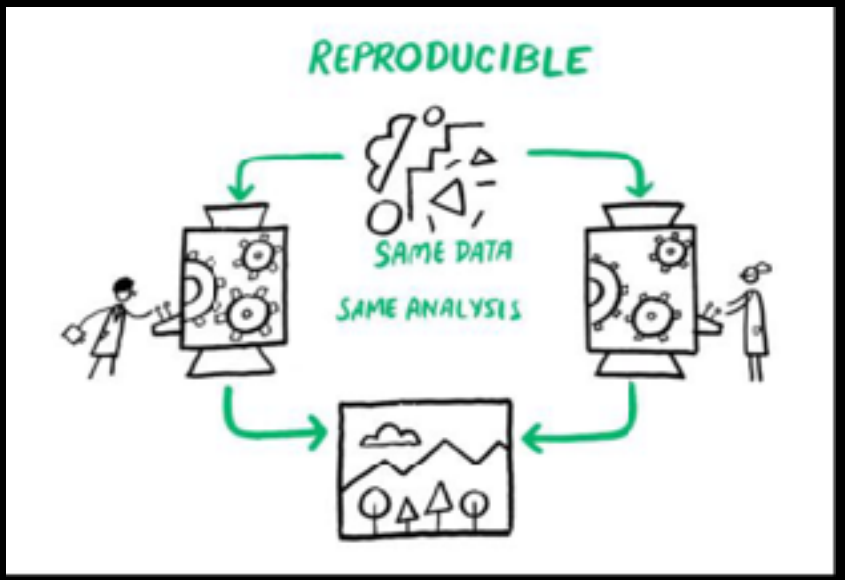
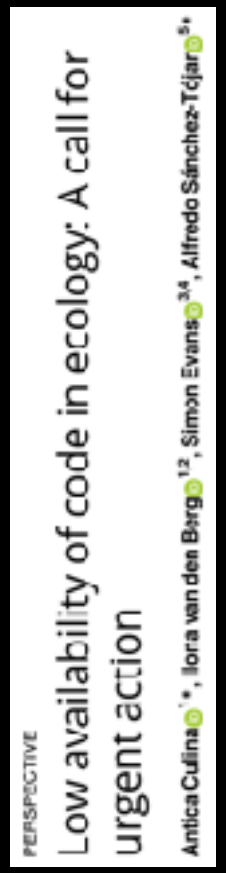
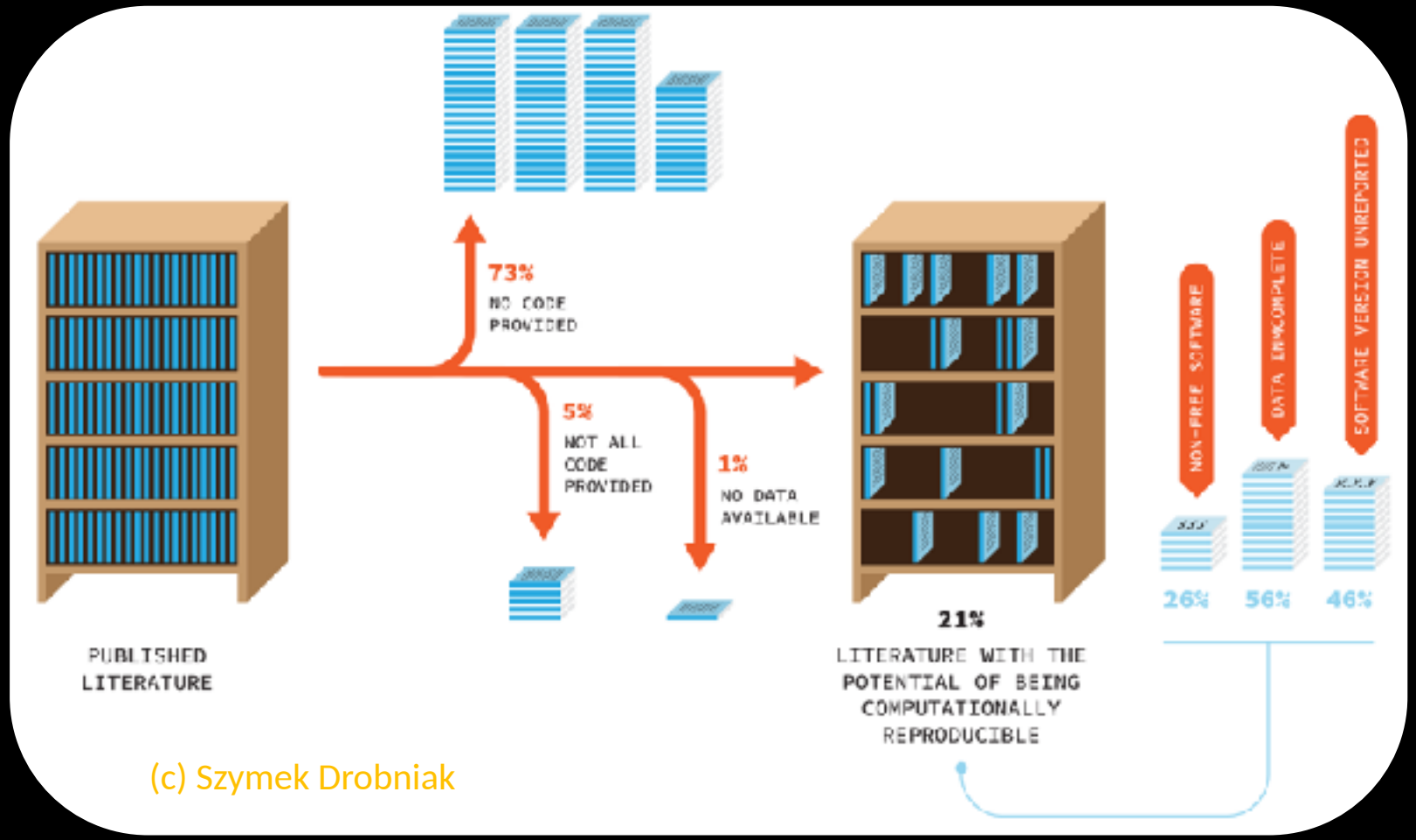
- Reproducibility: same methods, same data





Reproducibility potential





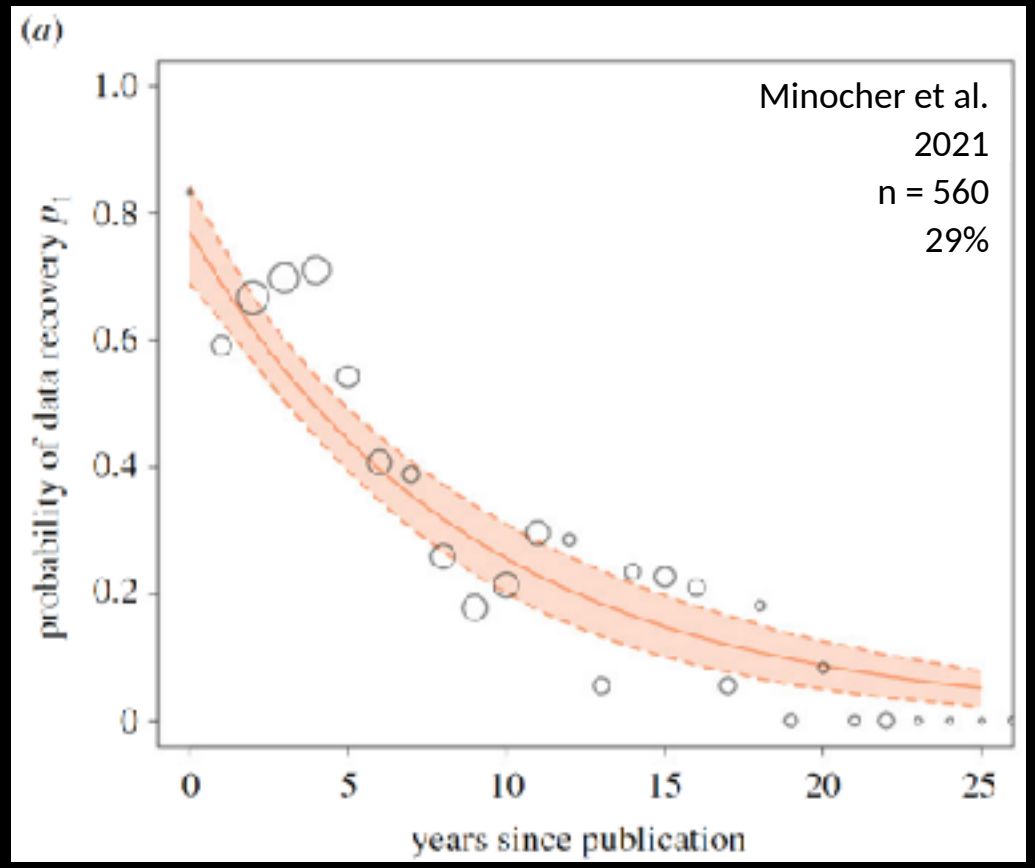
(c) Szymek Drobniak

Culina et al. 2020
2015-2019
n = 346

Why? Data availability

Why? Data availability

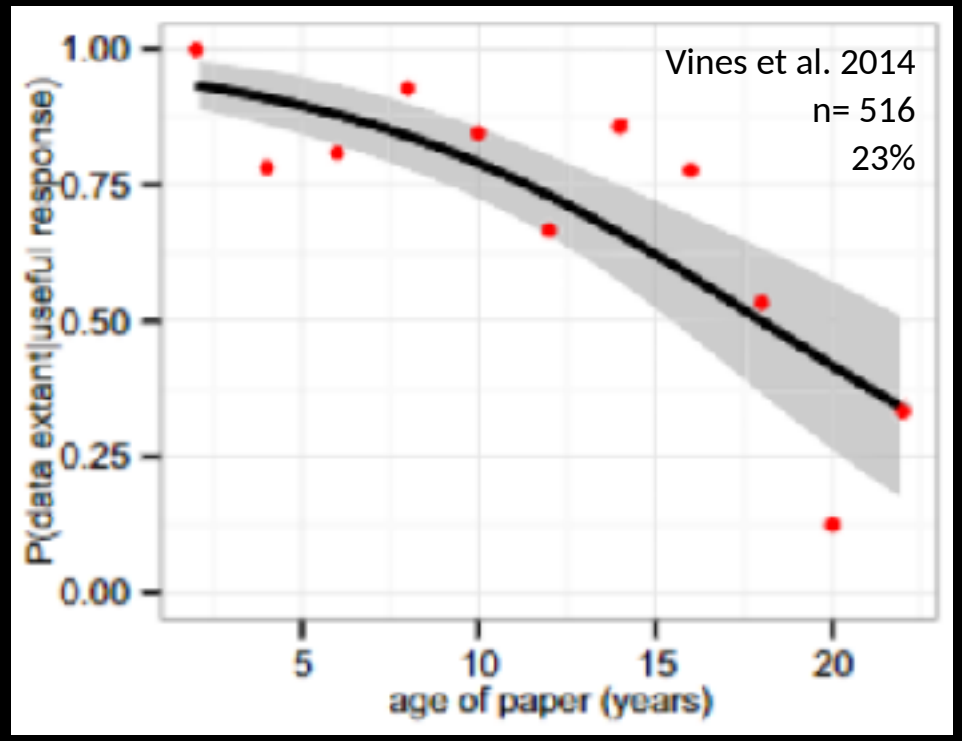
1955-2018



P(data available) halves every 6 years

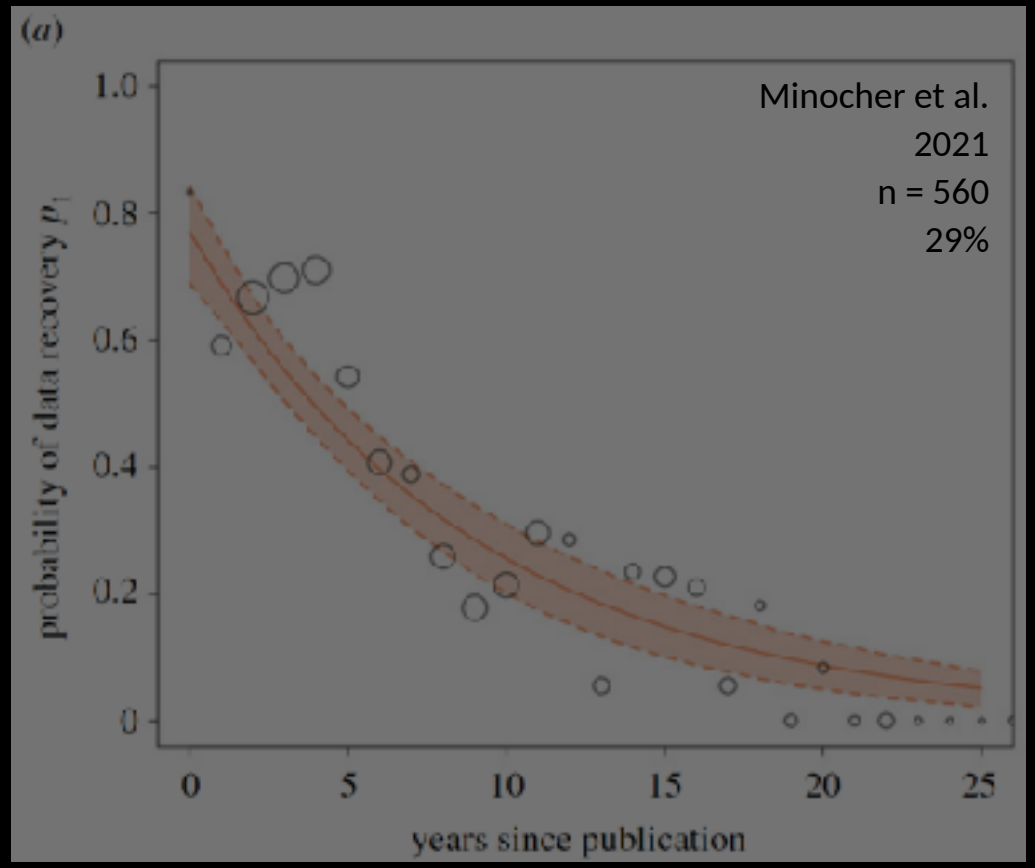
Why? Data availability

1991-2011



P(data available) reduces 17% every year

1955-2018



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Why? Data reusability

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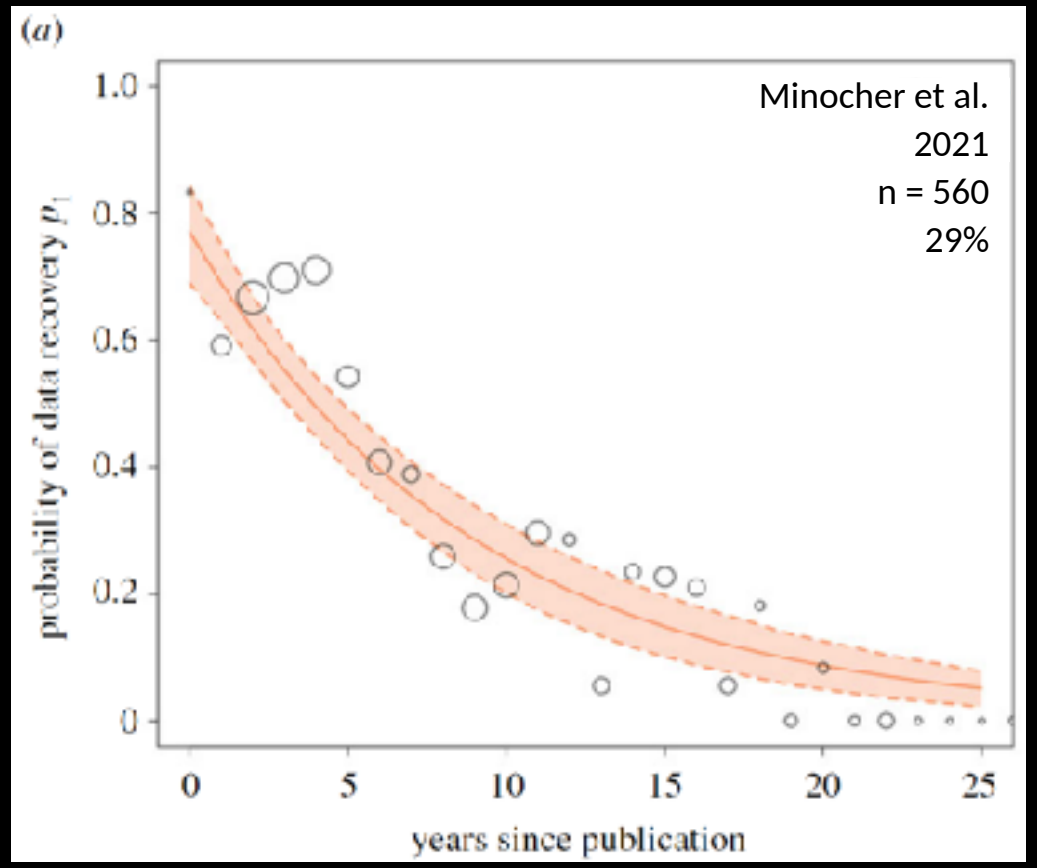
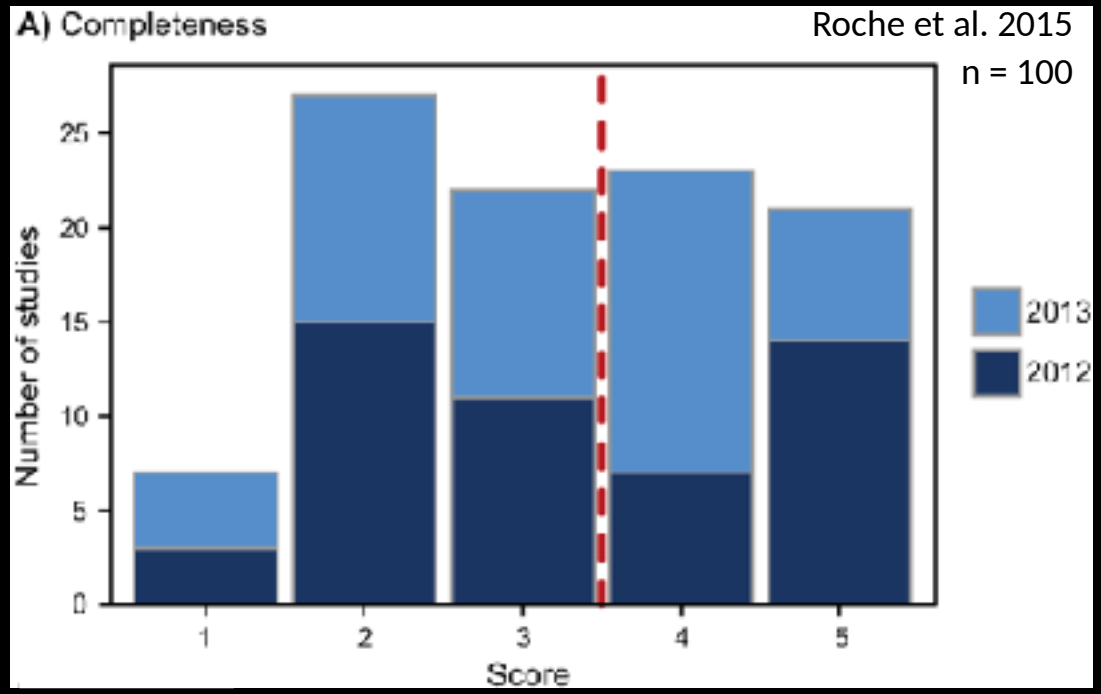
1955-2018



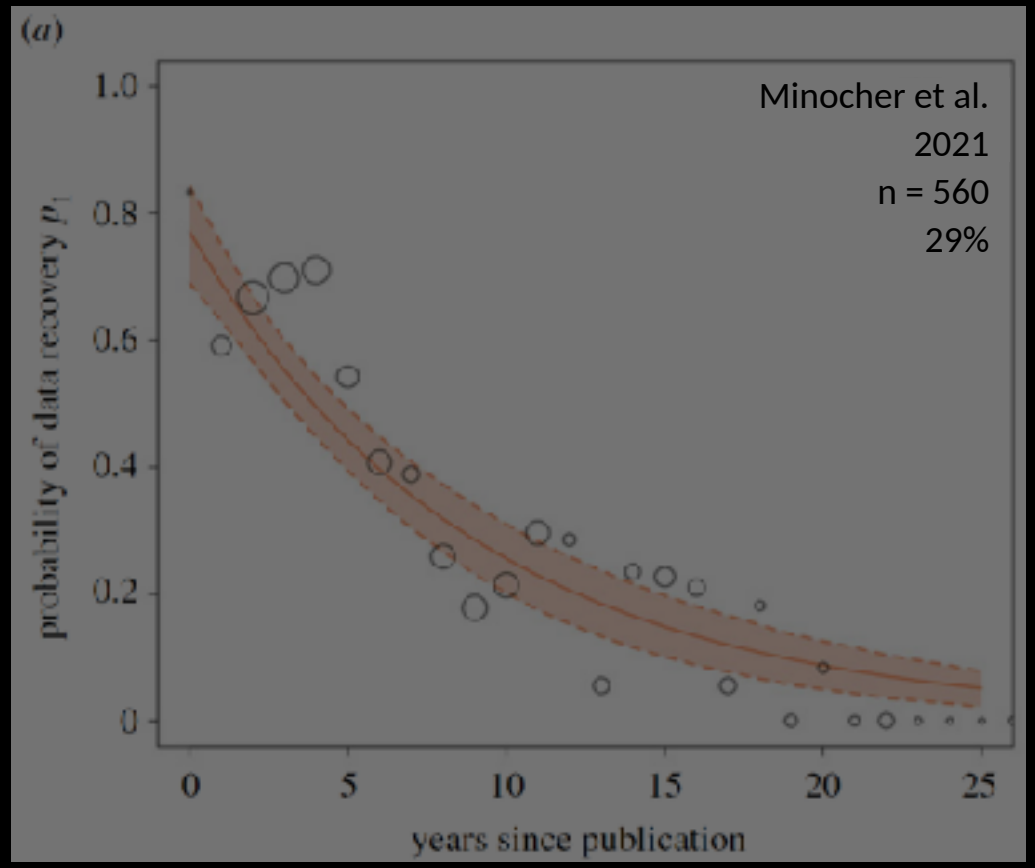
P(data reusable) = 87%

Why? Data reusability



56% datasets are incomplete

1955-2018



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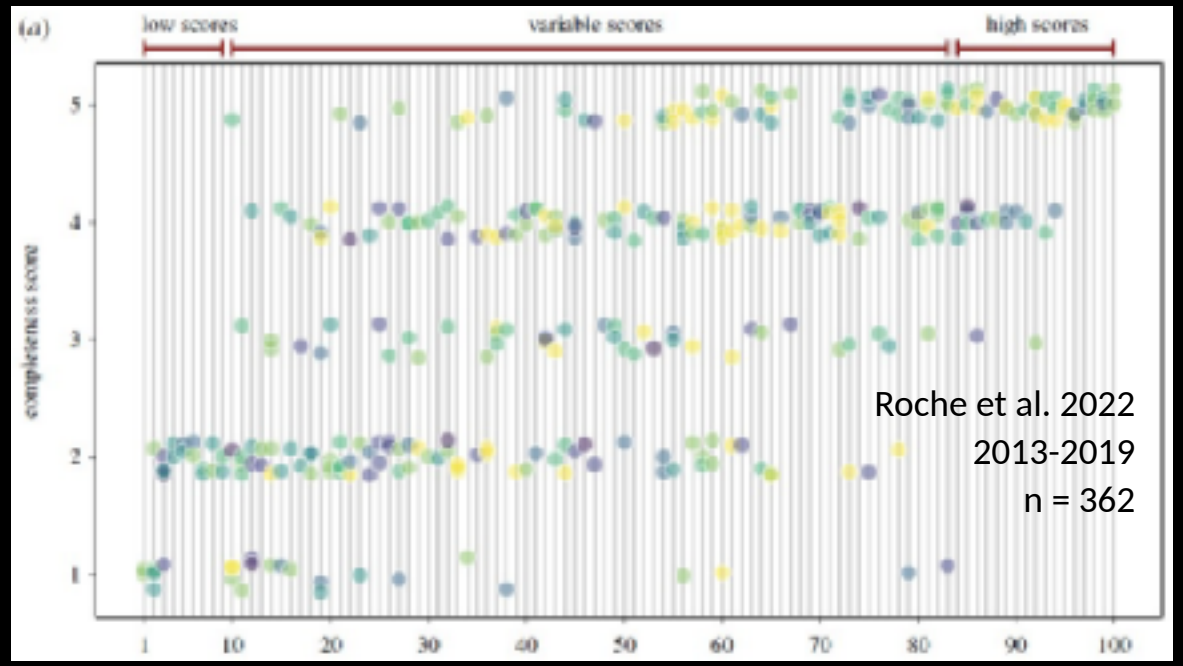
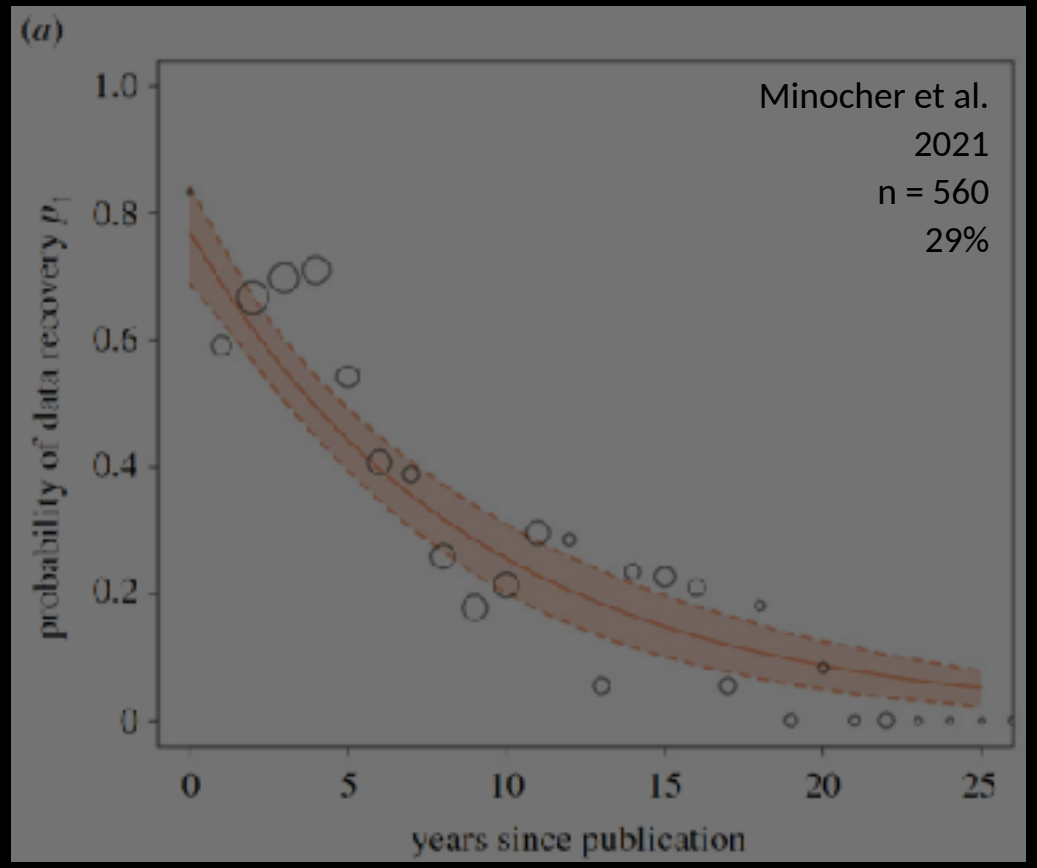


56% datasets are STILL incomplete

1955-2018



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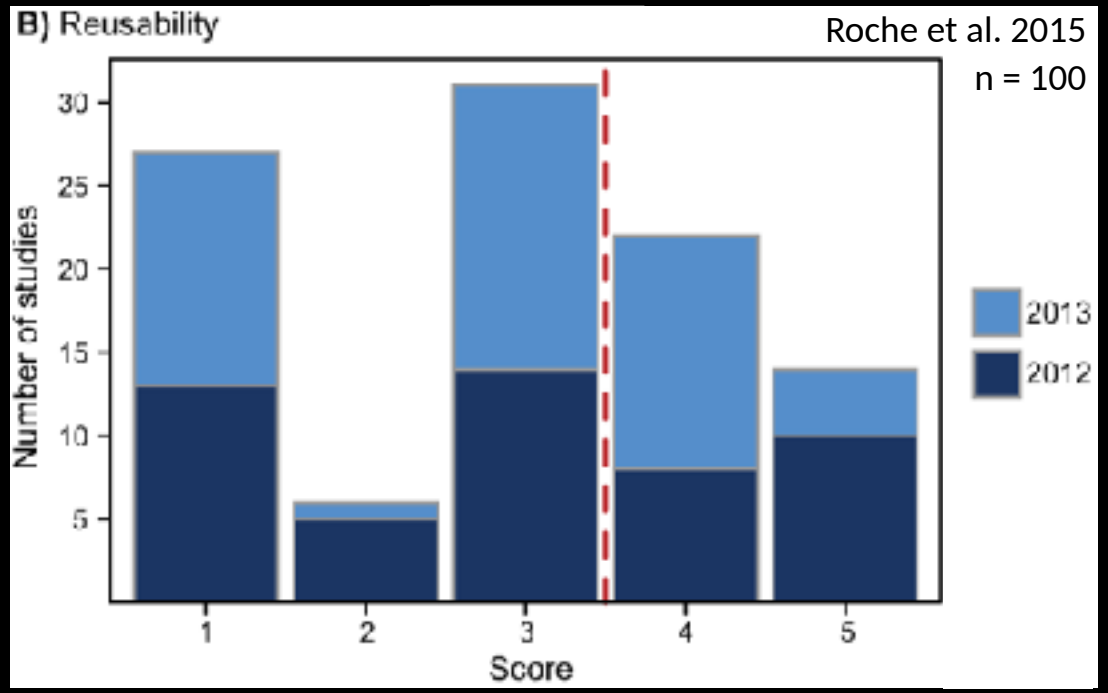
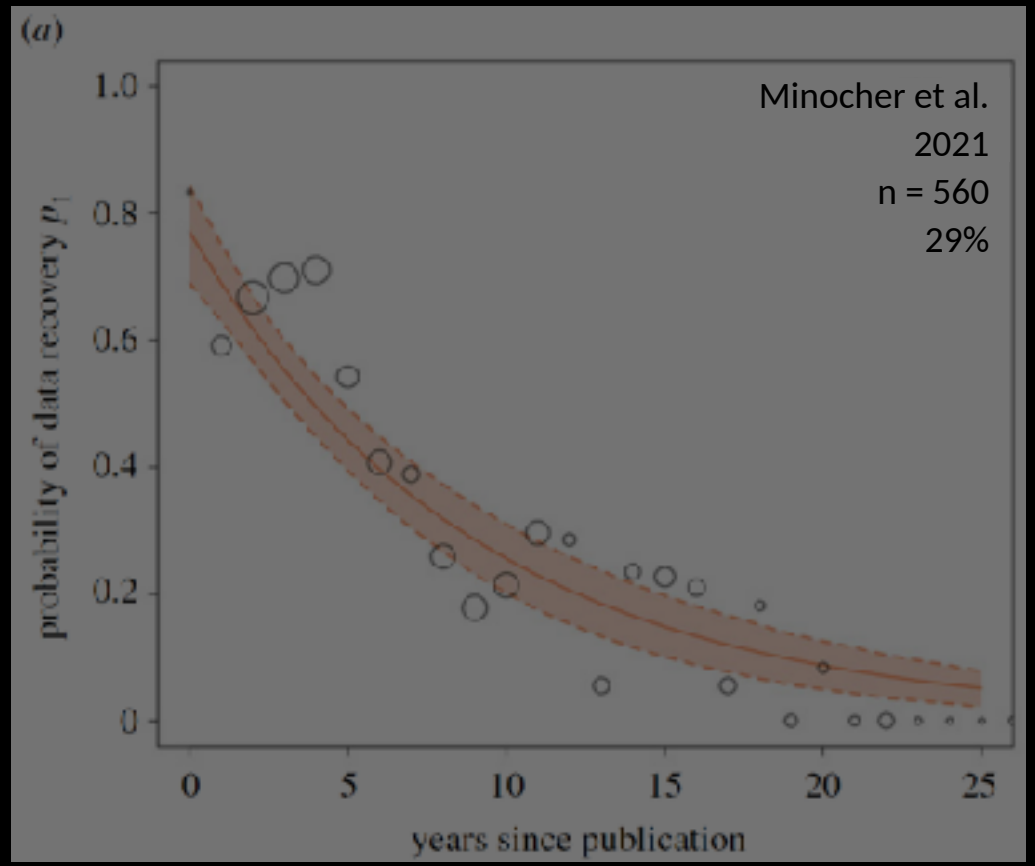


64% datasets are not usable

1955-2018



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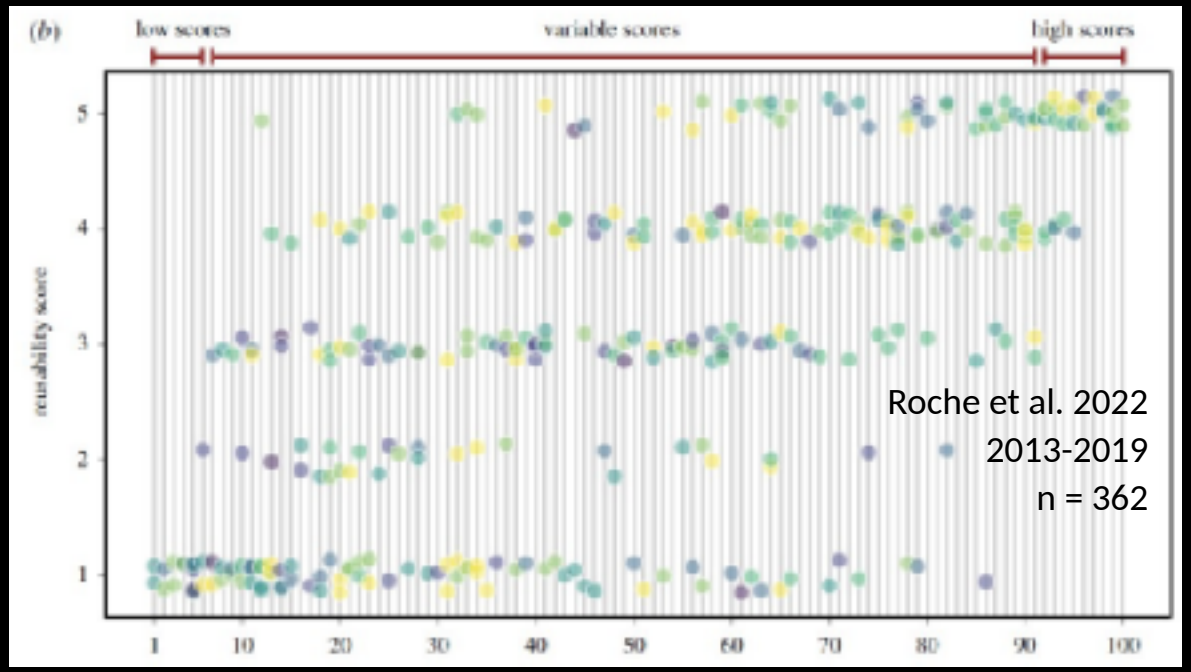
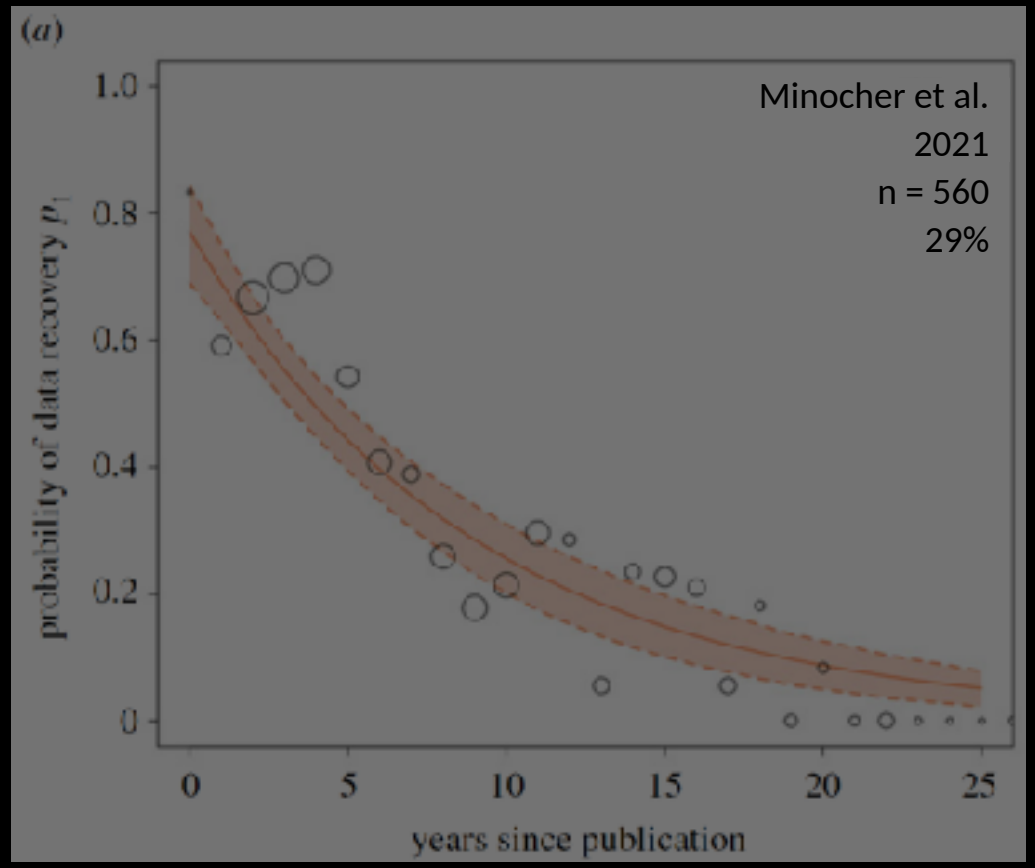


46% datasets are not usable

1955-2018



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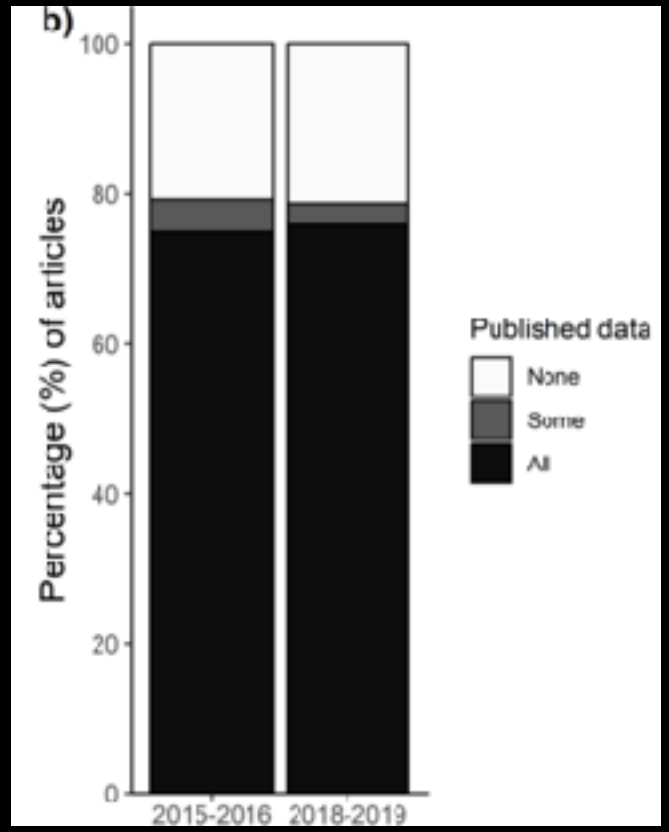
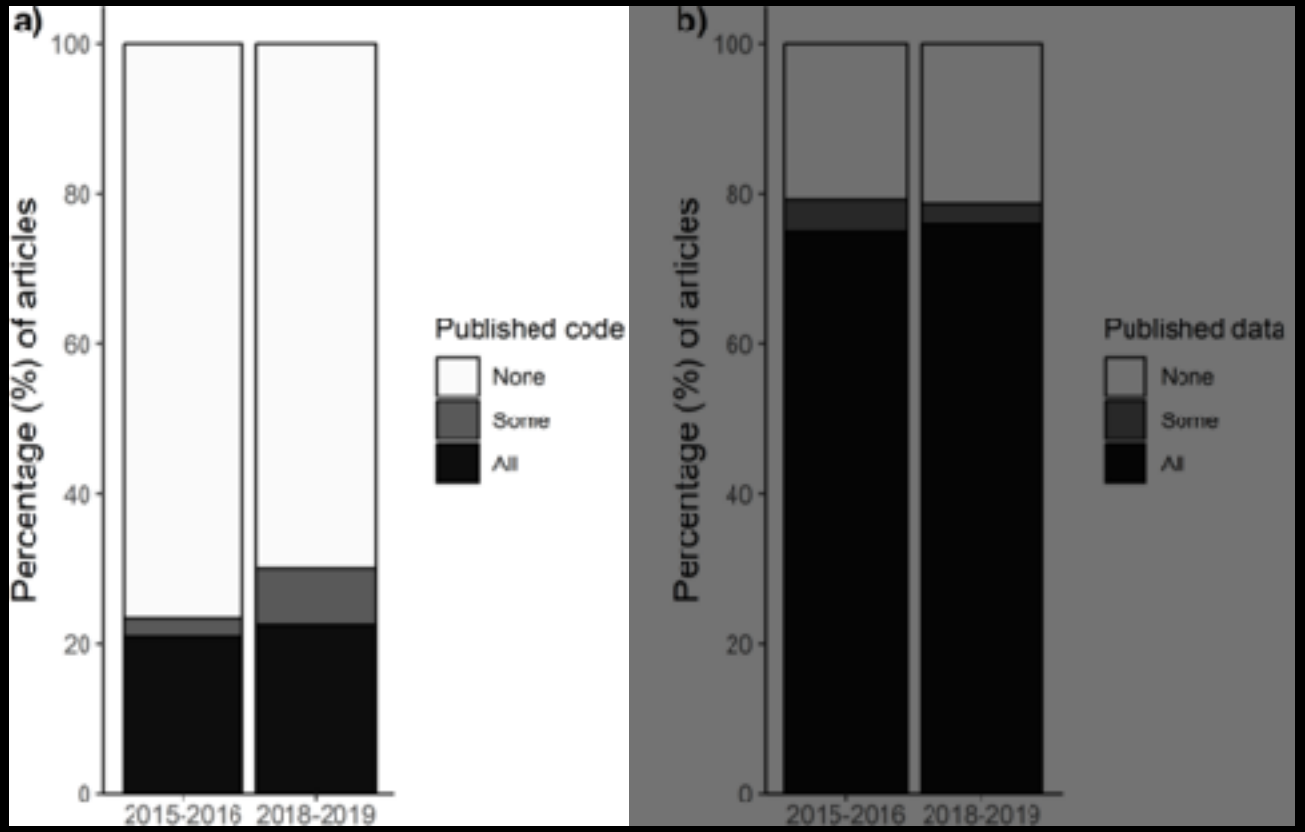


79% data-sharing

Why? Code availability

Culina et al. 2020
2015-2019
n = 346



27% code-sharing

79% data-sharing

Why? Code availability

Culina et al. 2020
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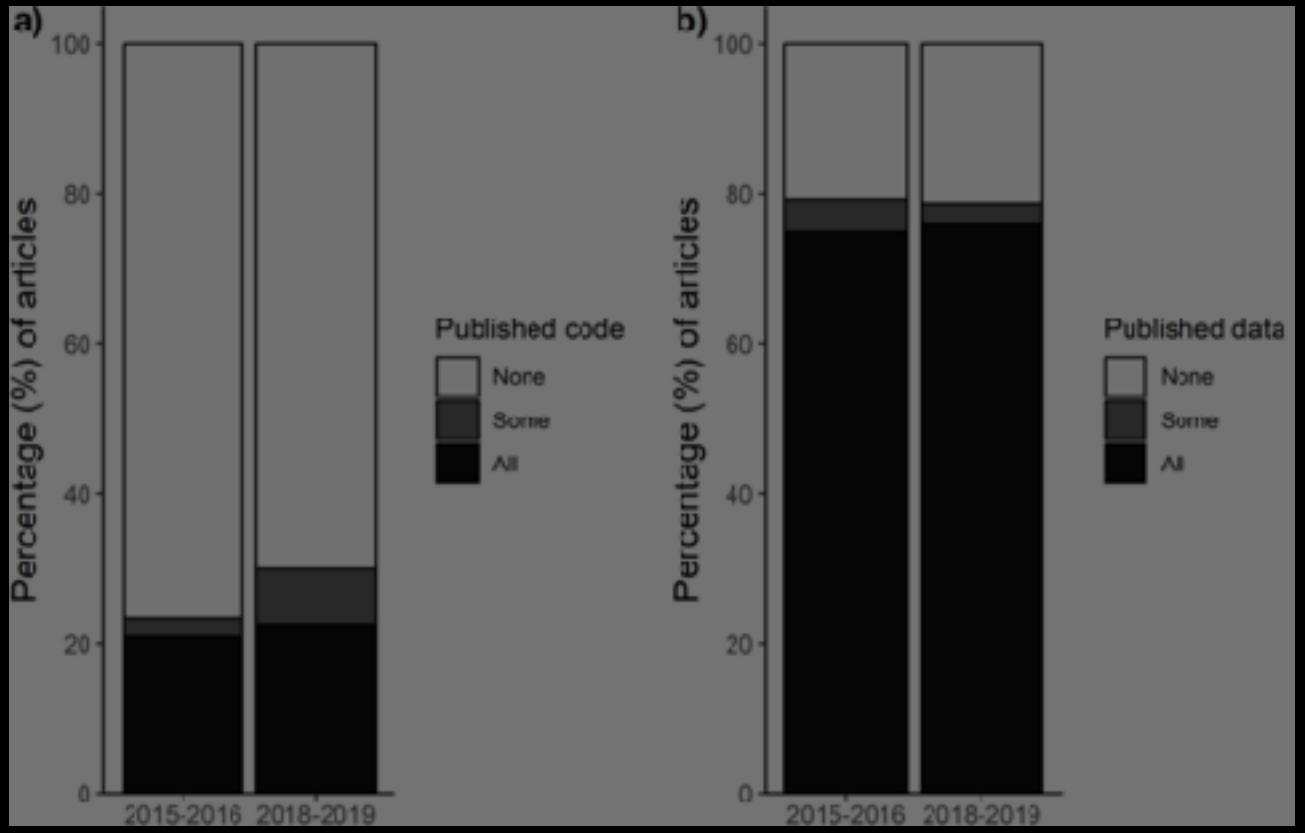
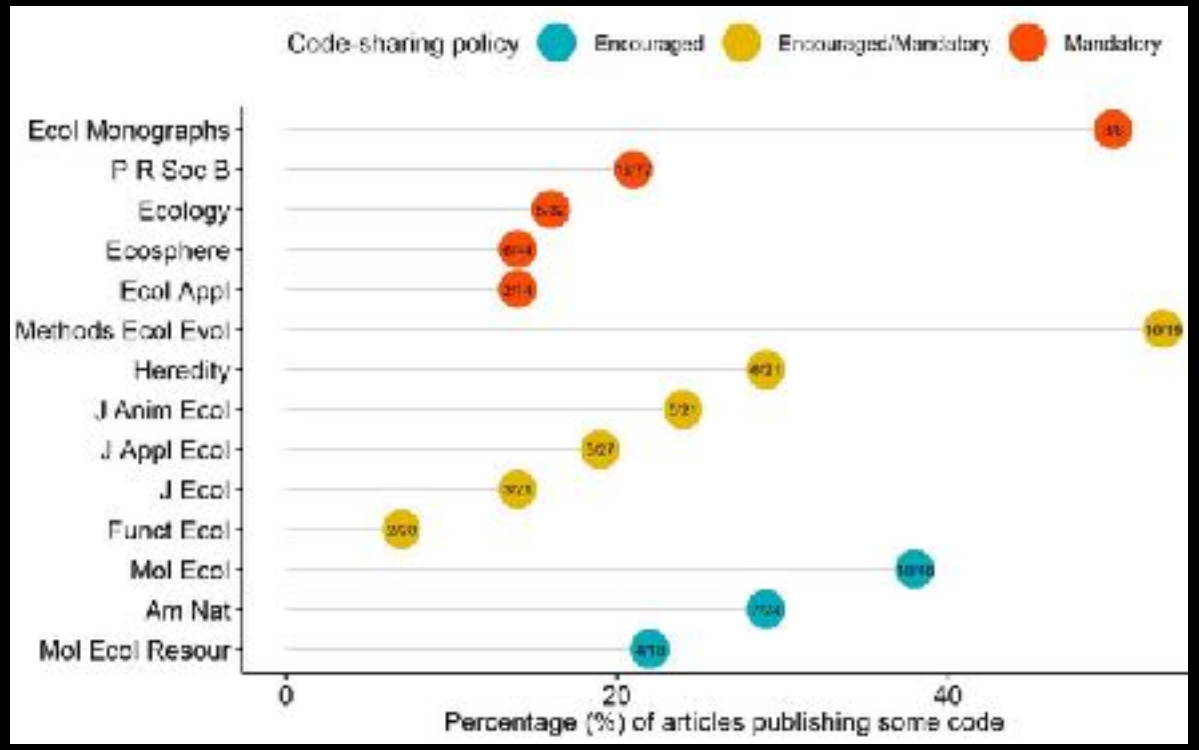


27% code-sharing

79% data-sharing



Among-journal: 7% – 53% code-sharing

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THE JOURNAL OF WILDLIFE MANAGEMENT

2016-2018

Note | Open Access

Computational Reproducibility in The Wildlife Society's Flagship Journals

Althea A. Archmiller, Andrew D. Johnson, Jane Nolan, Margaret Edwards, Lisa H. Elliott, Jake M. Ferguson, Fabiola Iannarilli, Juliana Vélez, Kelsey Vitense, Douglas H. Johnson, John Fieberg ... See fewer authors

First published: 17 March 2020 | https://doi.org/10.1002/jwmg.21855 | Citations: 1

Testable = 18% (n = 74)

THE JOURNAL OF WILDLIFE MANAGEMENT

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First published: 17 March 2020 | https://doi.org/10.1002/jwmg.21855 | Citations: 1

Testable = 18% (n = 74)

Reproducible = 68% (n = 19)

THE JOURNAL OF WILDLIFE MANAGEMENT

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Reproducible = 68% (n = 19)

ROYAL SOCIETY OPEN SCIENCE

royalsocietypublishing.org/journal/rsos

Research

Cite this article: Minocher R, Atmaca S, Bavero C, McElreath R, Beheim B. 2021 Estimating the reproducibility of social learning research

Estimating the reproducibility of social learning research published between 1955 and 2018

Riana Minocher, Silke Atmaca, Claudia Bavero, Richard McElreath and Bret Beheim

Testable = 24% (n = 560)

THE JOURNAL OF WILDLIFE MANAGEMENT

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ROYAL SOCIETY OPEN SCIENCE

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Research

Cite this article: Minocher R, Atmaca S, Bavero C, McElreath R, Beheim B. 2021 Estimating the reproducibility of social learning research

Estimating the reproducibility of social learning research published between 1955 and 2018

Riana Minocher, Silke Atmaca, Claudia Bavero, Richard McElreath and Bret Beheim

Testable = 24% (n = 560)

Reproducible = 81% (n = 40)

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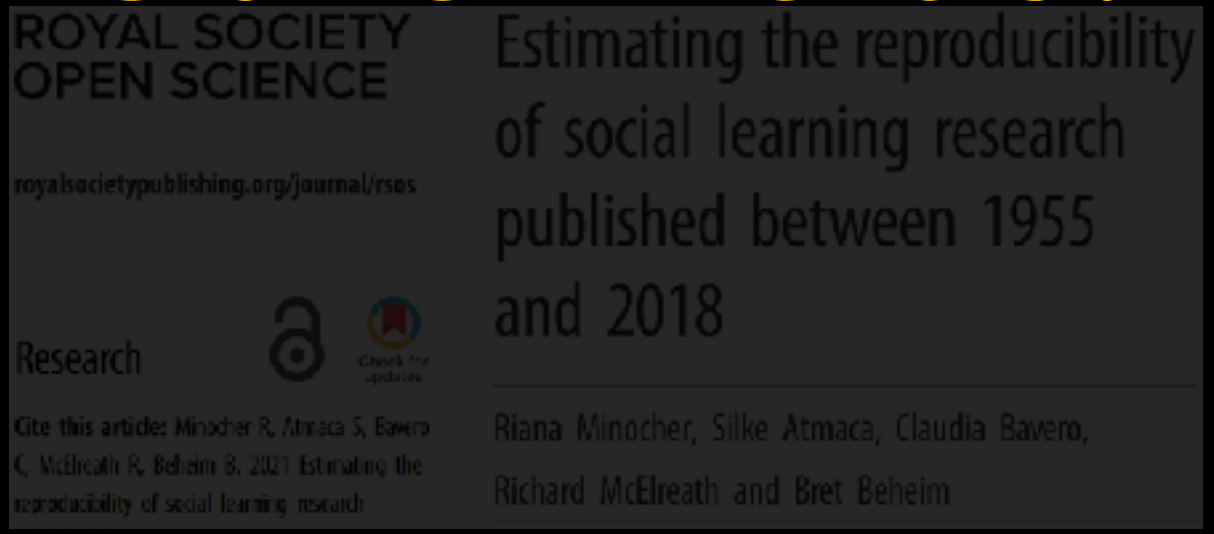
Testable = 18% (n = 74)

Reproducible = 68% (n = 19)

Other fields: 18% to 80%



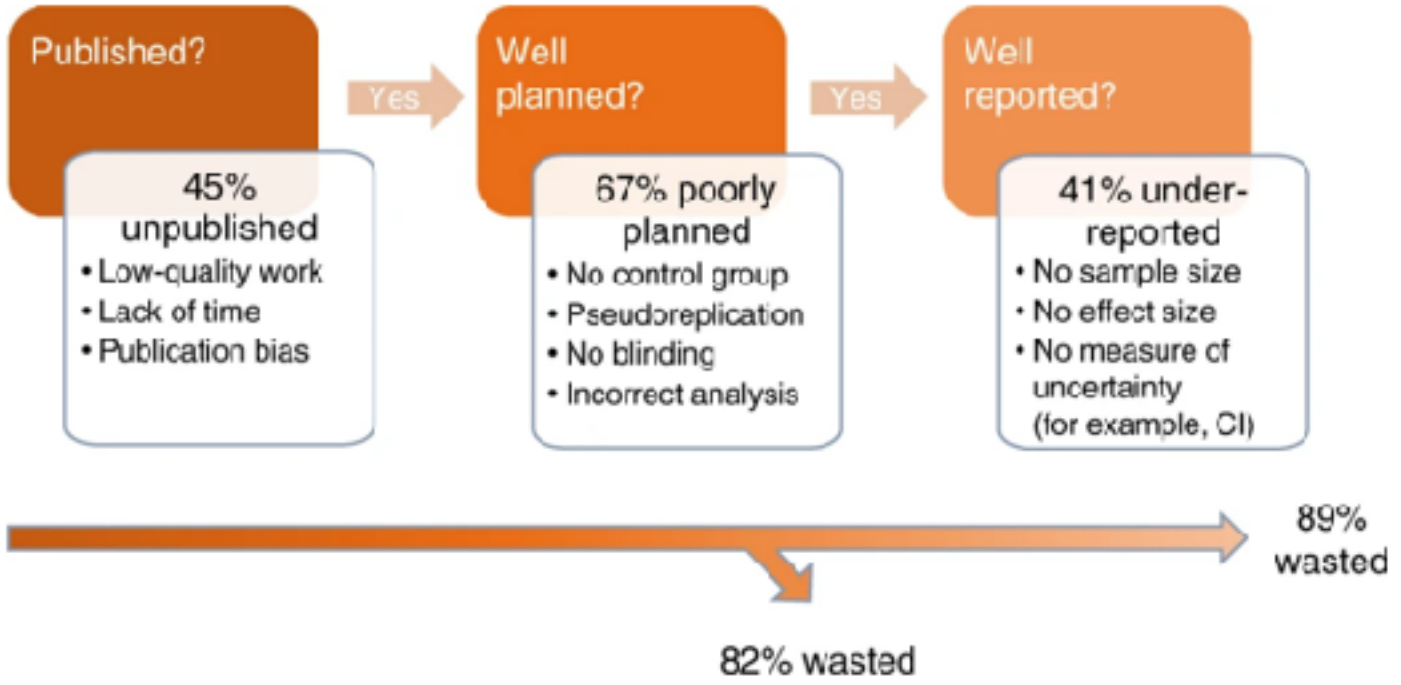
Testable = 24% (n = 560)

Reproducible = 81% (n = 40)

All in all

Fig. 2: Overall estimate of research waste of ecological research based on a meta-analysis of waste at each stage (with examples of causes).

From: Quantifying research waste in ecology



In the best-case scenario, 82% of research is wasted and thus is unused because all under reporting is assumed to happen in poorly planned studies. In the worst-case scenario, 89% of the research is unused because all of the under reporting is assumed to happen in the otherwise well-planned research. Consequently, only 11–18% of conducted ecological research can inform users (other researchers, public, policymakers) fully.

Purgar et al. 2022

No, but really, what about Ecology and Evolutionary Biology?

Positive results

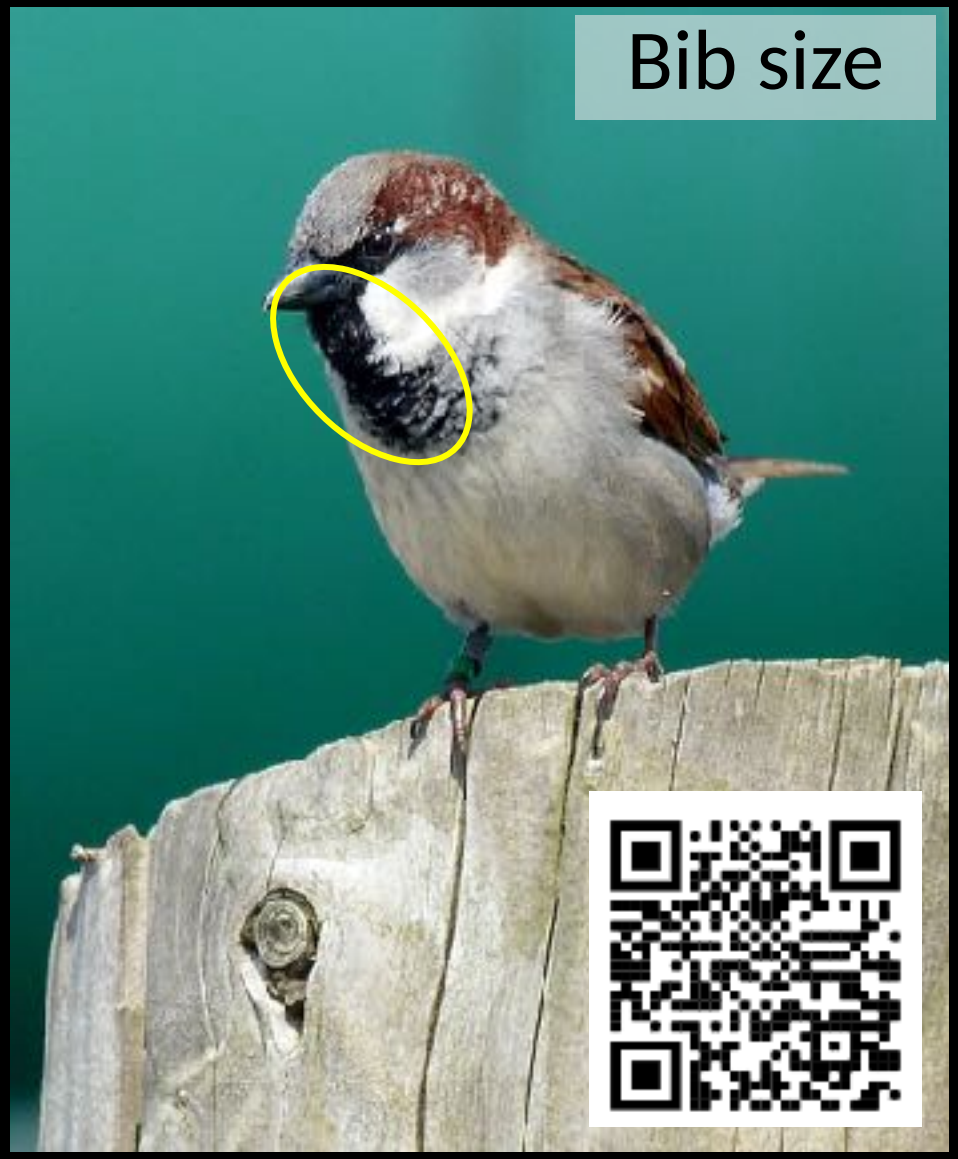
$p < 0.05$

Negative results

$p > 0.05$

Meta-analysis challenges a textbook example of status signalling and demonstrates publication bias

Alfredo Sánchez-Tójar[1,2†*], Shinichi Nakagawa[3], Moisès Sánchez-Fortún[1,4‡], Dominic A Martin[2§], Sukanya Ramani[1,5], Antje Girndt[1,2], Veronika Bókony[6], Bart Kempenaers[7], András Liker[8], David F Westneat[9], Terry Burke[4], Julia Schroeder[1,2]



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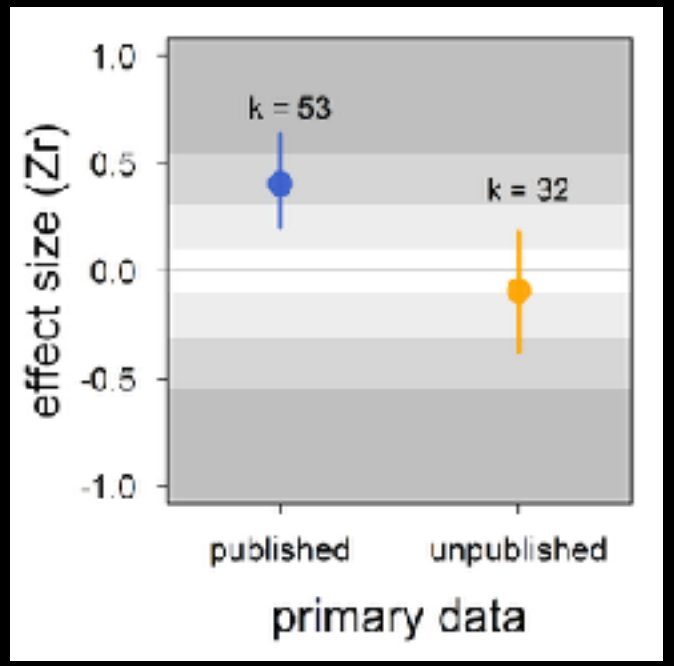

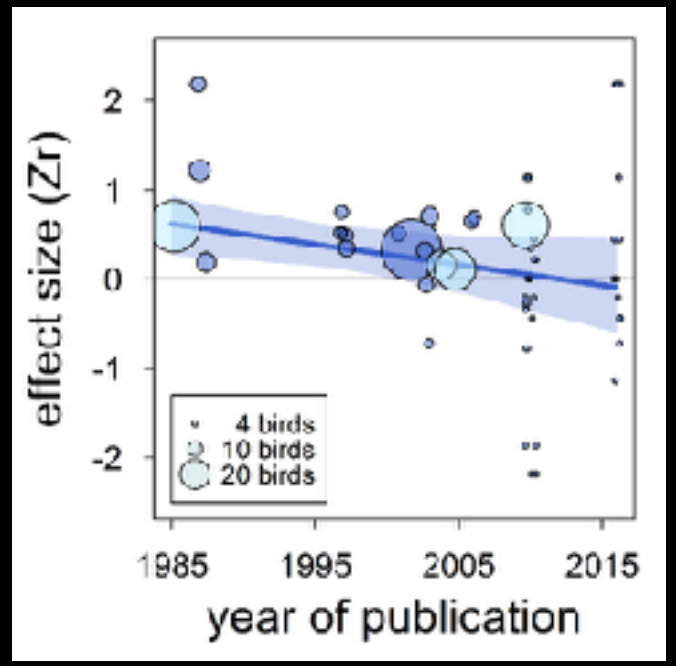

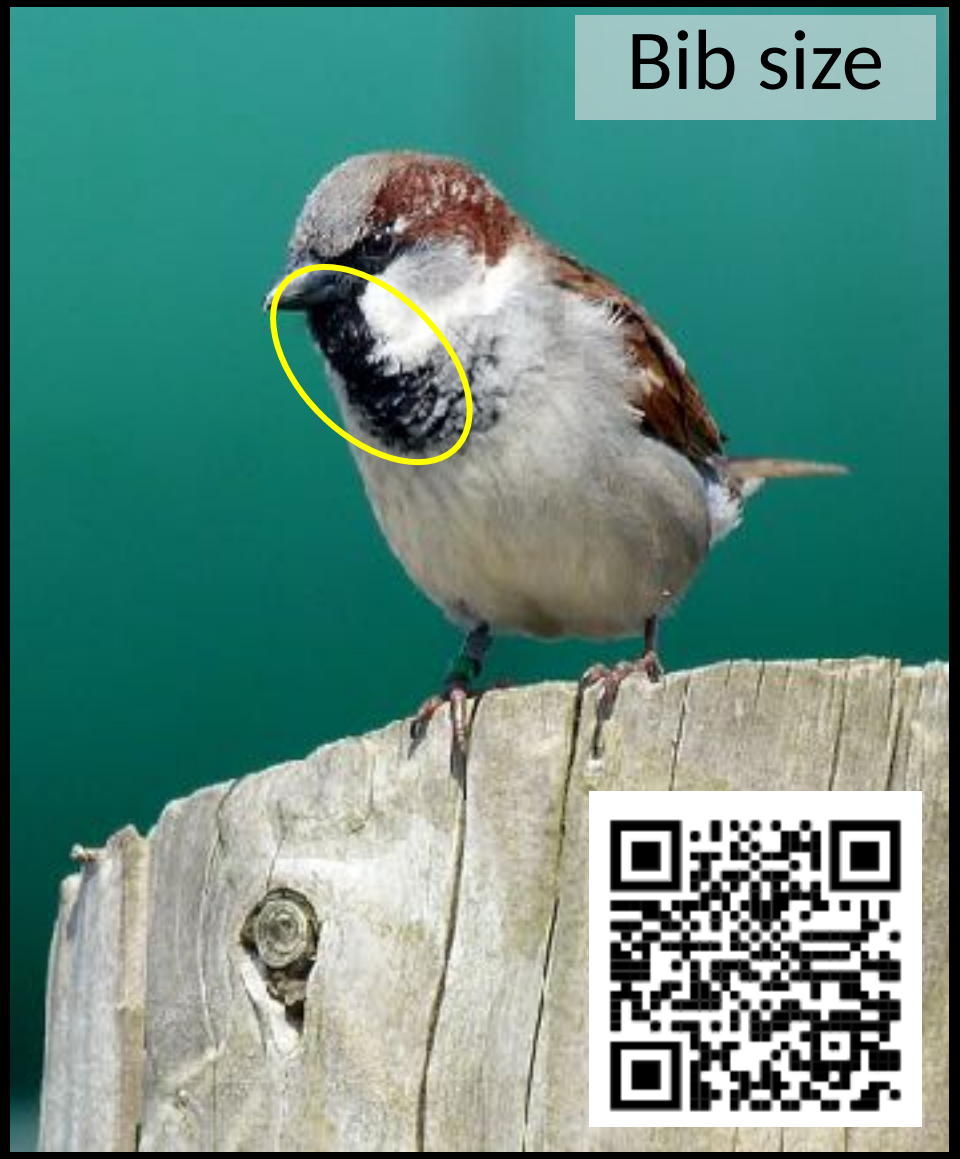

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BIOLOGICAL REVIEWS

Cambridge Philosophical Society

Received: 6 February 2021 | Accepted: 5 June 2021

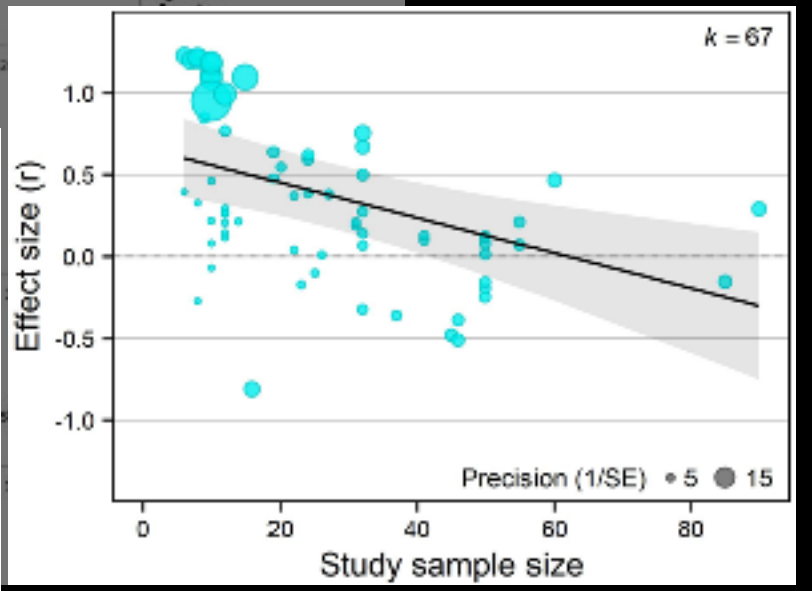
DOI: 10.1111/1365-2656.13554

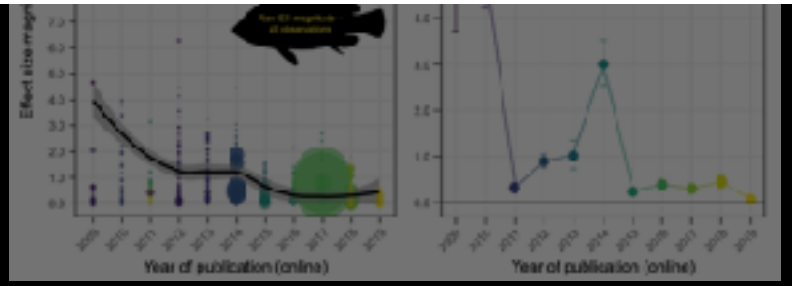
RESEARCH ARTICLE

Journal of Animal Ecology

Male size and reproductive performance in three species of livebearing fishes (*Gambusia* spp.): A systematic review and meta-analysis

Bora Kim[1] | Nicholas Patrick Moran[1,2] | Klaus Reinhold[1] | Alfredo Sánchez-Tójar[1]





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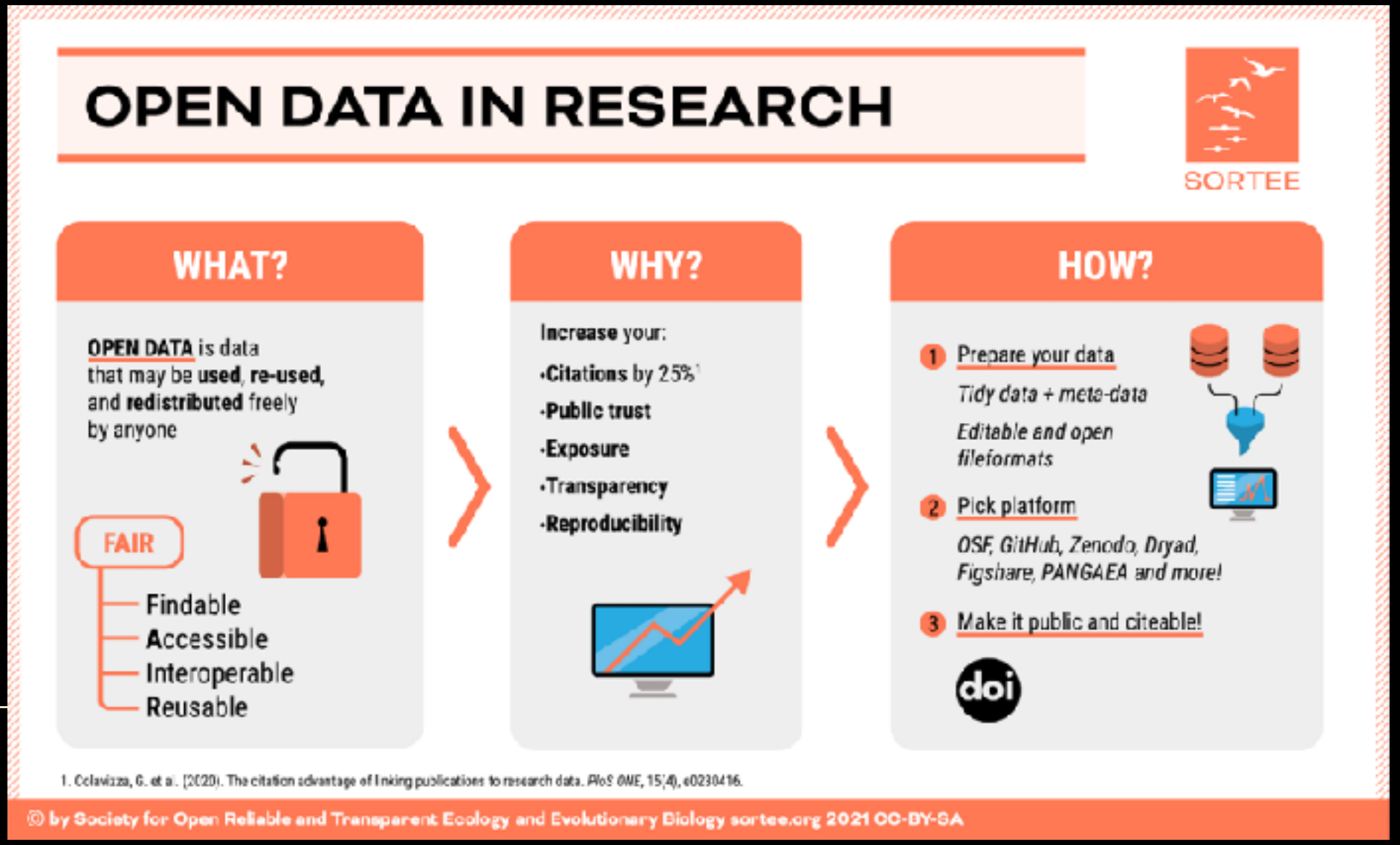
What can we do about it?

Transparency



evolutionary biology

Transparency

>WHY OPEN CODE IN RESEARCH?

SORTEE

RESEARCHERS STUDENTS

- **Learning** new computational **methods**
- **Sharing** verified resources
- **Collaborating** efficiently
- **Reproducing** statistical analyses
- Improving **employability**

FUNDERS

- Reducing **costs**
- Improving research **efficiency**
- Increasing **transparency** and **integrity**
- Facilitating project **evaluations**
- **Showcasing** best projects

JOURNALS PUBLISHERS

- Increasing **impact** of papers
- Improving journal's **metrics/ranking**
- Improving **peer-review** process
- Ensuring integrity
- Becoming role **models** in open science

PRACTICIONERS AGENCIES

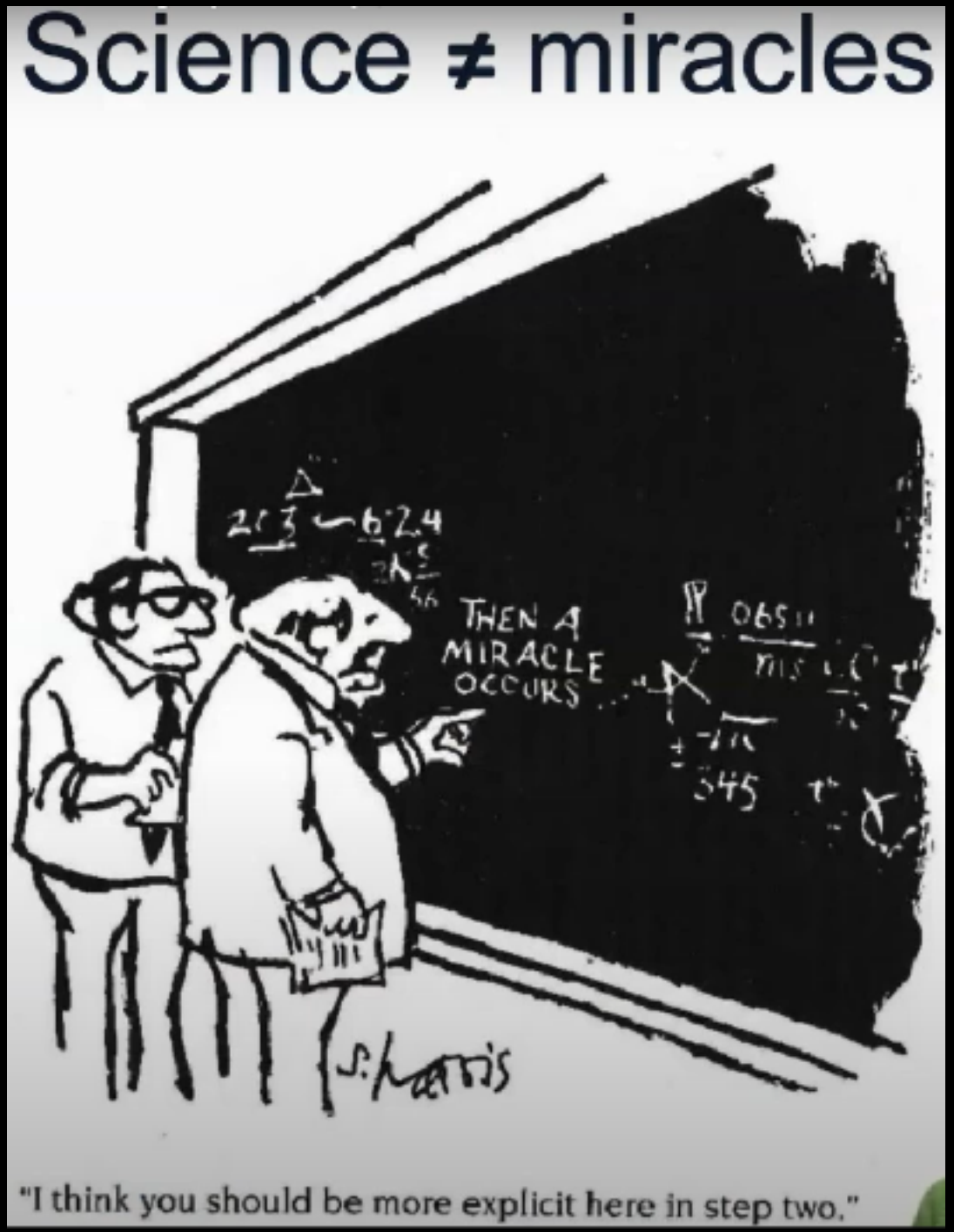
- Facilitating **industry applications**
- Encouraging **collaborations**
- **Leading change** to best practice
- Supporting **R&D** information transfer
- **Repurposing** code

GENERAL PUBLIC

- **Building trust** in science
- Encouraging **public access**
- Delivering robust, science-based **solutions**
- Promoting public **computational literacy**
- Reusing code in **citizen-science**

evolutionary biology

Science ≠ miracles



"I think you should be more explicit here in step two."

Pre-registration & Registered Reports

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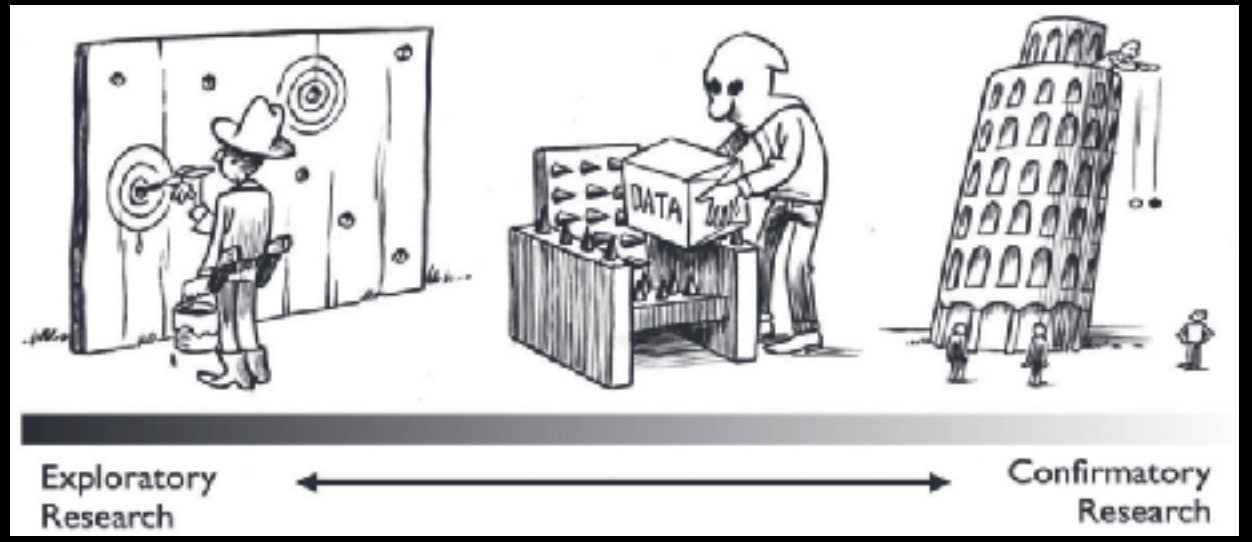
Pre-registration

Time-stamped record of decisions around study design, methods and analysis, that is created before data are collected or become accessible

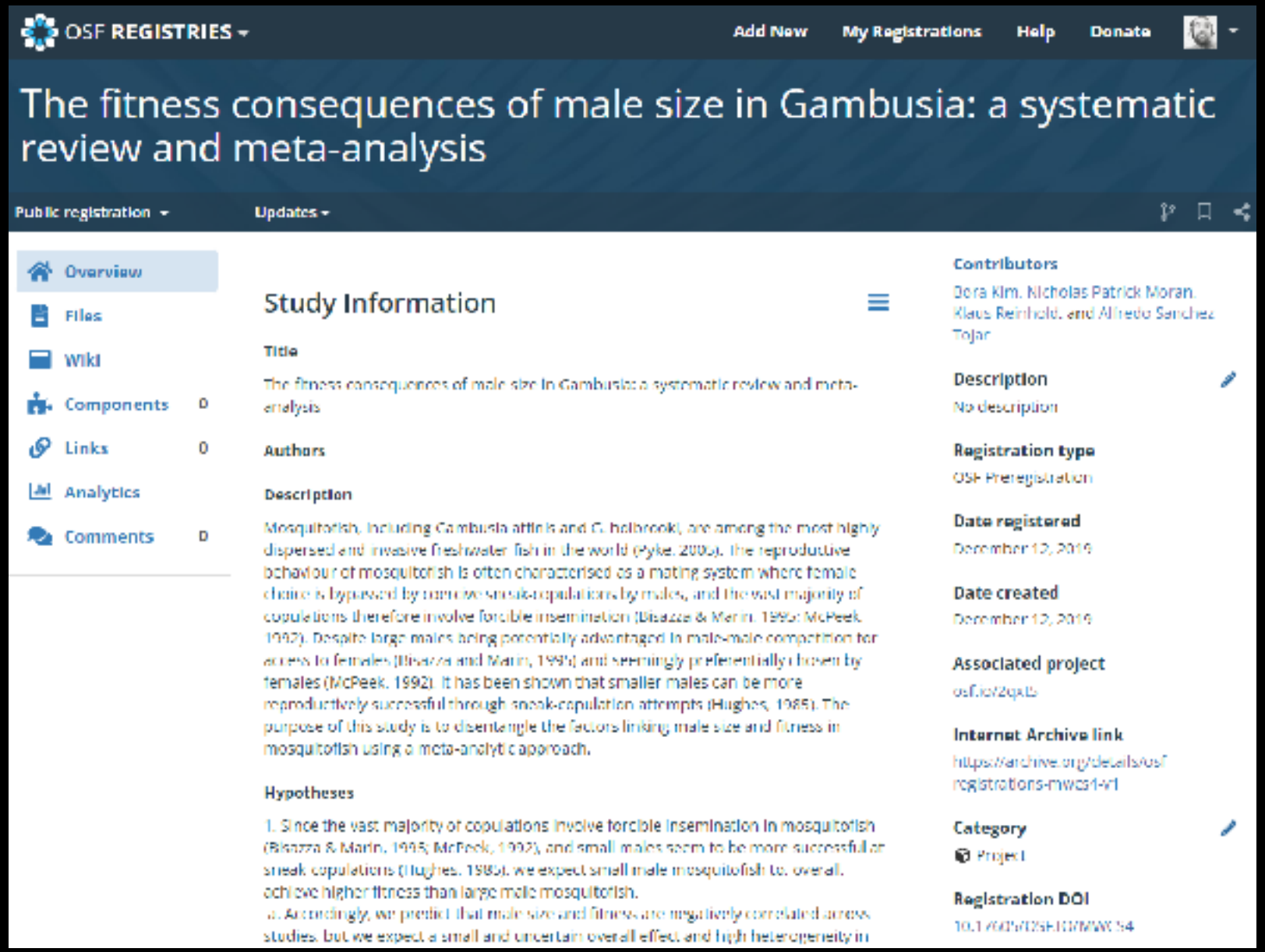
Stewart et al. 2020

Pre-registration

Time-stamped record of decisions around study design, methods and analysis, that is created before data are collected or become accessible



Stewart et al. 2020



Pre-registration template!

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Sampling Plan

Existing Data

Registration prior to analysis of the data

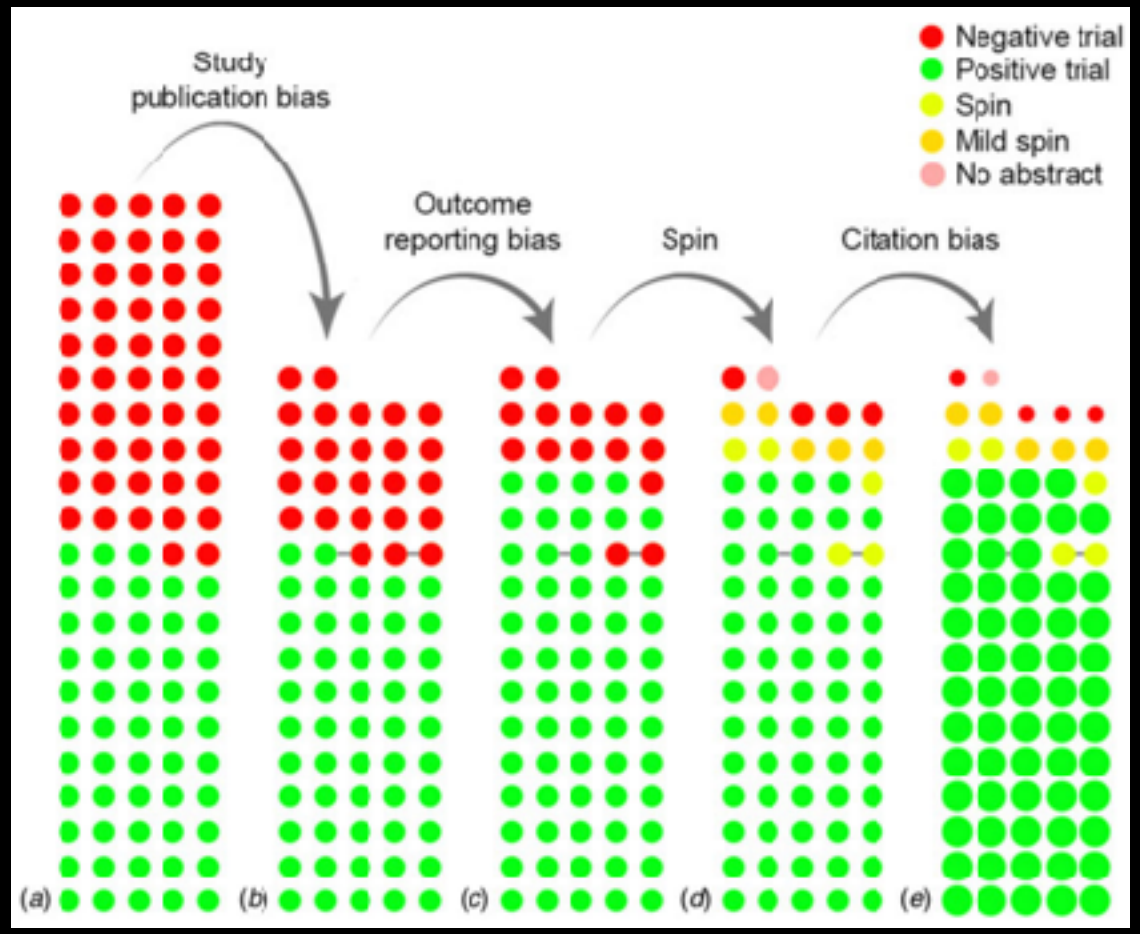
Explanation of existing data

Extraction of data from included studies has begun by one author (BK) as of the time of preregistration, but is only partially complete. The hypotheses contained herein have been formulated without knowledge of the data that have been extracted, with no awareness of any patterns therein, prior to the calculation of any effect sizes and prior to any analysis of those data.

Data collection procedures

We conducted a systematic search of literature in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (Moher et al., 2009). The literature search was performed in two electronic search engines, Web of Science (https://www.webofknowledge.com) and PubMed (https://www.ncbi.nlm.nih.gov/pubmed), to increase the number of relevant studies found. The search query was designed to find papers that: (1) used Gambusia sp. as a model organism; (2) included a measure of male size; and, (3) a measure or proxy of male fitness. The specific search string used (with some minor syntax edits for each database) was: ("gambusia" OR "mosquitofish") AND ("social rank" OR dominan* OR subordinat* OR leadership OR hierarch* OR compet* OR aggressi* OR fight* OR "body size" OR "body length" OR "body mass" OR "body weight" OR "male size" OR "male length" OR "mate choice" OR "mate defen*e" OR "mate monopol*" OR "genital* length" OR "genital* size" OR "gonopodi* length" OR "gonopodi* size" OR "intromittent organ length" OR "intromittent organ size" OR "individual* size" OR "individual* length") AND (fitness OR success OR "sexual selection" OR "sexual dimorphism" OR paternity OR heterozygosity OR "inbreeding depression" OR "alternative reproductive tactic*" OR reproduct* OR mating)

Pre-registration



The cumulative effect of reporting and citation biases on the apparent efficacy of treatments: the case of depression

Y. A. de Vries[1,2], A. M. Roest[1,2], P. de Jonge[1,2], P. Cuijpers[3], M. R. Munafò[4,5] and J. A. Bastiaansen[1,6]

Food and Drug Administration database (FDA):

➢ Pharmaceutical companies must preregister all trials they intend to use to obtain FDA approval

De Vries et al. 2018

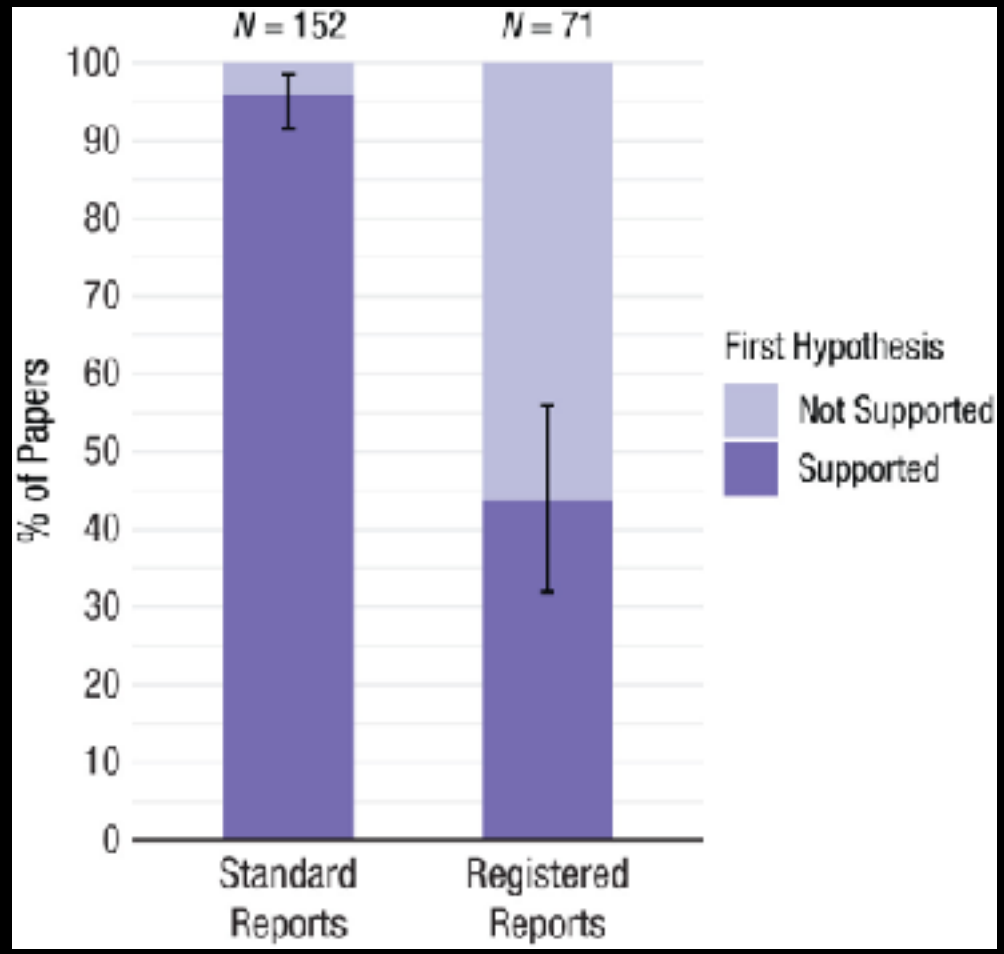
Registered Reports

Type of journal article that involves peer review of the pre-registration before data are collected. If the proposed study is accepted by the journal, the study's results will be published regardless of the outcome (i.e. no publication bias)

Stewart et al. 2020

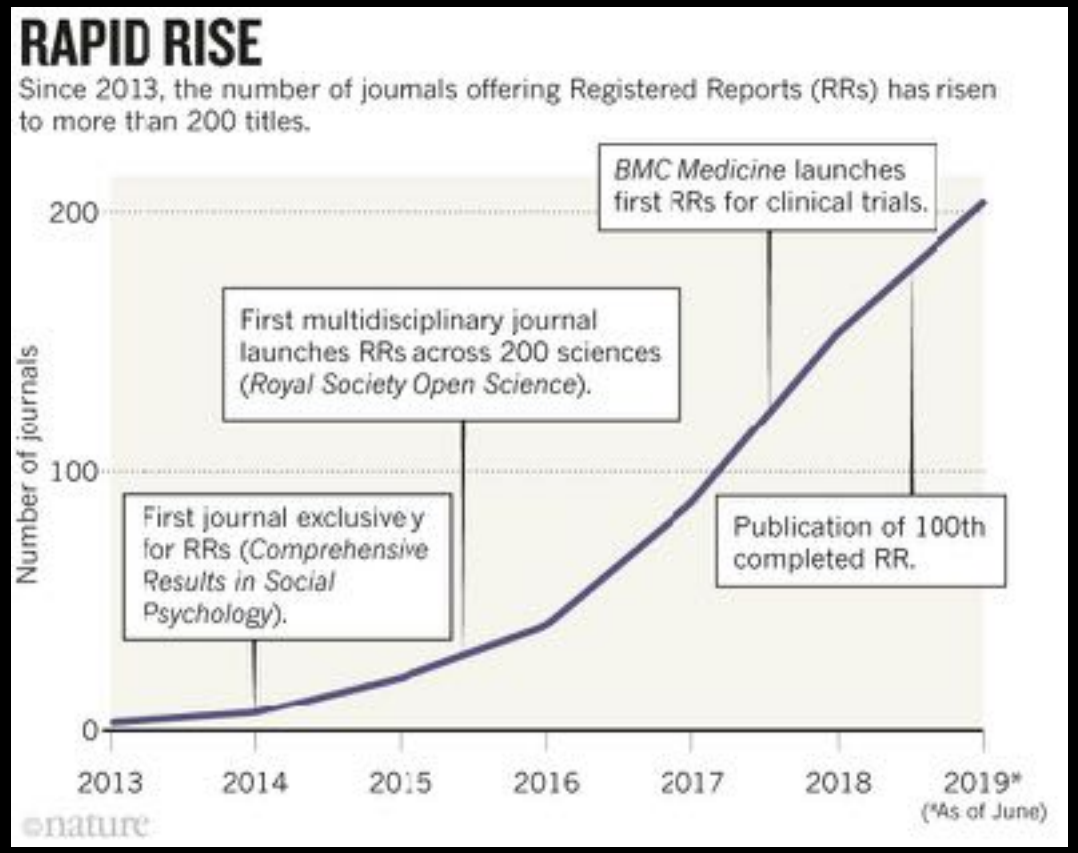
Registered Reports

Psychology



Scheel et al. 2021

Registered Reports



BMC Biology
BMC Ecology
Conservation Biology
Ecology and Evolution
Ethology
Frontiers in Ecology
Frontiers in Plant Science
F1000Research
Nature Communications
Nature Ecology and Evolution
PCI Registered Reports
PeerJ
PLoS Biology
PLoS ONE
Royal Society Open Science
Scientific Reports

Chambers 2019

Take home: we can do better!

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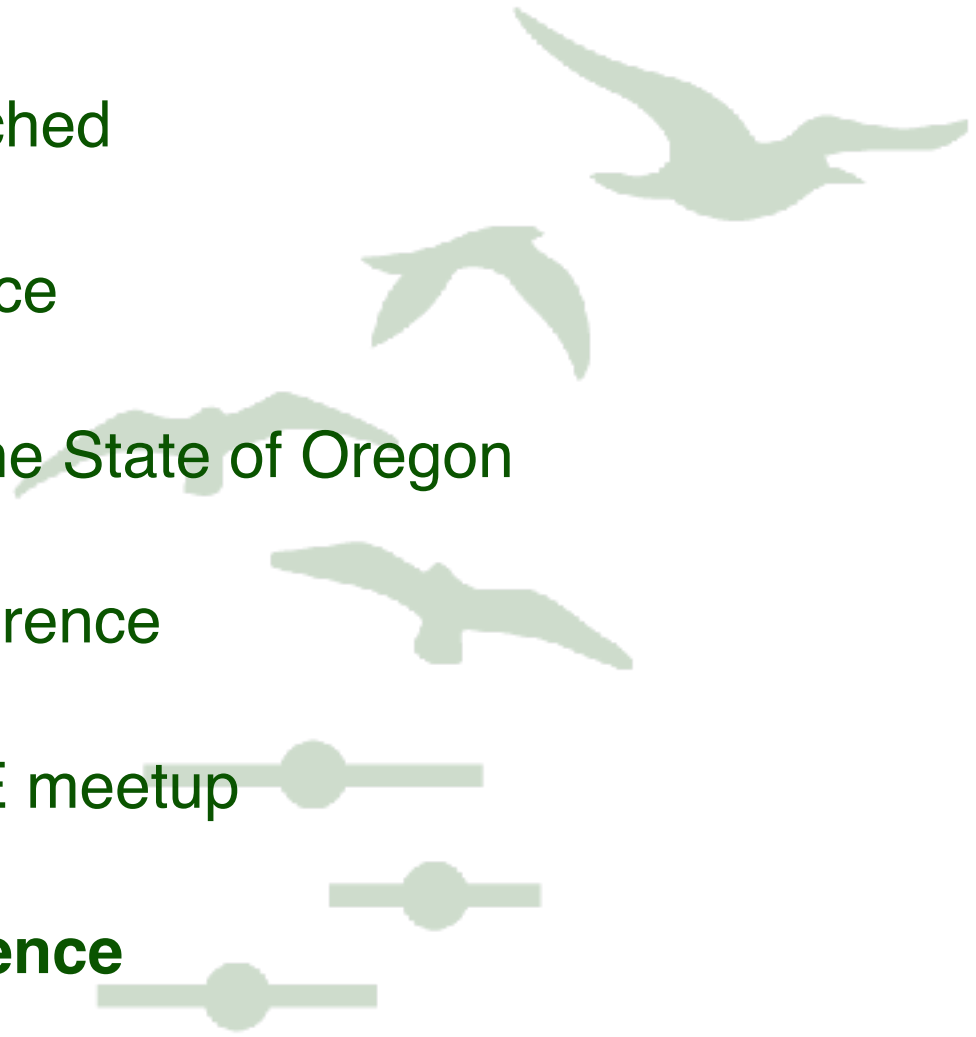
SORTEE

Society for Open, Reliable, and Transparent Ecology and Evolutionary Biology


SORTEE

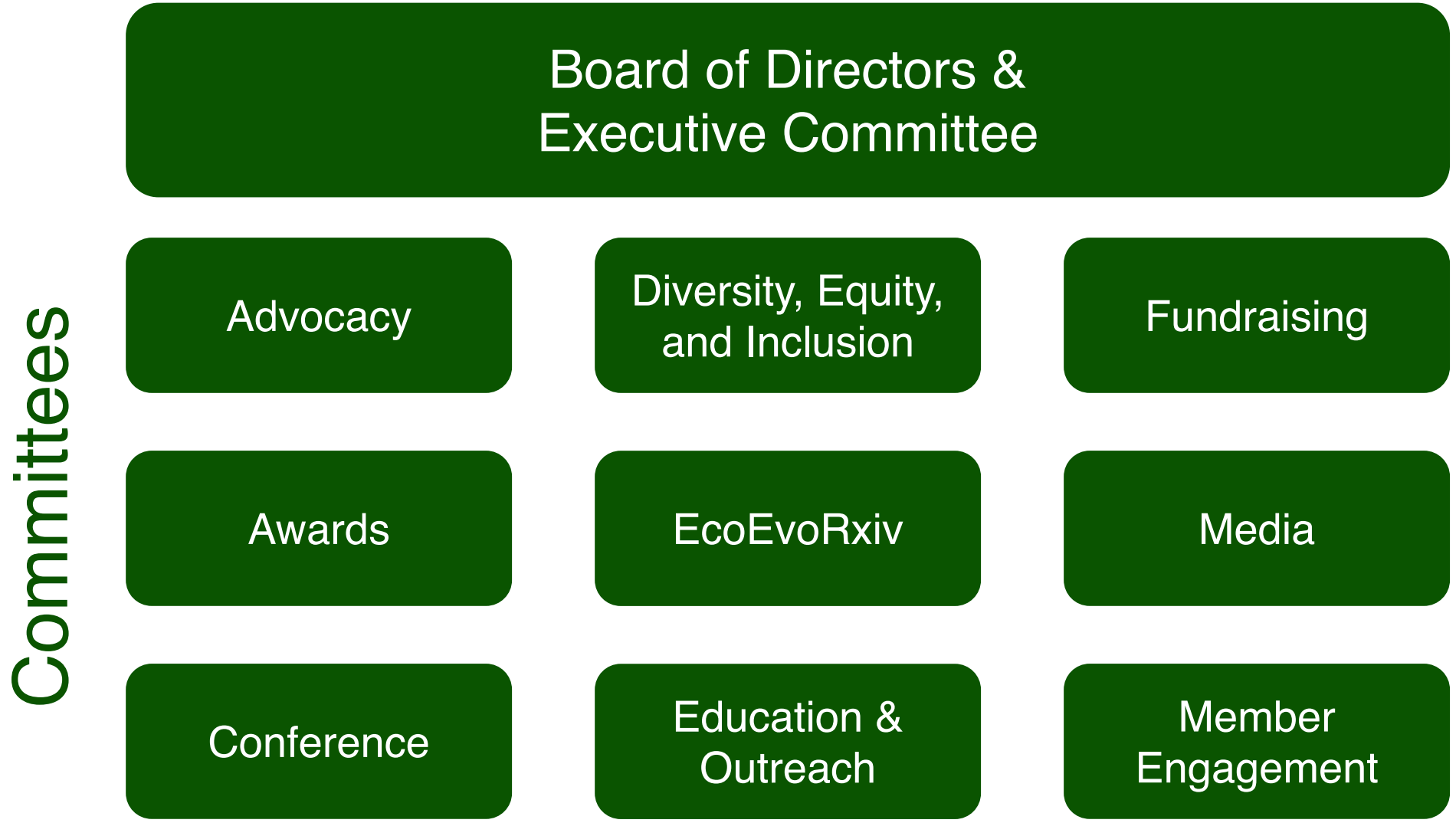
Short history of SORTEE

November 2019:	first zoom of founding committee
December 2020:	SORTEE publicly launched
July 2021:	first SORTEE conference
February 2022:	officially registered in the State of Oregon
July 2022:	second SORTEE conference
April 2022:	first in-person SORTEE meetup
October 2023:	**third SORTEE conference**



Structure of SORTEE:

www.sortee.org/people



Structure of SORTEE:

https://www.sortee.org/bylaws/

Board of Directors &
Executive Committee

Board:

- 2 student seats
- 2 early/mid-career seats
- 2 senior-career seats
- 3 open seats

Executive:

- President
- President-Elect
- Past President
- Secretary
- Treasurer

Spread the word!

https://tinyurl.com/volunteerSORTEE2024

Help run SORTEE next year!

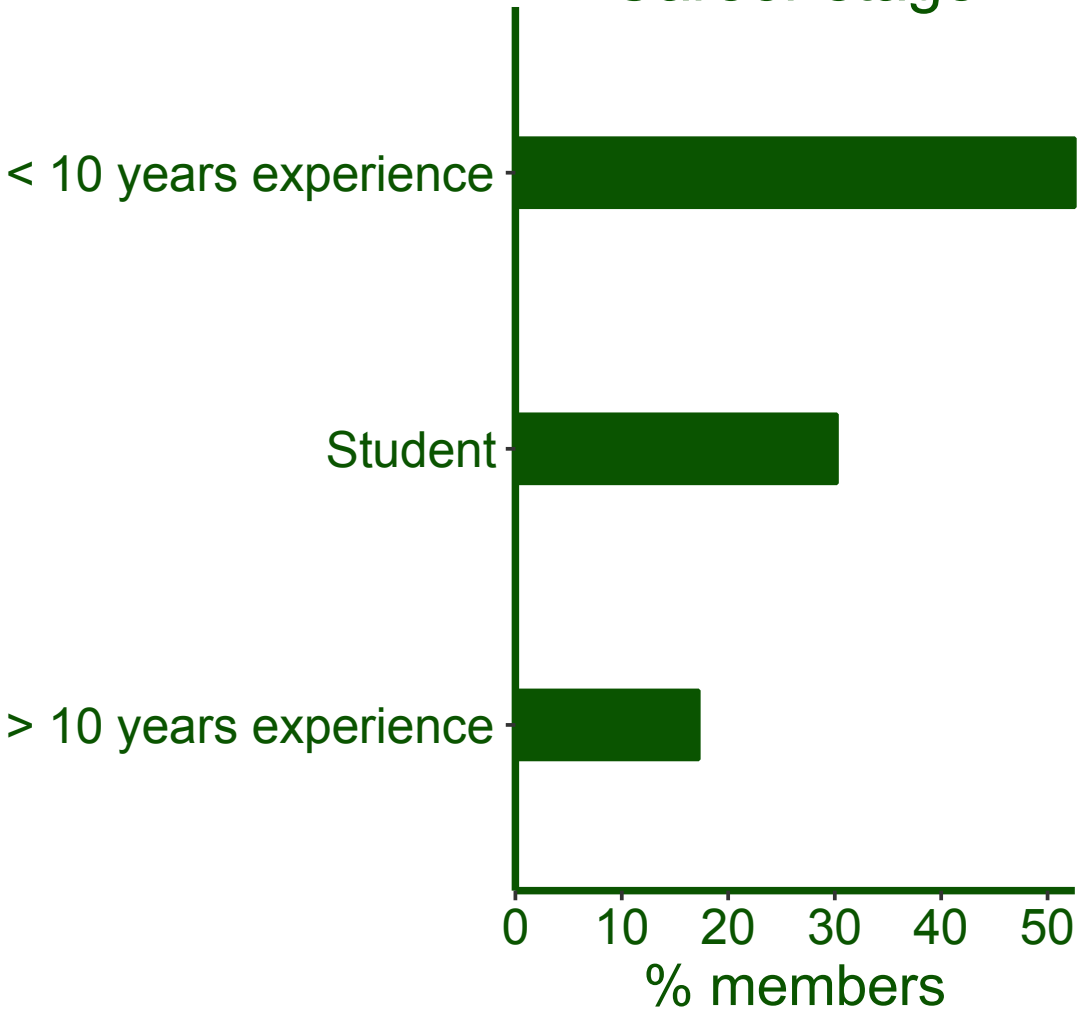
We're seeking **board** members, committee **chairs**, and committee **volunteers**

Nominate yourself **by October 25**

SORTEE

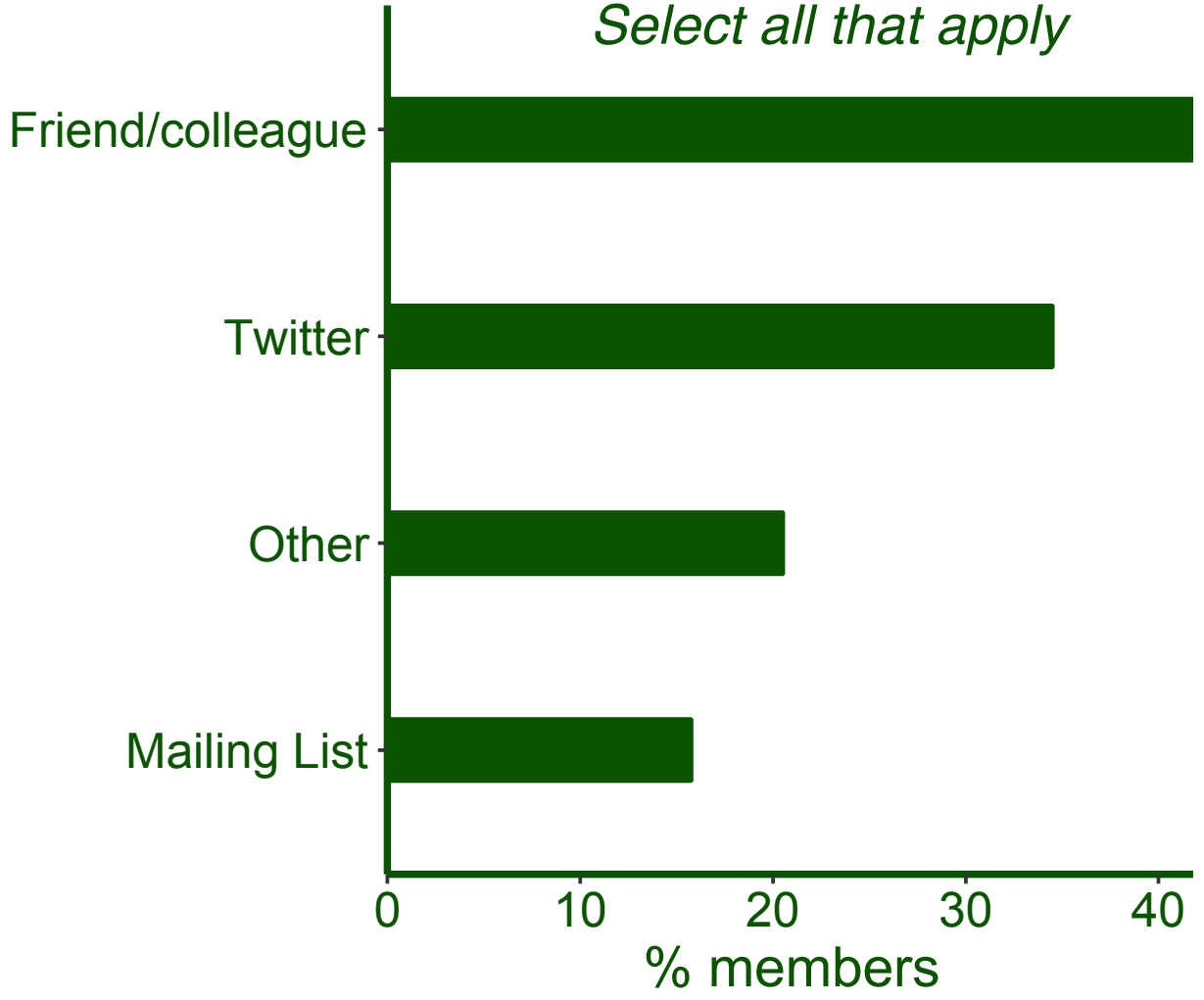
2023 SORTEE Members

Career stage



How did you learn about SORTEE?

Select all that apply



http://www.sortee.org/join/.

What issues related to open, reliable, and transparent science are most important to you? Select all that apply.

- [ ] Advocacy (advocating for policy change, institutional incentives, research assessment criteria)
- [ ] Article sharing practice (open access, overlay journal, right retention strategy, preprint)
- [ ] Code Sharing practice (Open code, computational reproducibility, licenses)
- [ ] Data sharing practices (Open and/or FAIR data)
- [ ] Meta-science, science and technology studies, philosophy and sociology of science
- [ ] Peer review reform
- [ ] Pre-analysis plan and study design (Pre-registration, Registered reports, Bias in reporting and inference)
- [ ] Replication

→ 57% of members

SORTEE members care about open data and code

What issues related to open, reliable, and transparent science are most important to you? Select all that apply.

- [ ] Advocacy (advocating for policy change, institutional incentives, research assessment criteria)
- [ ] Article sharing practice (open access, overlay journal, right retention strategy, preprint)
- [ ] Code Sharing practice (Open code, computational reproducibility, licenses)
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- [ ] Pre-analysis plan and study design (Pre-registration, Registered reports, Bias in reporting and inference)
- [ ] Replication

→ 76% of members

→ 80% of members

Spread the word!

EcoEvoRxiv currently accepts manuscripts in English, **Spanish**, and Portuguese

https://ecoevorxiv.org

Upskill with SORTEE's Workshops & Webinars

https://www.sortee.org/other_events/

Propose an event (honoraria offered to presenters)

Past events:

- Authoring documents, websites, presentations, and more with Markdown
- Creating reproducible workflows in R with the targets:: package
- An Ecologist's Introduction to Transitioning into Data Science
- Open Educational Resources as a Tool for More Inclusive Teaching in E&E
- Using and contributing open data to the Global Biodiversity Information Facility (GBIF)
- Equitability in data reuse in microbial ecology
- UK ambassadors for life sciences data stewardship
- The UNESCO Recommendation on Open Science
- Integrating JavaScript libraries into R for Dynamic Visualizations

https://www.sortee.org/meet-ups/

SORTEE in person meet-ups and/or presentation of SORTEE at in-person, hybrid, or online conference

Are you attending a conference for another organization?
Would you like to meet up with other SORTEE members at the conference?
Would you like to share information about SORTEE at the conference?
Please use this form to coordinate these efforts

Become a 2023 SORTEE Member

http://www.sortee.org/join/.

Suggested membership fees:

Senior-career professionals: $40

Early-career professionals: $20

Students: $10

Alternative options:

Pay No Fees

Pay What You Can

#SORTEE2023

SORTEE

Society for Open, Reliable, & Transparent
Ecology & Evolutionary Biology

Virtual Annual Conference

17 October 0700 UTC to 18 October 0830 UTC

www.sortee.org

Help shape the future of SORTEE by joining U5.1 or U5.2 ‘unconference’ sessions:

What is SORTEE and what could we become?

WHEN

First time zone: **17 October 1630–1730 UTC**

Second time zone: **18 October 0700–0800 UTC**

WHO

Discussion lead by Board members, open to everyone interested in the future of SORTEE

https://sortee2023.shinyapps.io/program-app/

SORTEE on Social Media

https://twitter.com/sortecoevo

https://ecoevo.social/@sortee

https://bsky.app/profile/sortee.bsky.social

https://www.linkedin.com/company/sortee/

#SORTEE2023