SNSF Conference on Best Practices in Research Funding

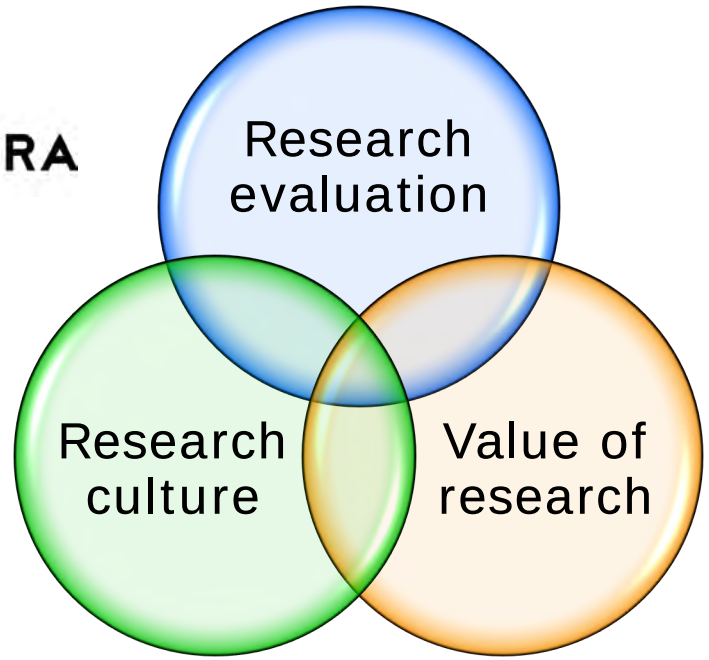
Swiss National Science Foundation

Research on Research at the SNSF

Goals

- Expand research policy expertise
- Enable evidence-based research funding and policy
- Optimise internal processes (e.g. evaluation procedures, OA funding, career promotion)
- Demonstrate the impact of research funding and research
- Contribute to research policy issues

Collaborative approach



Improving Reproducibility in Science

Some Lessons for Research Funding

SNSF Conference on Best Practices in Research Funding

27. September 2021

Leonhard Held

University of Zurich

University of Zurich[UZH]

My Background

- Professor of Biostatistics
- Director Center for Reproducible Science
- Steering Committee Swiss Reproducibility Network

Reproducibility and Replicability

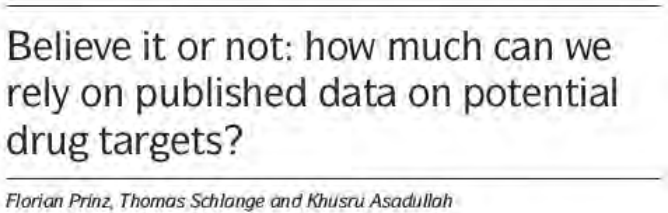
Good Research Practice

The Swiss Reproducibility Network

Lessons for Research Funding

Reproducibility in Drug Development

***Nature Reviews Drug Discovery* (2011)**



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

Florian Prinz, Thomas Schlange and Khusru Asadullah

"With reasonable efforts (sometimes the equivalent of 3–4 full-time employees over 6–12 months), we have frequently been unable to reconfirm published data."

The Reproducibility of Psychological Science

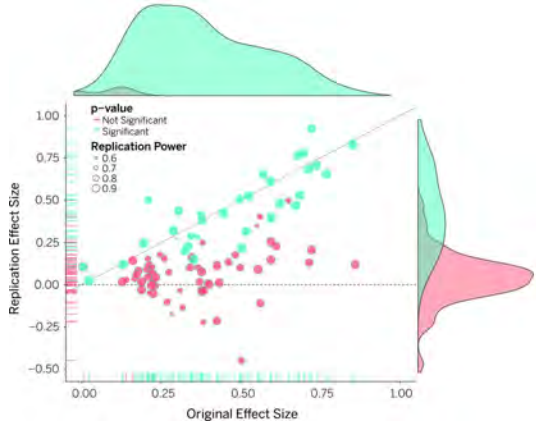
***Science* (2015)**

RESEARCH ARTICLE SUMMARY

PSYCHOLOGY

Estimating the reproducibility of psychological science

Open Science Collaboration*



"Collectively these results offer a clear conclusion: A large portion of replications produced weaker evidence for the original findings"

The Replicability of Social Science Experiments

***Nature Human Behaviour* (2018)**

nature human behaviour

LETTERS

https://doi.org/10.1038/s41562-018-0399-z

Evaluating the replicability of social science experiments in *Nature* and *Science* between 2010 and 2015

Colin F. Camerer[1,16], Anna Dreber[2,16], Felix Holzmeister[3,16], Teck-Hua Ho[4,16], Jürgen Huber[3,16], Magnus Johannesson[2,16], Michael Kirchler[3,5,16], Gideon Nave[6,16], Brian A. Nosek[7,8,16*], Thomas Pfeiffer[9,16], Adam Altmejd[2], Nick Buttrick[7,8], Taizan Chan[10], Yiling Chen[11], Eskil Forsell[12], Anup Gampa[7,8], Emma Heikensten[2], Lily Hummer[8], Taisuke Imai[13], Siri Isaksson[2], Dylan Manfredi[6], Julia Rose[3], Eric-Jan Wagenmakers[14] and Hang Wu[15]

"The effect size of the replications is on average about 50% of the original effect size."

Reproducibility in Cancer Biology

eLife (2014)

REPRODUCIBILITY
PROJECT
CANCER BIOLOGY

SCIENCE FORUM

An open investigation of the reproducibility of cancer biology research

Abstract It is widely believed that research that builds upon previously published findings has reproduced the original work. However, it is rare for researchers to perform or publish direct replications of existing results. The Reproducibility Project: Cancer Biology is an open investigation of reproducibility in preclinical cancer biology research. We have identified 50 high impact cancer biology articles published in the period 2010-2012, and plan to replicate a subset of experimental results from each article. A Registered Report detailing the proposed experimental designs and protocols for each subset of experiments will be peer reviewed and published prior to data collection. The results of these experiments will then be published in a Replication Study. The resulting open methodology and dataset will provide evidence about the reproducibility of high-impact results, and an opportunity to identify predictors of reproducibility.

Science (2018)

Plan to replicate 50 high-impact cancer papers shrinks to just 18

After 5 years, reproducibility project nears finish line

A Replication Crisis in Methodological Research?

***Significance* (2020)**

Reproducibility and Replicability

Good Research Practice

The Swiss Reproducibility Network

Lessons for Research Funding

Reproducibility in Preclinical Research

***Nature* (2014)**

NIH plans to enhance reproducibility

Francis S. Collins and **Lawrence A. Tabak** discuss initiatives that the US National Institutes of Health is exploring to restore the self-correcting nature of preclinical research.

"Preclinical research [. . .] seems to be the area that is currently most susceptible to reproducibility issues.

The NIH is deeply concerned about this problem. "

Proposed NIH actions:

- Training modules
- Checklist for grant applications
- Greater transparency of the data
- PubMed Commons (discontinued in 2018)

Reproducibility in Clinical Trials

"Human clinical trials seem to be less at risk because they are already governed by various regulations that stipulate rigorous design and independent oversight."

- Randomisation
- Blinding
- Sample Size Calculations
- Preregistration
- Institutional Review Boards
- Standardized Reporting

Statistical Analysis Plans

JAMA | Special Communication

Guidelines for the Content of Statistical Analysis Plans in Clinical Trials

Carrol Gamble, PhD; Ashma Krishan, BSc; Deborah Stocken, PhD; Steff Lewis, PhD; Edmund Juszczak, MSc; Caroline Doré, BSc; Paula R. Williamson, PhD; Douglas G. Altman, DSc; Alan Montgomery, PhD; Pilar Lim, PhD; Jesse Berlin, ScD; Stephen Senn, PhD; Simon Day, PhD; Yolanda Barbachano, PhD; Elizabeth Loder, MD, MPH

Guidelines for Statistical Analysis Plans

David L. DeMets, PhD; Thomas D. Cook, PhD; Kevin A. Buhr, PhD

"Ultimately, a prespecified SAP is necessary to ensure interpretability and integrity of final results."

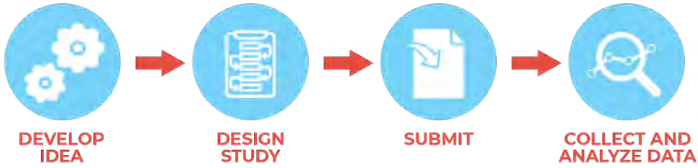
Rein in the Four Horsemen of Irreproducibility

Dorothy Bishop (2019) in Nature

Questionable research practices (QRPs)

Preregistration

PLOS guidelines



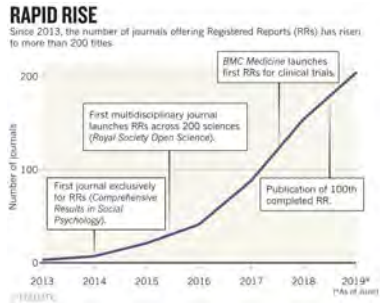
Preregistration is the practice of depositing a research question and study design with a registration service or journal before conducting a scientific investigation.

Registered Reports

Chris Chambers in Nature (2019)

What's next for Registered Reports?

Reviewing and accepting study plans before results are known can counter perverse incentives. **Chris Chambers** sets out three ways to improve the approach.



University of Zurich[UZH]

High Replicability is Achievable

Protzko *et al.* 2020, psyarxiv.com

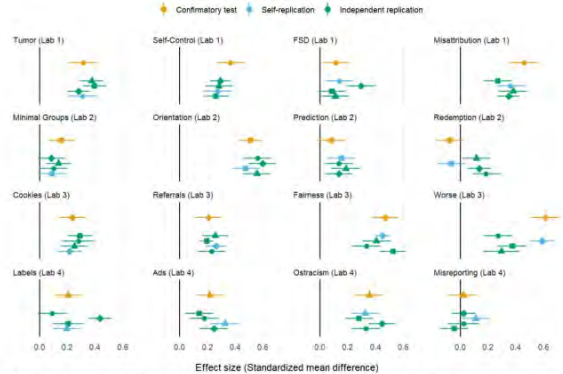


Fig 1. Effect sizes and 95%CI from 16 new discoveries (yellow marks) in the social-behavioral sciences with four replications each. Each lab is designated by a unique shape for observed effect size; blue marks correspond to self-replications, green marks to independent replications.

Computational Reproducibility

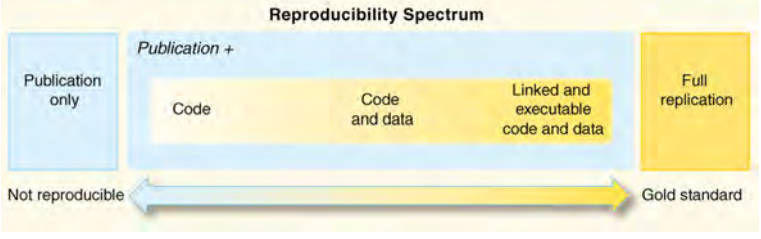
Roger Peng in *Science* (2011)

Data Replication & Reproducibility

PERSPECTIVE

Reproducible Research in Computational Science

Roger D. Peng



Open is Not Enough

nature physics

PERSPECTIVE

https://doi.org/10.1038/nphys3843

Corrected: Publisher Correction

OPEN

Open is not enough

Xiaoli Chen[1,2], Sünje Dallmeier-Tiessen[1*], Robin Dasler[1,11], Sebastian Feger[1,3], Pamfilos Fokianos[1], Jose Benito Gonzalez[1], Harri Hirvonsalo[1,4,12], Dinos Kousidis[1], Artemis Lavasa[1], Salvatore Mele[1], Diego Rodriguez Rodriguez[1], Tibor Šimko[1*], Tim Smith[1], Ana Trisovic[1,5*], Anna Trzcinska[1], Ioannis Tsanaktsidis[1], Markus Zimmermann[1], Kyle Cranmer[6], Lukas Heinrich[6], Gordon Watts[7], Michael Hildreth[8], Lara Lloret Iglesias[9], Kati Lassila-Perini[4] and Sebastian Neubert[10]

The solutions adopted by the high-energy physics community to foster reproducible research are examples of best practices that could be embraced more widely. This first experience suggests that reproducibility requires going beyond openness.

Table 1 | Terminology related to reproducible research introduced by Carole Goble and Lorena A. Barba

Term	Purpose	Description
Rerun	Robust	Variations on experiment and set-up, conducted in the same lab
Repeat	Defend	Same experiment, same set-up, same lab
Replicate	Certify	Same experiment, same set-up, independent lab
Reproduce	Compare	Variations on experiment and set-up, independent labs
Reuse	Transfer	Different experiment

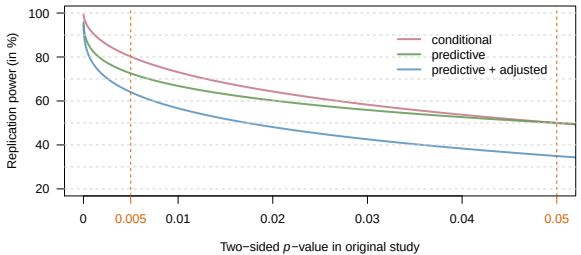
"Simple compliance with openness is not sufficient to foster reuse and reproducibility in particle physics."

Misunderstanding of Statistical Significance

Significance Magazine (2000)

Replication power and regression to the mean

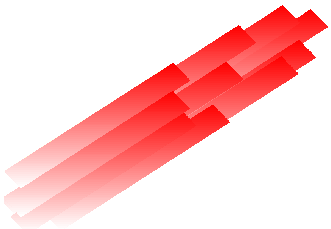
If a scientific study reports a discovery with a *p*-value at or around 0.05, how credible is it? And what are the chances that a replication of this study will produce a similarly "significant" finding? **Leonhard Held**, **Samuel Pawel** and **Simon Schwab**'s answers may surprise you



Replication is Standard in Drug Regulation

Guidance for Industry

Providing Clinical Evidence of Effectiveness for Human Drug and Biological Products



U.S. Department of Health and Human Services
Food and Drug Administration
Center for Drug Evaluation and Research (CDER)
Center for Biologics Evaluation and Research (CBER)
May 1998
Clinical 6

FDA's "two-trials rule" requires

"at least two adequate and well-controlled studies, each convincing on its own, to establish effectiveness."

No Publication Without Confirmation

***Nature* (2017)**

No publication without confirmation

Jeffrey S. Mogil and **Malcolm R. Macleod** propose a new kind of paper that combines the flexibility of basic research with the rigour of clinical trials.

Bundesministerium für Bildung und Forschung

DECIDE

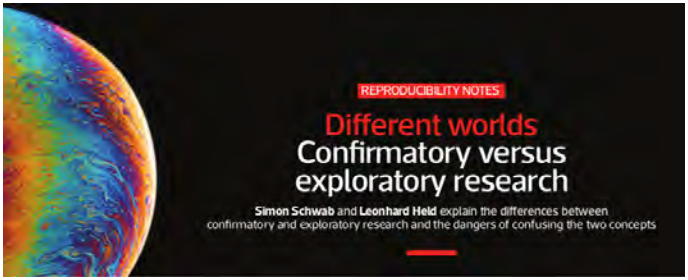
DECIDE – Decision-Enabling Confirmation of Innovative Discoveries and exploratory Evidence – is the accompanying project within the BMBF funded consortium Richtlinie zur Förderung von konfirmatorischen präklinischen Studien – Qualität in der Gesundheitsforschung (Guidelines for Promotion of Confirmatory Preclinical Studies – Quality in Health

QUEST CENTER

Transforming Biomedical Research

Berlin Institute of Health

We Need Both Exploratory and Confirmatory



Reproducibility and Replicability

Good Research Practice

The Swiss Reproducibility Network

Lessons for Research Funding

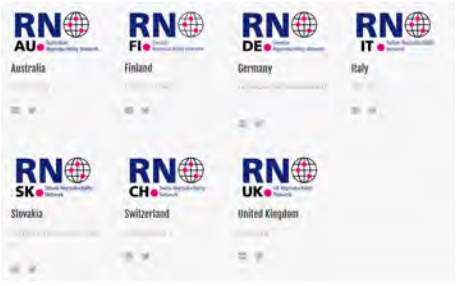
The Swiss Reproducibility Network

RN CH Swiss Reproducibility Network

www.swissrn.org

- Computational Reproducibility
- Preregistration and Registered Reports
- Research Assessment and Incentives
- Replication Studies
- Research Methodology
- Training

International Networks



Reproducibility and Replicability

Good Research Practice

The Swiss Reproducibility Network

Lessons for Research Funding

Open Research Practices

A consortium of 18 universities – members of the UK Reproducibility Network – has received significant funding to drive uptake of open research practices across the sector, furthering the UK's position at the forefront of rigorous and reproducible research.

The Bristol-led project is worth £8.5M over five years and includes £4.5M from the Research England Development (RED) Fund.

Train the PIs

Ulrich Dirnagl in *Nature* (2018)

ULRICH DIRNAGL

Train the PIs

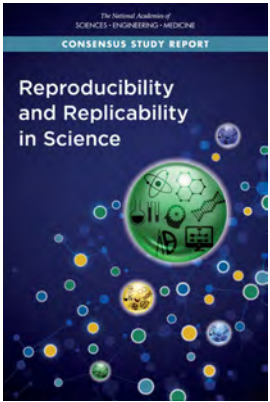
Professor of neuroscience, Charité University Medicine, Berlin.

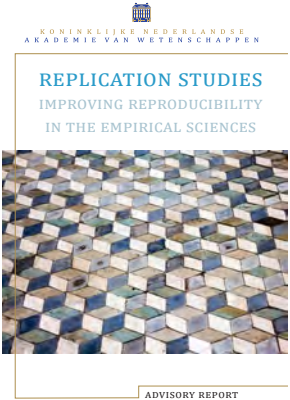
"Let's start with mandatory courses in basic statistics and open science."

Health tips for research groups

Nature asked scientists to recommend one thing that institutional and laboratory leaders could do to make science more productive, rigorous and happy.

Replication and Confirmation





- NWO Programme Replication Studies
- DFG Priority Programme META-REP

Registered Report Grant Model

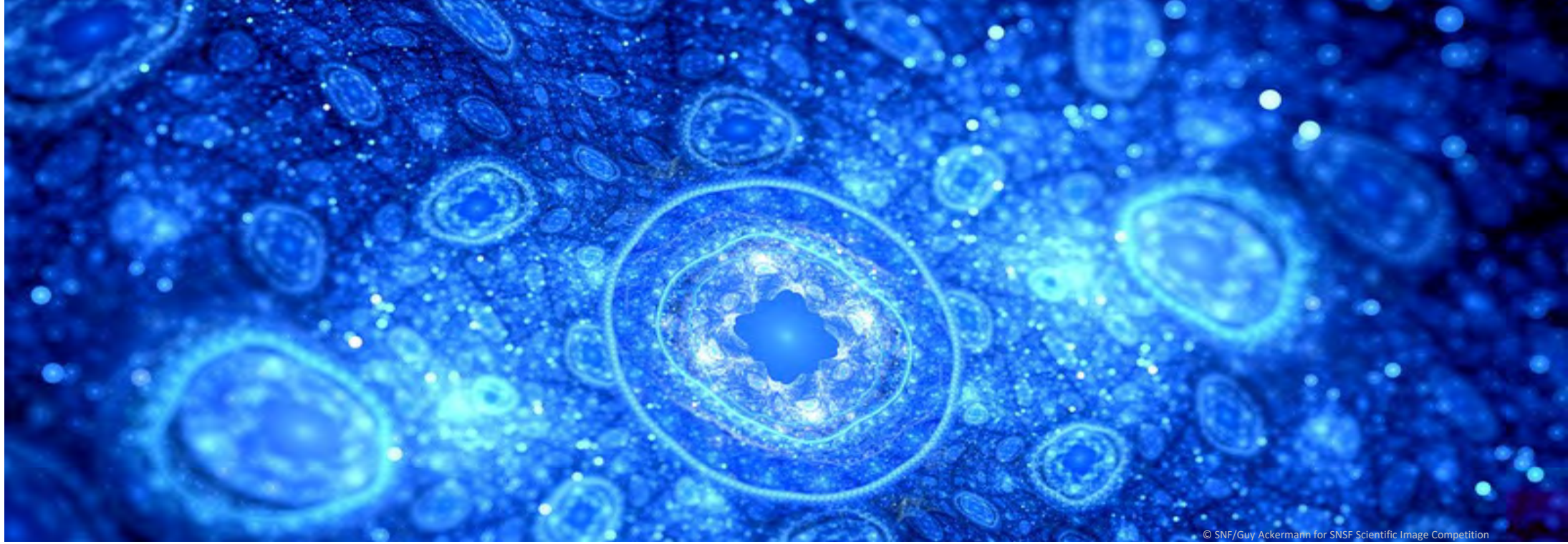
Summary

- Reproducibility issues are haunting various scientific disciplines.
- An interdisciplinary perspective helps to identify common problems and provide targeted solutions.
- More research funding should be devoted to
  - Methodology
  - Replication Studies
  - Meta-Science

Backup: Definitions

- Reproducibility is obtaining consistent results using the same input data; computational steps, methods, and code; and conditions of analysis.
- Replicability is obtaining consistent results across studies aimed at answering the same scientific question, each of which has obtained its own data.
- Generalizability refers to the extent that results of a study apply in other contexts or populations that differ from the original one.

National Science Foundation (2018)



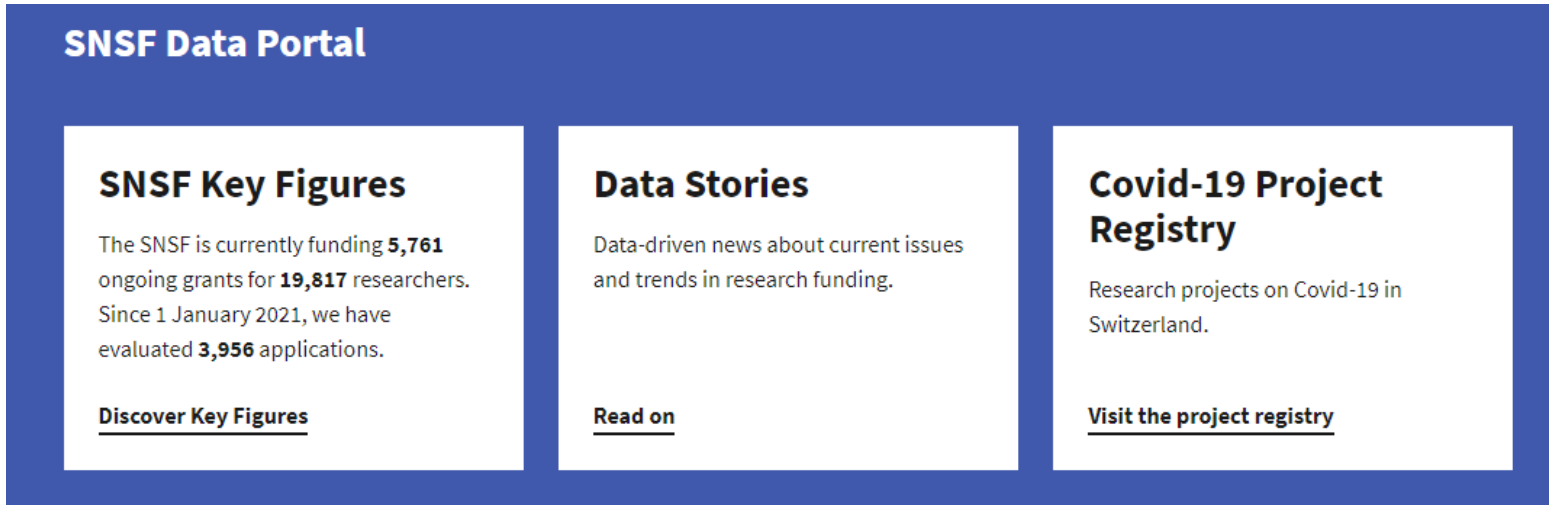
Towards better practices in research evaluation

Thomas Werder Schläpfer

Swiss National
Science Foundation

The SNSF

- Private foundation, sponsored by the State, based on scientific self-governance
- One core task : fund scientific research
- Interested in numbers? → have a look at **data.snf.ch** !



Key figures

6,000
Ongoing SNSF projects

20,000
Researchers in projects

1,000
Panel members

100
Panels

Data 2020

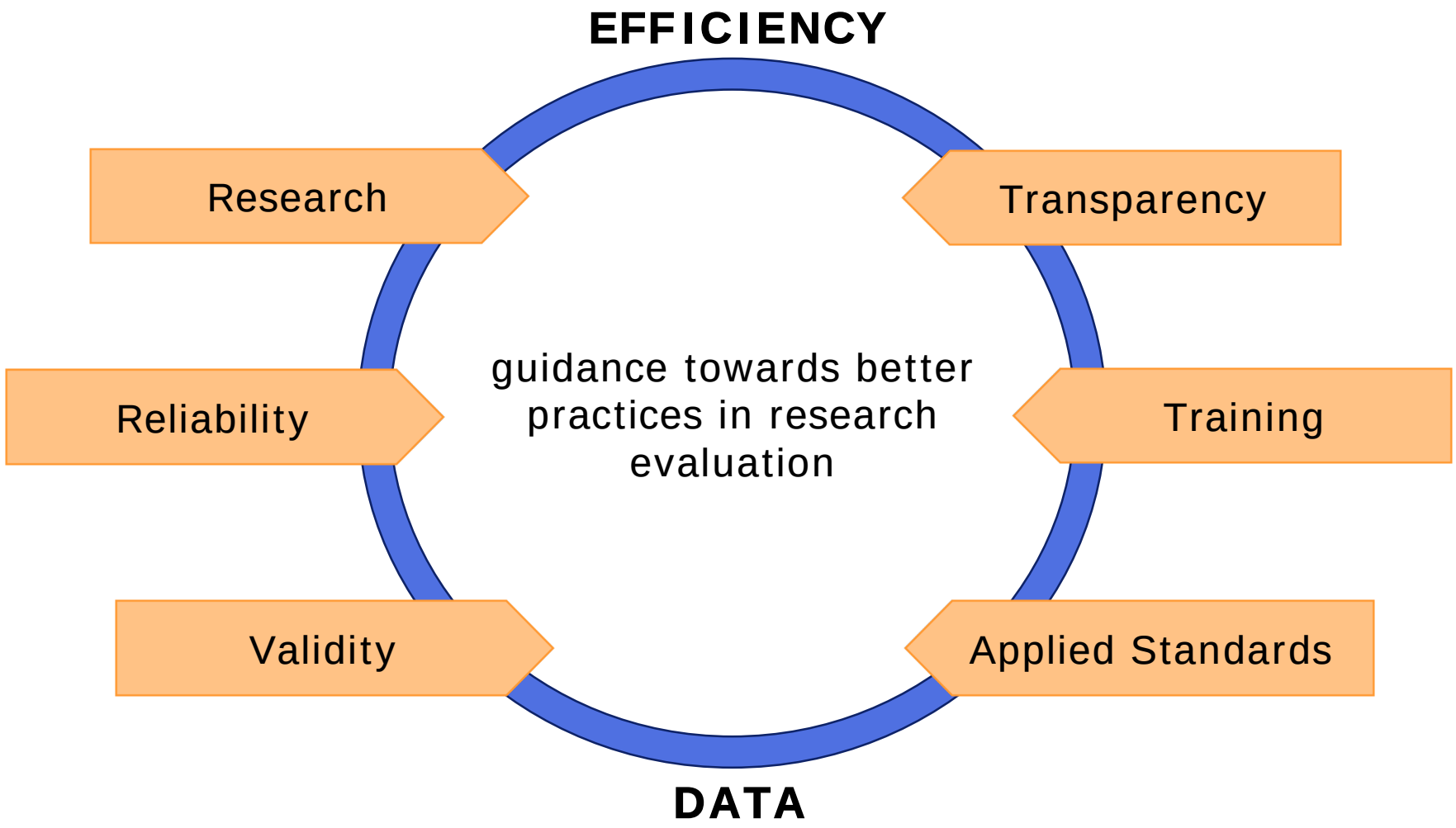
Evaluation process – reduced to the max

- Money → SNSF → researchers
- We organize competitions based on scientific quality criteria

- **Core process:**
  gather basis for decision, evaluate against criteria, funding decision

- What guides us towards better practices?

Evaluation process – guidance

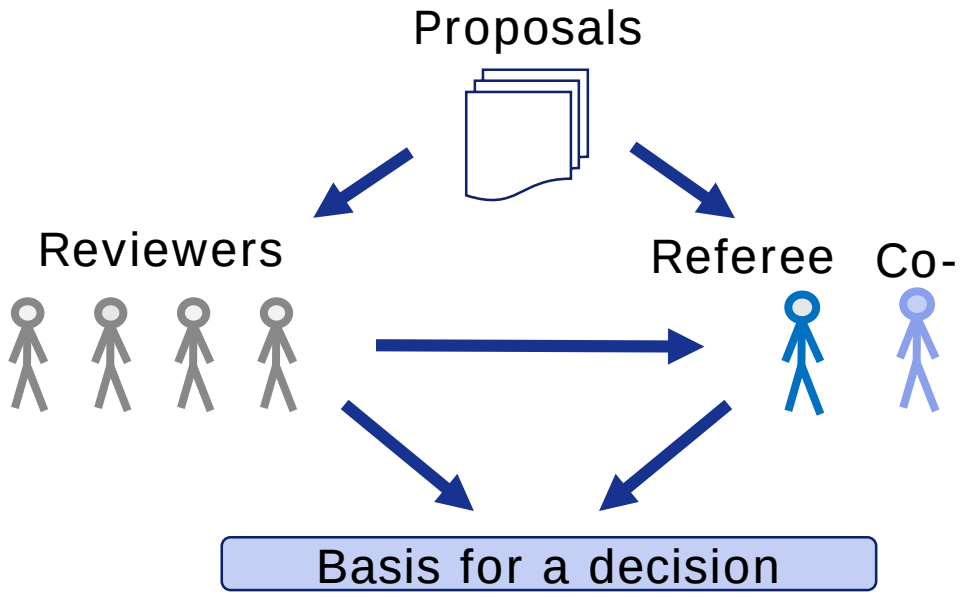


Project funding

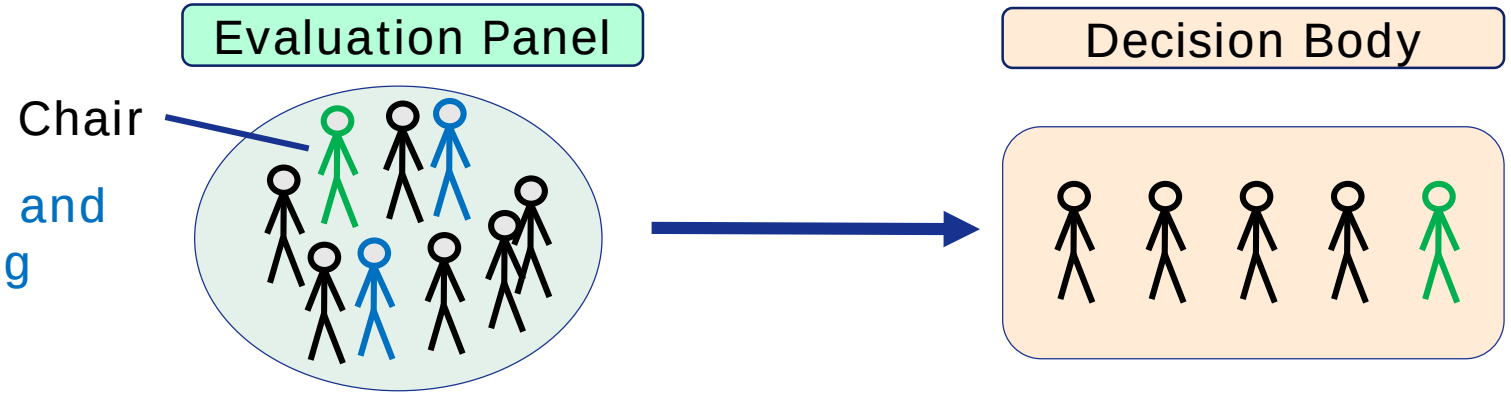
- For established researchers
- Free choice of research themes
- All scientific disciplines
- Competitive selection process based on peer review and a scientific panel

Evaluation Process: Reviewers – Referees – Panels

Each proposal is reviewed by international experts

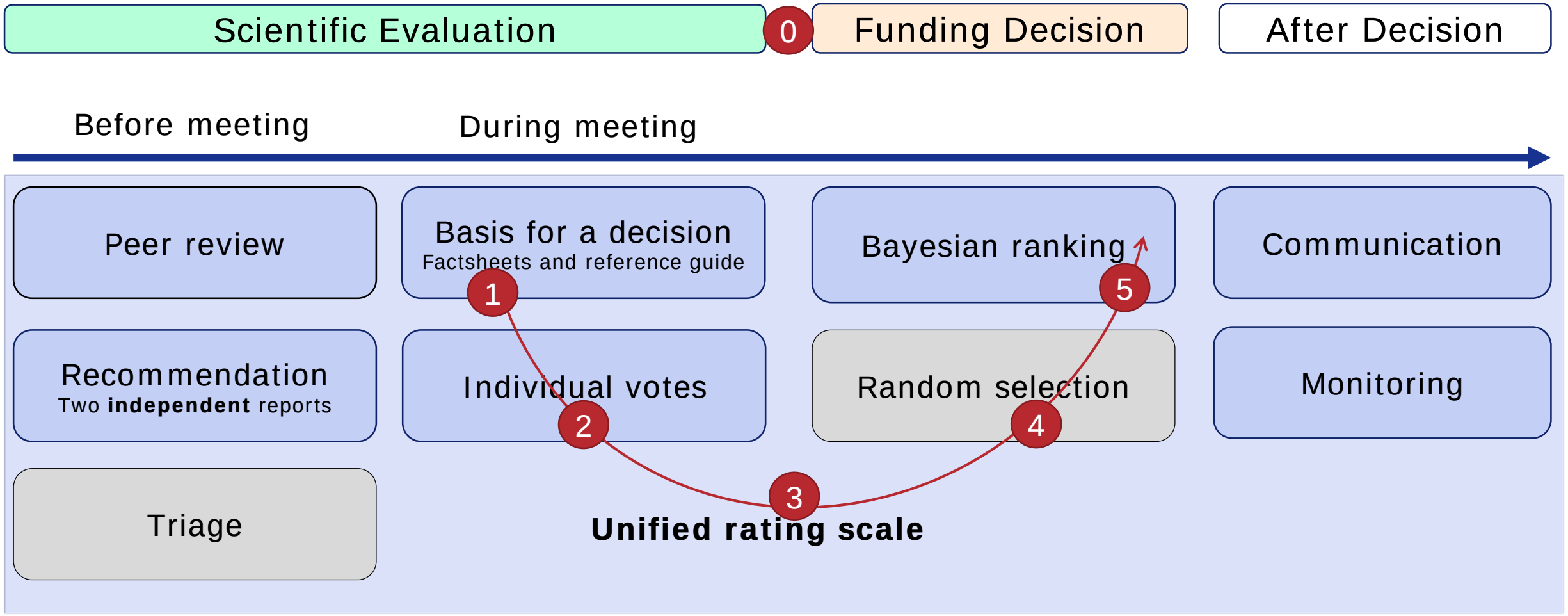


synthesis / recommend a rating



The panel discusses and establishes a ranking

A Unified Evaluation Procedure at the SNSF



Acknowledgments

RESEARCH COUNCIL

Matthias Egger, RC President

Laura Bernardi, Ben Jann

Bernd Gotsmann

Matthias Peter

Stuart Lane

Rainer Wallny

SNSF OFFICE

Marco Bieri, Laura Binz, Toby Braun, Janine Bühler, Rachel Heyard, Emmanuel Schweizer, Deborah Studer, Thomas Zimmermann

EXTERNAL EXPERTS

Gemma Derrick
Senior Lecturer, Education Research, Lancaster University

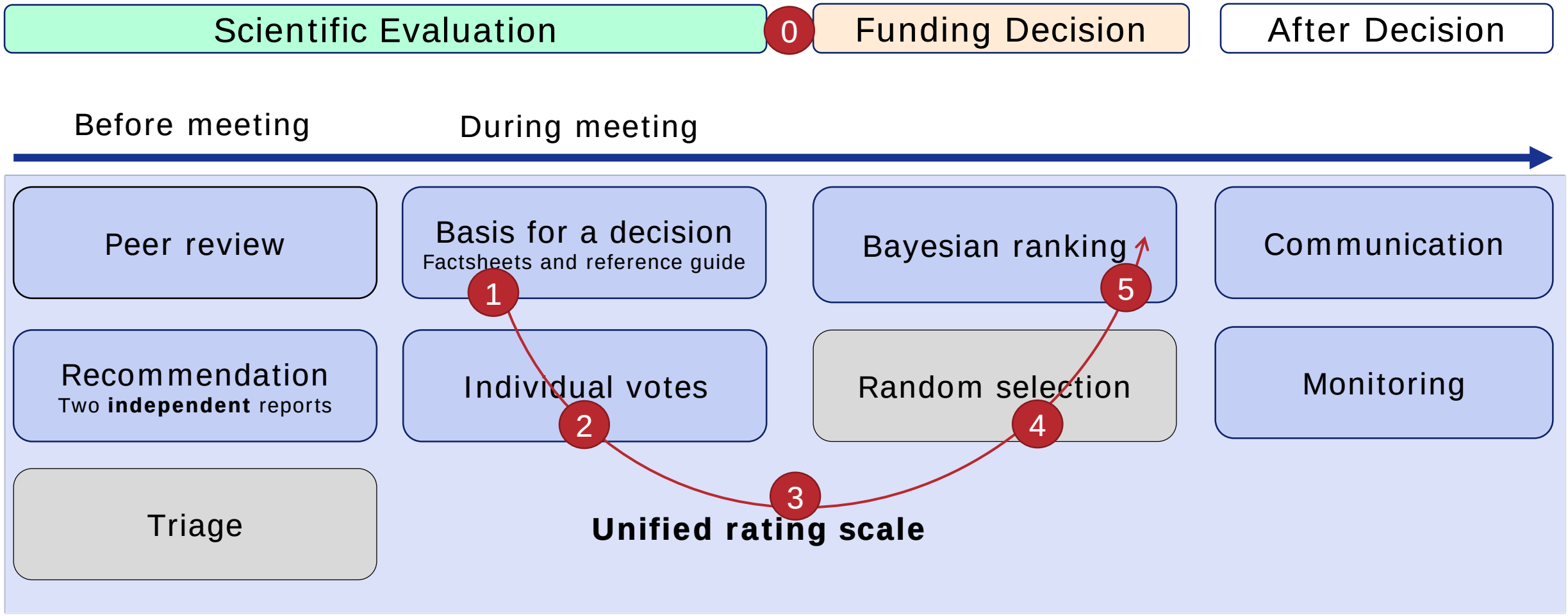
Diana Hicks
ublic Policy

Senior Researcher, Research Evaluation
FORS / ETH Zurich

James Wilsdon
Professor of Research Policy, Director RoRI University of Sheffield

And many more!

A «Unified Evaluation Procedure» at the SNSF



Separate evaluation from funding decision

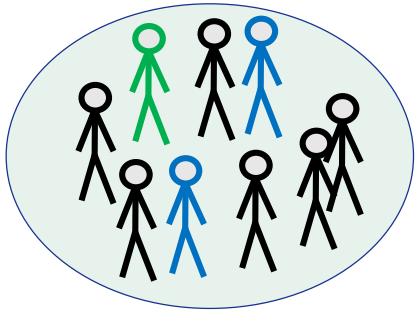
- Why? Keep tasks separated. Prevent “substitution”.

Actual question	Simpler question
How likely is it that this candidate could be tenured in our department?	How impressive was the talk?
How relevant/original/feasible/… is this proposal? Why?	Would I like to fund this project?

Not new, best practice in other places

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 49–81). Cambridge University Press https://doi.org/10.1017/CBO9780511808098.004

Factsheets → structured discussion



Basis for a decision

Applicant Name | **310030-196XXX (#12)** | **Project Title** | **A/A**

1

2

APPLICANTS

Name	Affiliation
Applicant 1	Affiliation 1
Applicant 2	Affiliation 2

PARTNERS

Name	Affiliation
Project Partner 1	Affiliation 1

FLAGS & RELATIONS

continuation of resubmission of use-inspired project	171XXX
lead agency partner	

3

REVIEWS

	applicants as a team						relevance, originality, topicality						suitability of methods, feasibility						overall assessment and ranking					
	outstanding	excellent	very good	good	average	poor	outstanding	excellent	very good	good	average	poor	outstanding	excellent	very good	good	average	poor	outstanding	excellent	very good	good	average	poor
Reviewer 1																								
Reviewer 2																								
Reviewer 3																								
Reviewer 4																								

not useful
not assessed

4

REFEREES

	Applicants						Project						Overall					
Referee	X						X						A					
Co-referee													A					

5

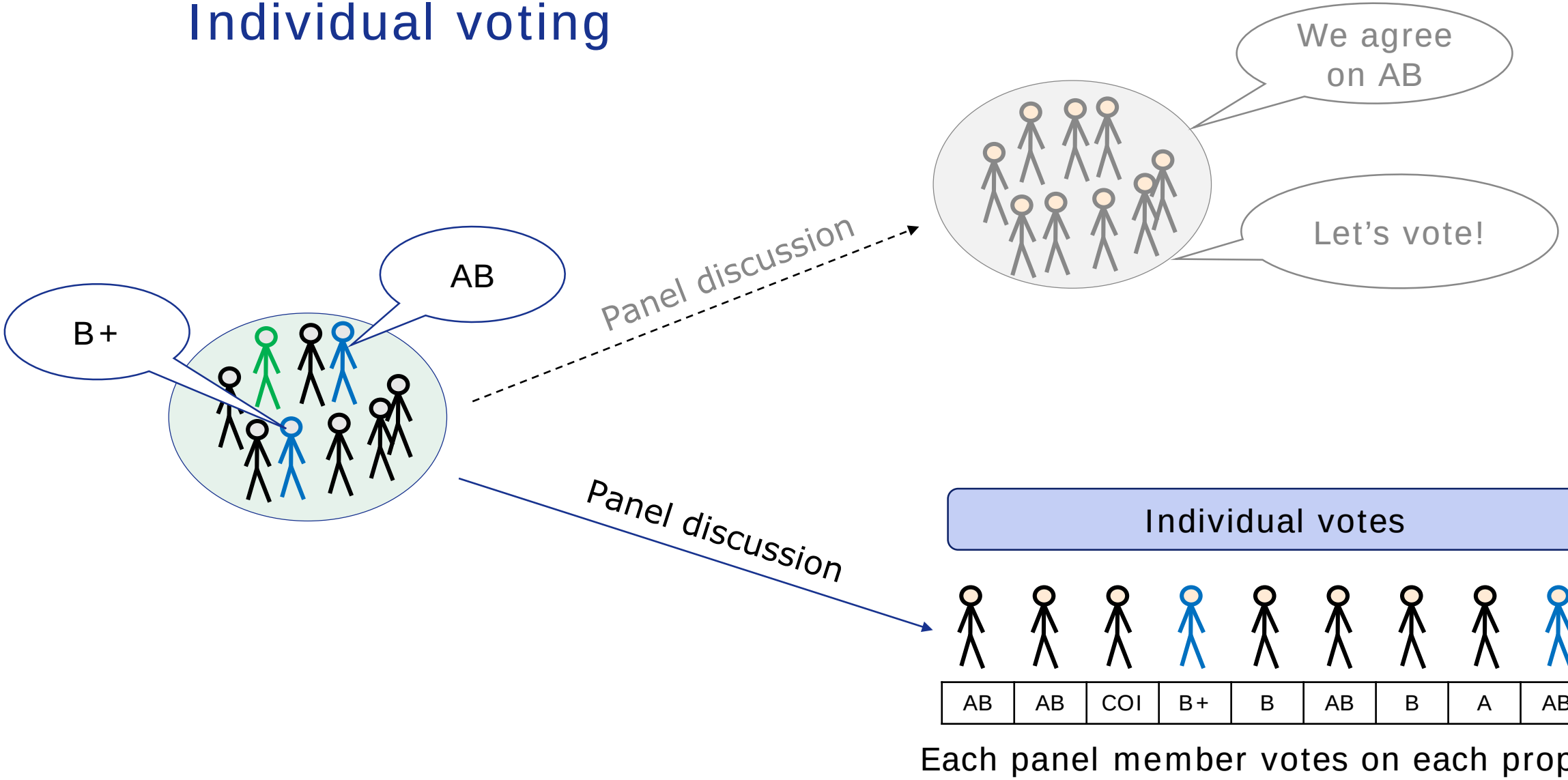
RESOURCES

		application	recomm.	reason for cut
STAFF (FTE)	PhD	3.0	3.0	
	postdoc	--	--	
	further employee	1.0	1.0	
BUDGET (kCHF)	salaries	895	895	
	research costs	322	322	
	equipment	0	0	
	total	**1216**	**1216**	

Duration (months)	**36**	**36**
Spending level (kCHF)	405	405
Spending level per applicant (kCHF)	202	202
Funding level (%)	-	100%

FNSNF
SWISS NATIONAL SCIENCE FOUNDATION

Individual voting

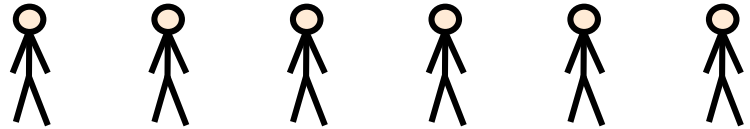


Each panel member votes on each proposal

Individual voting

Individual votes enable the splitting of evaluation and funding decision

Scientific Evaluation



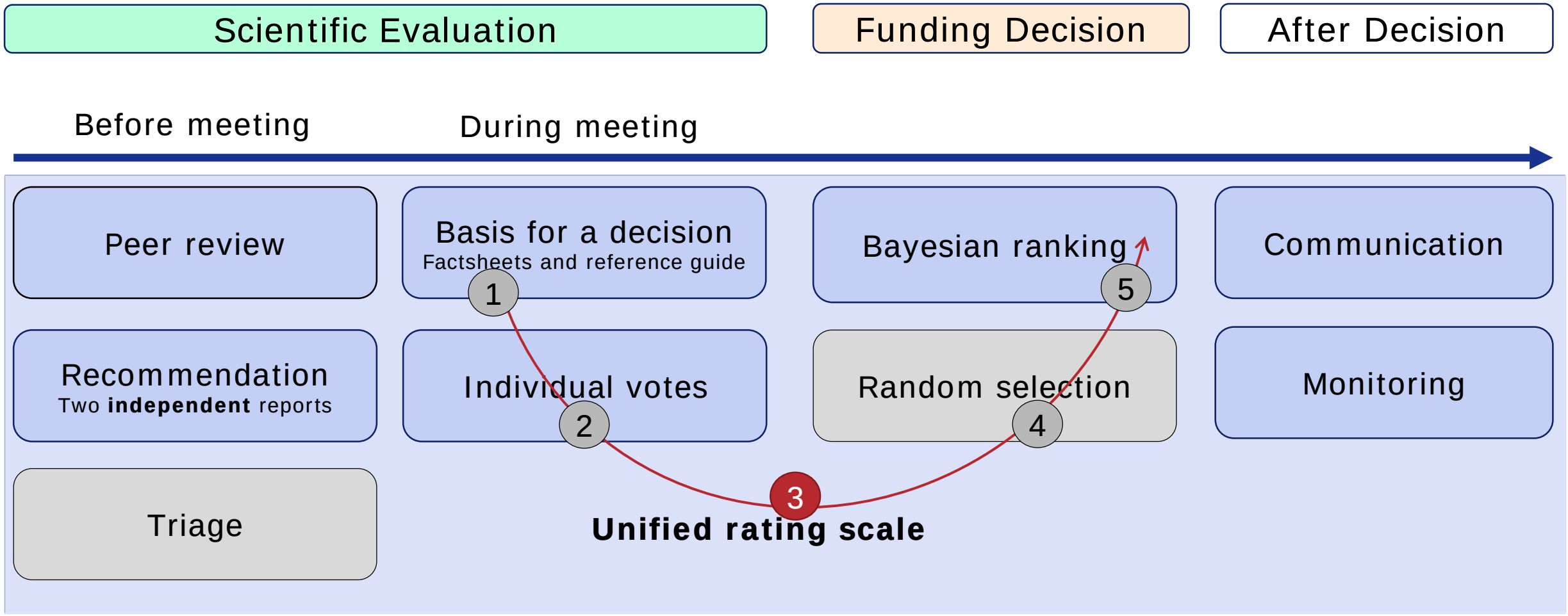
Proposal X	AB	COI	B+	B	AB	AB
Proposal Y	A	B+	A	B+	AB	A
Proposal Z	D	COI	COI	B+	C	B
...	...	...	...	...	...	...

Question 1

Funding Decision

Rank	
1	Proposal Y
2	Proposal X
3	Proposal Z
...	...

A Unified Evaluation Procedure at the SNSF



Motivation for a numeric rating scale

1. Works at all stages (external review, recommendation, panel)

   → Coherence and transparency, facilitates monitoring

2. Allows direct statistical analysis to establish ranking

   → No hidden mapping of categories to numbers

3. Works for all panel configurations

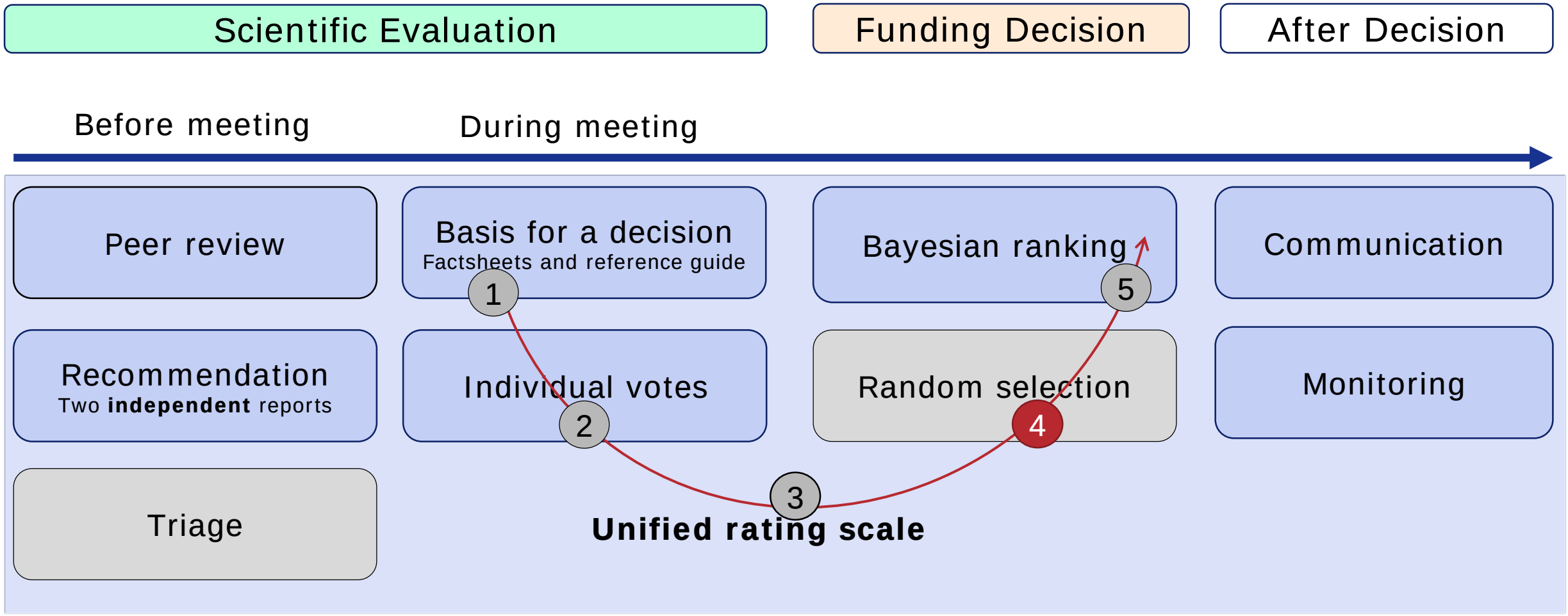
   → Allows for treatment of proposals in sub-panels

9-point numeric rating scale

Please provide a rating on the following scale regarding your assessment of [evaluation criteria]. 5 should be considered as the entry point; from that point, you should develop arguments to grade the [evaluation criteria] higher or lower.

9	Strong in all relevant aspects. No or negligible weaknesses.
8	
7	Strong in most relevant aspects. Few clearly identified weaknesses.
6	
5	Strong in several relevant aspects. Some clearly identified weaknesses.
4	
3	Some strengths in relevant aspects. Several clearly identified weaknesses.
2	
1	Few or no strengths in relevant aspects. Many serious weaknesses.

A Unified Evaluation Procedure at the SNSF



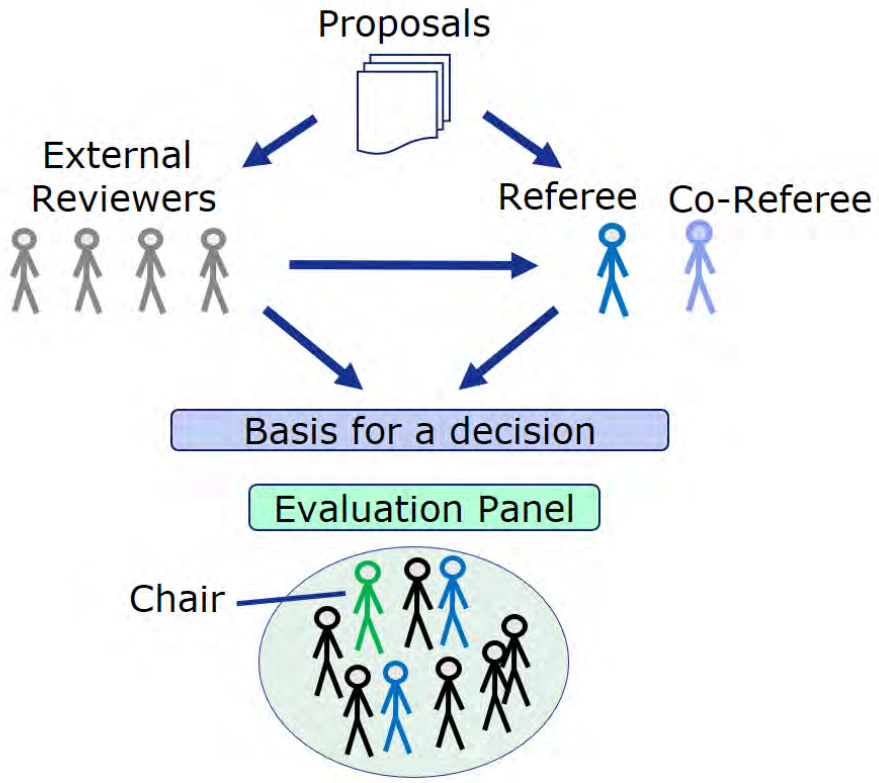
Randomness

- expert reviews, expert judgment, expert panel

  → randomness? yes

- Elements to consider
  - “Luck of the draw” (referees, reviewers, sequence, …)
  - Social dynamics

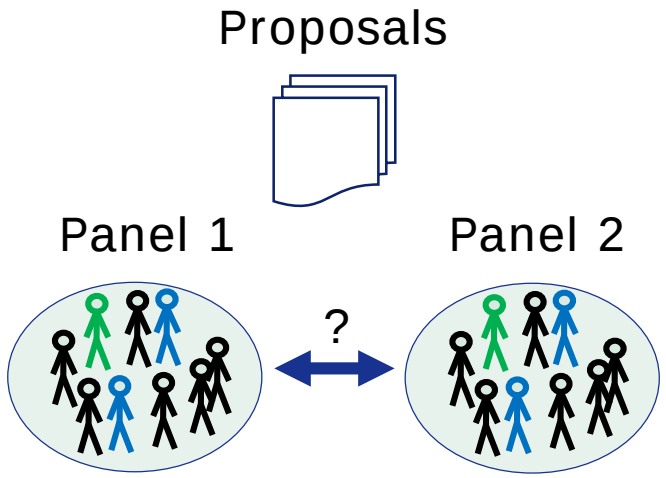
- All lost? no



Heyard, R., Hottenrott, H. The value of research funding for knowledge creation and dissemination: A study of SNSF Research Grants. *Humanit Soc Sci Commun* **8,** 217 (2021). https://doi.org/10.1057/s41599-021-00891-x

https://careertrackercohorts.ch/

Randomness in evaluation?

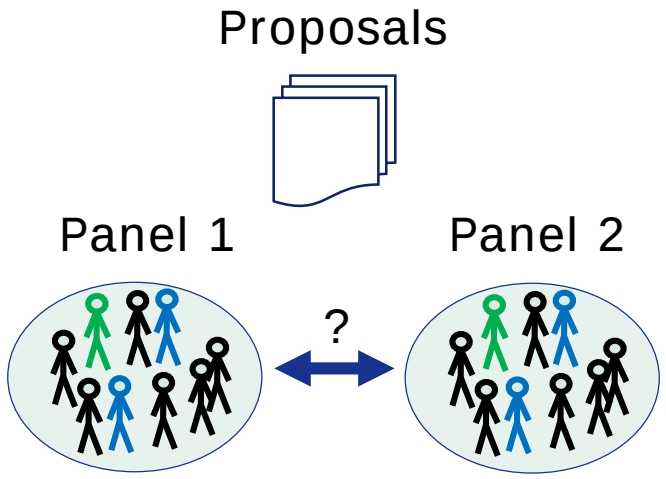


PANEL		Panel 2	
		fund	reject
Panel 1	fund	a	b
	reject	c	d

Agreement=(a+d)/(a+b+c+d)

Study	Setting	Type	Agreement
Cole, 1981	National Science Foundation	Grant proposals	
Hodgson, 1997	Canadian funding agencies	Grant proposals	
Fogelholm, 2012	Finnish Academy	Grant proposals	
Cortes, 2014	Machine learning conference	Abstracts	

Randomness in evaluation?



PANEL		Panel 2	
		fund	reject
Panel 1	fund	20	15
	reject	15	50

Agreement = 70 /100 (!)

Study	Setting	Type	Agreement
Cole, 1981	National Science Foundation	Grant proposals	70-76%
Hodgson, 1997	Canadian funding agencies	Grant proposals	73%
Fogelholm, 2012	Finnish Academy	Grant proposals	69%
Cortes, 2014	Machine learning conference	Abstracts	74%

Elements of the Postdoc.Mobility pilots 2019

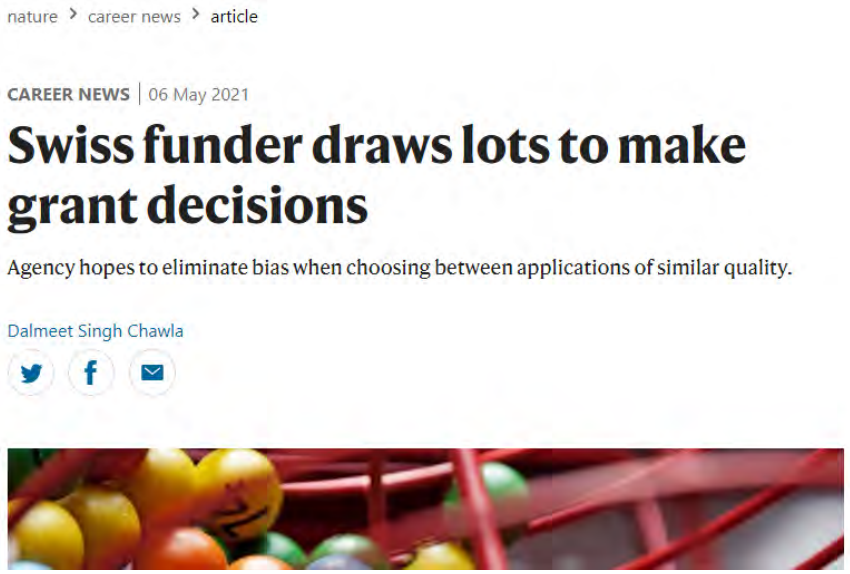
- Fellowship for a stay abroad for postdocs, many applications
- Need for a fair, transparent, efficient, state-of-the art procedure

- **Draw lots to break ties** ➔ prevent arbitrariness and bias
- **Triage**; discuss only proposals in «middle group» ➔ increase efficiency
- **Learn** how a **remote evaluation agrees** with **panel meetings**

Bieri M, Roser K, Heyard R, et al. Face-to-face panel meetings versus remote evaluation of fellowship applications: simulation study at the Swiss National Science Foundation. BMJ Open 2021;11:e047386. doi:10.1136/ bmjopen-2020-047386

Random selection: Learnings from pilot

- Random selection was applied on a **small set** of **applications** (~4%)
- Mixed reception by panel members, acceptance growing
- Few reactions by applicants



nature › career news › article

CAREER NEWS | 06 May 2021

Swiss funder draws lots to make grant decisions

Agency hopes to eliminate bias when choosing between applications of similar quality.

Dalmeet Singh Chawla

Upcoming in December

RoRI RESEARCH ON RESEARCH INSTITUTE

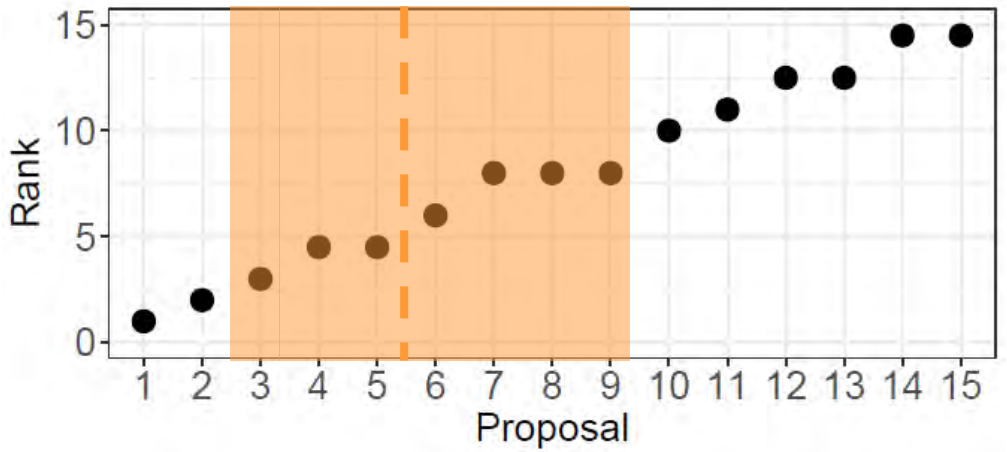
RoRI RANDOMISATION project

Are lottery-style funding mechanisms a good idea?

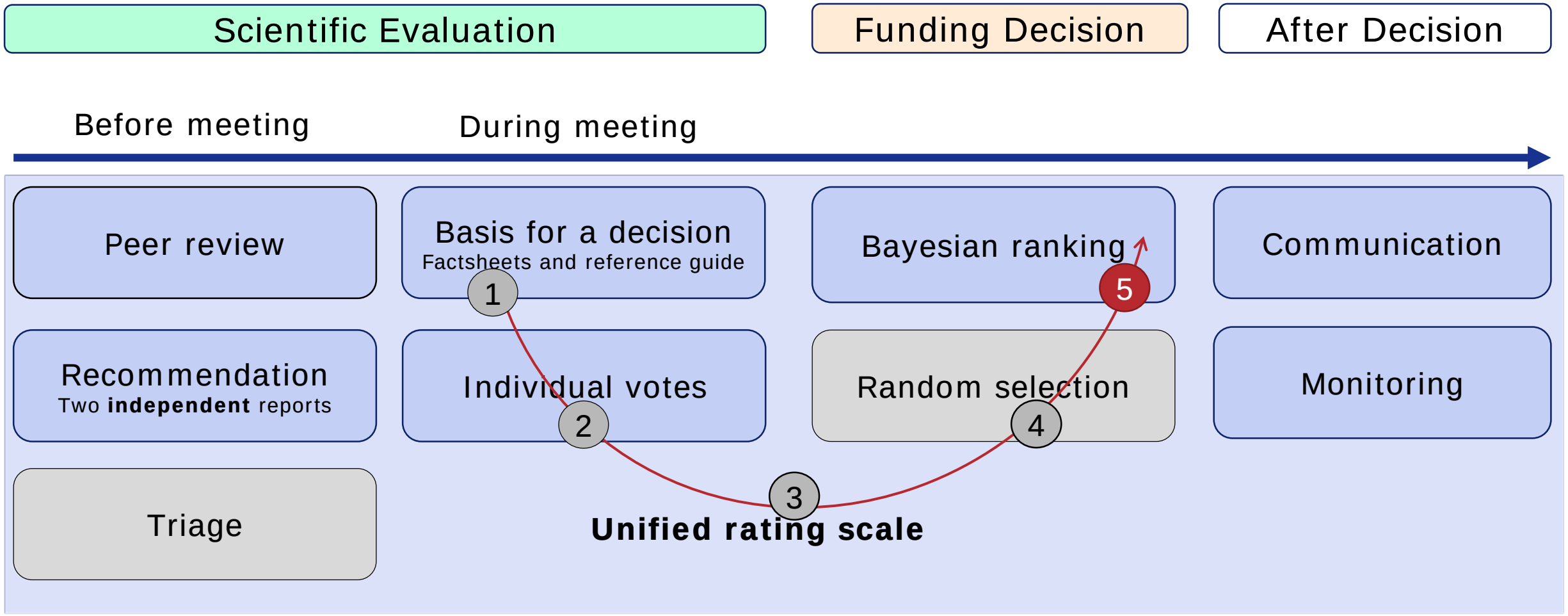
Key questions

Question 1 How to generate a ranking from individual votes?

Question 2 How to identify a random selection group?



A Unified Evaluation Procedure at the SNSF



Bayesian Ranking

- There are many ways of ranking
- E.g. averages, intuitive, but not optimal

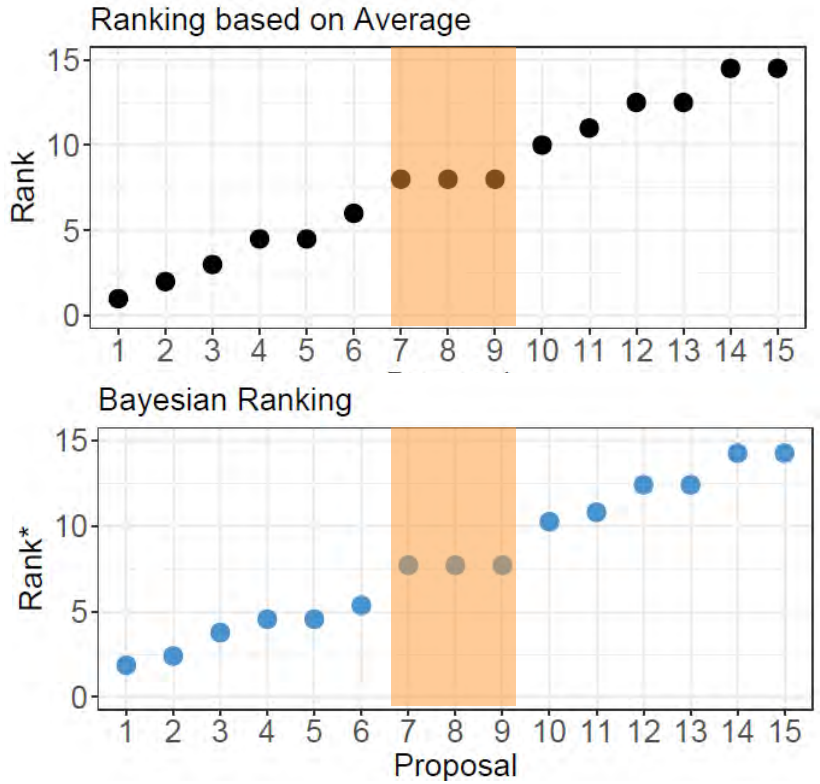
- The Bayesian Ranking (BR) is a statistical model that *increases fairness*

Answer 1
- BR compares each proposal with all the others to produce a relative ranking

Answer 2
- It provides a sound method to define random selection groups

Example (illustrative)

Proposal	Referee 1	Referee 2	Referee 3	Referee 4	Referee 5	Average	Rank
1	9	9	9	9	9	9.0	1
2	9	9	8	9	9	8.8	2
3	9	9	8	7	9	8.4	3
4	9	8	8	8	8	8.2	4
5	9	8	8	8	8	8.2	4
6	9	8	8	7	8	8.0	6
7	9	7	7	7	7	7.4	7
8	9	7	7	7	7	7.4	7
9	9	7	7	7	7	7.4	7
10	9	6	6	6	6	6.6	10
11	9	6	6	5	6	6.4	11
12	9	5	5	5	5	5.8	12
13	9	5	5	5	5	5.8	12
14	9	4	4	4	4	5.0	14
15	9	4	4	4	4	5.0	14



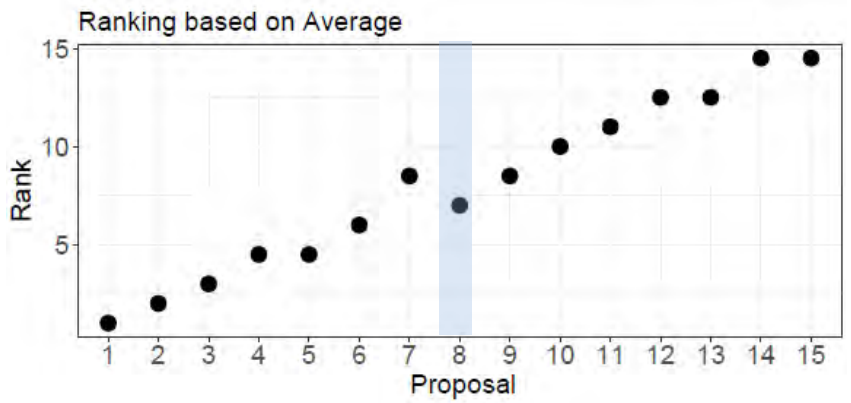
Similar result with average score and Bayesian Ranking method

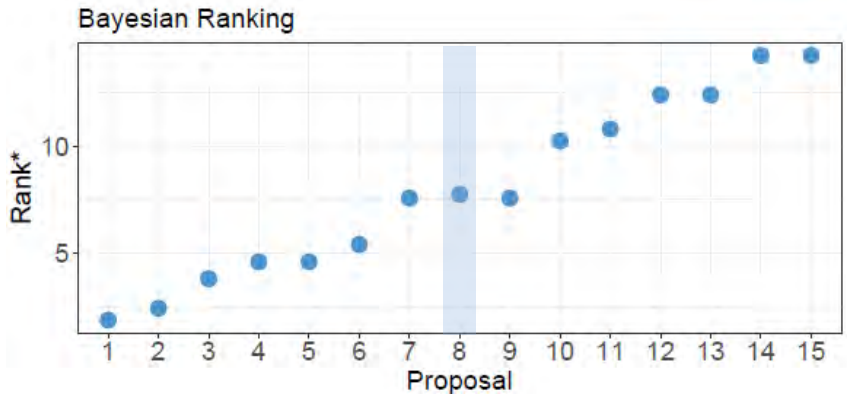
Example (illustrative) – with conflicts of interest

Proposal	Referee 1	Referee 2	Referee 3	Referee 4	Referee 5	Average	Rank
1	9	9	9	9	9	9.0	1
2	9	9	8	9	9	8.8	2
3	9	9	8	7	9	8.4	3
4	9	8	8	8	8	8.2	4
5	9	8	8	8	8	8.2	4
6	9	8	8	7	8	8.0	6
7	COI	7	7	7	7	7.0	8
8	9	7	7	7	7	7.4	7
9	COI	7	7	7	7	7.0	8
10	9	6	6	6	6	6.6	10
11	9	6	6	5	6	6.4	11
12	9	5	5	5	5	5.8	12
13	9	5	5	5	5	5.8	12
14	9	4	4	4	4	5.0	14
15	9	4	4	4	4	5.0	14

Example (illustrative) – with conflicts of interest

Proposal	Referee 1	Referee 2	Referee 3	Referee 4	Referee 5	Average	Rank
1	9	9	9	9	9	9.0	1
2	9	9	8	9	9	8.8	2
3	9	9	8	7	9	8.4	3
4	9	8	8	8	8	8.2	4
5	9	8	8	8	8	8.2	4
6	9	8	8	7	8	8.0	6
7	COI	7	7	7	7	7.0	8
8	9	7	7	7	7	7.4	7
9	COI	7	7	7	7	7.0	8
10	9	6	6	6	6	6.6	10
11	9	6	6	5	6	6.4	11
12	9	5	5	5	5	5.8	12
13	9	5	5	5	5	5.8	12
14	9	4	4	4	4	5.0	14
15	9	4	4	4	4	5.0	14





How to identify a random selection group?

									mean	rank
AB	B	AB	B	B	AB	B	COI	AB	2.50	25
AB	B	B	B	AB	AB	AB	B	B	2.56	26
abstain	absent	AB	B	B	B	AB	AB	B	2.57	27
abstain	B	B	AB	B	AB	B	B	AB	2.63	28
abstain	B	AB	AB	AB	B	B	B	B	2.63	28
AB	AB	B	COI	B	B	B	B	AB	2.63	28
AB	B	B	AB	B	B	AB	B	abstain	2.63	28
B	B	AB	AB	B	AB	B	B	B	2.67	32
B	B	B	B	AB	AB	B	B	AB	2.67	32
B	B	B	AB	B	COI	COI	AB	absent	2.67	32
B	abstain	B	B	B	COI	COI	AB	B	2.83	35
COI	B	AB	B	B	B	B	B	absent	2.86	36

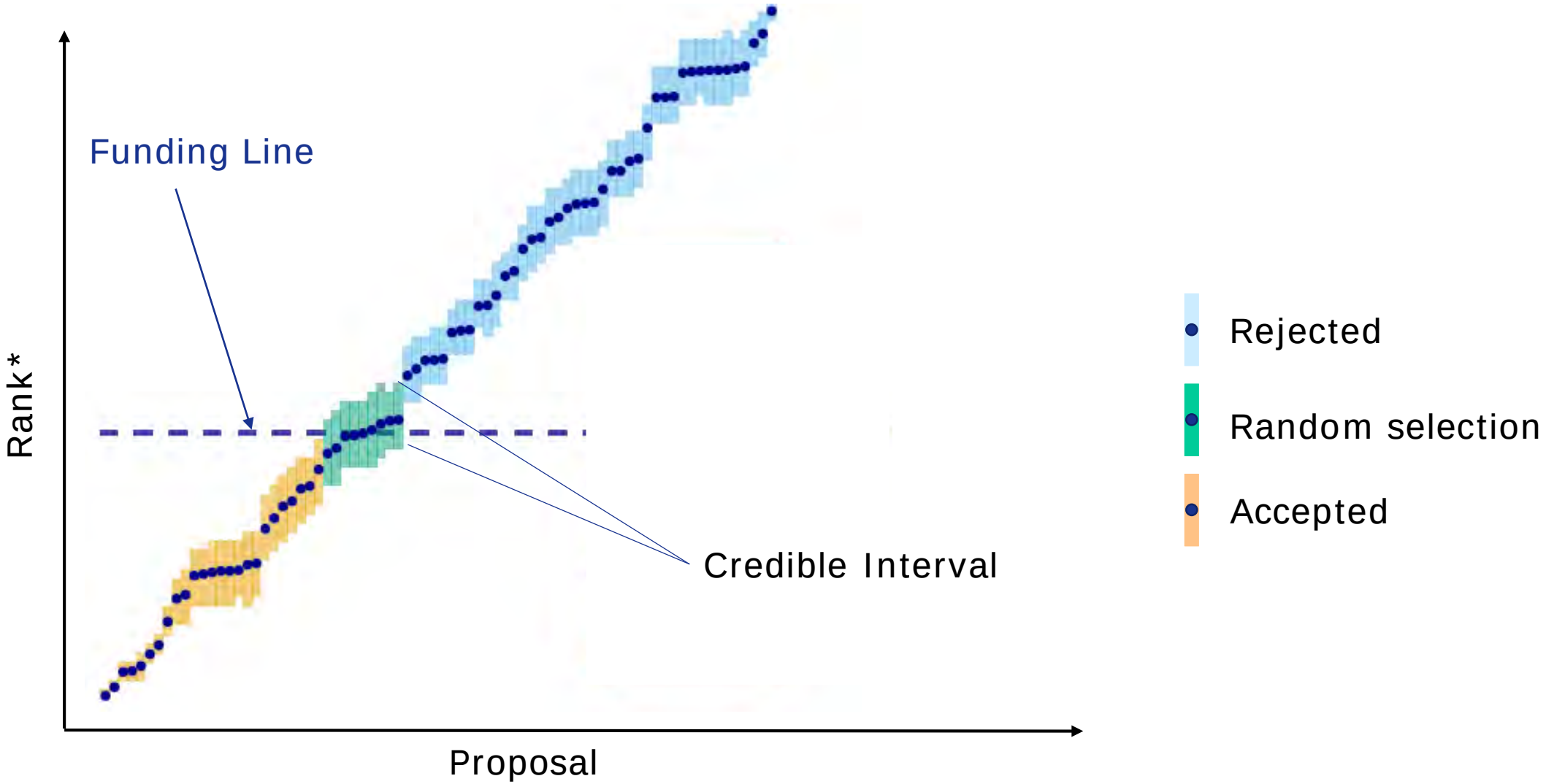
Note: different combinations of missing votes (abstentions, absences, COIs)

How to identify a random selection group?

									mean	rank
abstain	absent	AB	B	B	B	AB	AB	B	2.57	27
abstain	B	B	AB	B	AB	B	B	AB	2.63	28

Note: different combinations of missing votes (abstentions, absences, COIs)

→ by using computed credible intervals



A comment & further information

- BR is a help, a practical tool, a sound tool, a pretty exciting tool …

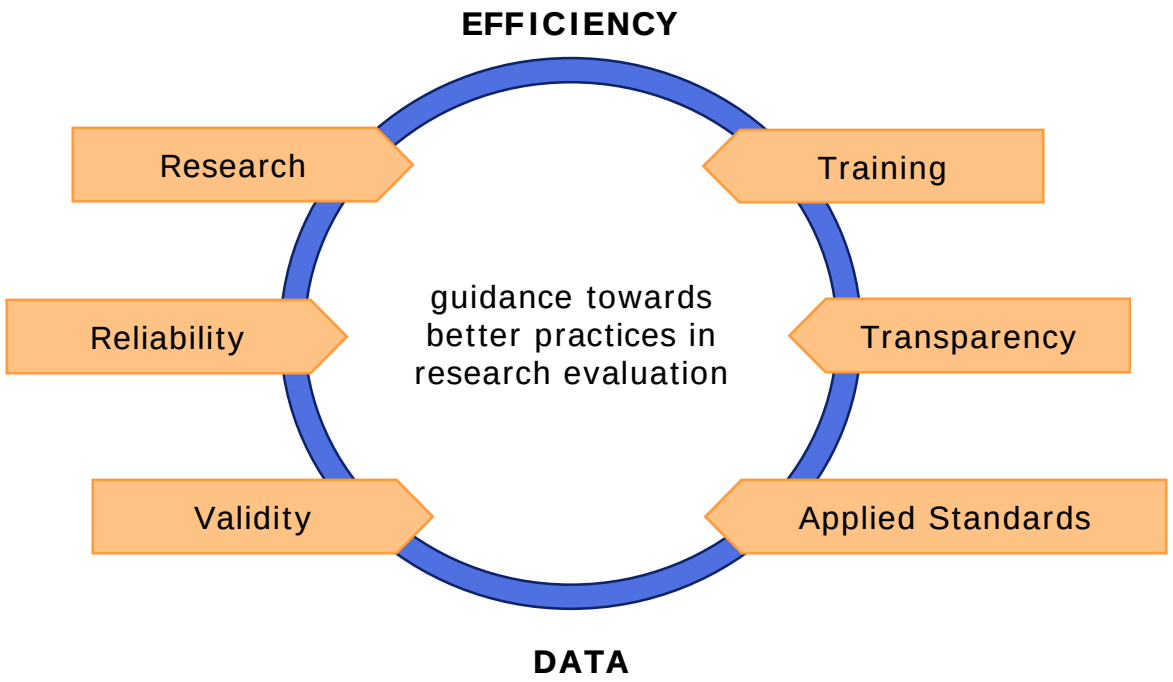
Rethinking the Funding Line at the Swiss National Science Foundation: Bayesian Ranking and Lottery

Rachel Heyard, Manuela Ott, Georgia Salanti, Matthias Egger

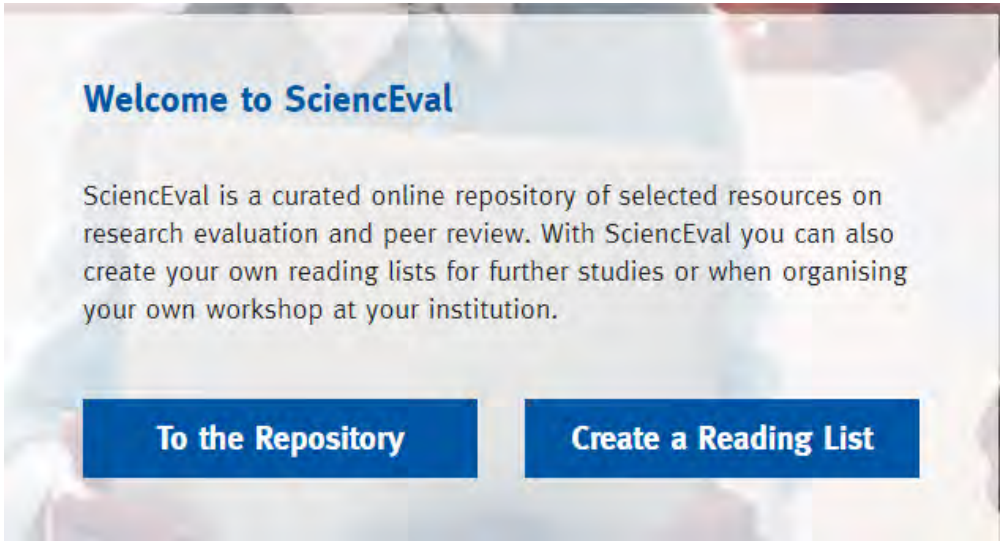
Funding agencies rely on peer review and expert panels to select the research deserving funding. Peer review has limitations, including bias against risky proposals or interdisciplinary research. The inter-rater reliability between reviewers and panels is low, particularly for proposals near the funding line. Funding

Submitted to Statistics and Public Policy, currently revised.
https://arxiv.org/abs/2102.09958

Train, exchange, learn …



→ https://scienceval.ch/



… monitor, and review!

- Data as basis for research
- Basis for policy decisions
- Gender monitoring as an example

Open access Original research

BMJ Open

Gender and other potential biases in peer review: cross-sectional analysis of 38 250 external peer review reports

Anna Severin,[1,2] Joao Martins,[3] Rachel Heyard,[4] François Delavy,[2] Anne Jorstad,[4] Matthias Egger [1,5]

Research funding in focus: even more transparent thanks to data stories

04.05.2021

The SNSF meticulously examines its funding activities. From now on, we will publish these analyses on our data portal. To kick things off, we'll take a look at Open Access, ERC grants and women scientists during the pandemic.

On the data.snf.ch site, the SNSF shows what figures alone cannot: insights into research

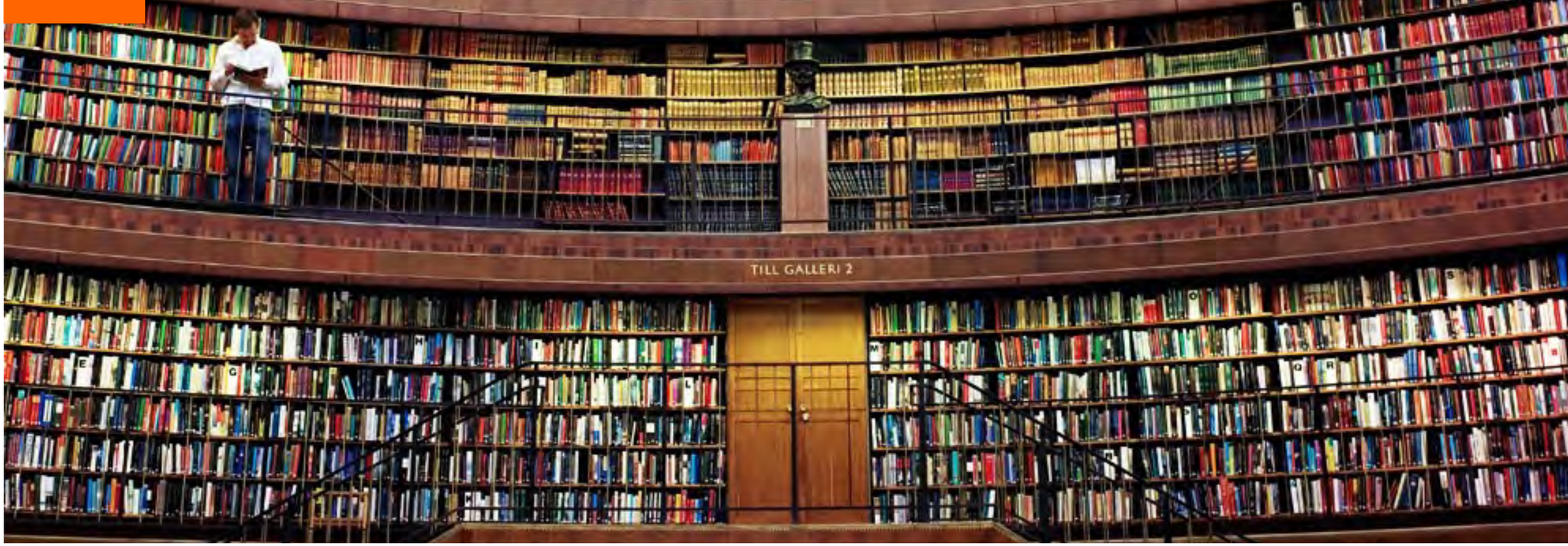
There is much to be done

New frontiers for research on research evaluation, J. Wilsdon, RoRI & Univ. of Sheffield

Summary

- Join forces to advance evidence-based decision making
- Best practice in research evaluation is continuously evolving
- We introduce a few practical elements that align with current research («split», individual voting, numeric scale, random selection, statistical tools)

Thank you!



The Structure of Research Evaluation

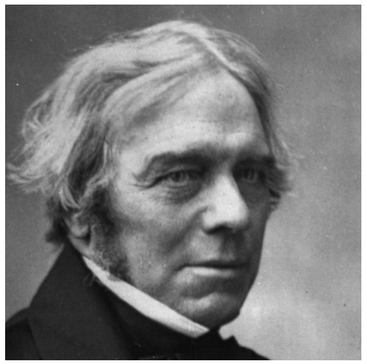
Michael Hill, Online, 27.09.2021

Swiss National
Science Foundation

Who Is the Fastest Athlete Ever?

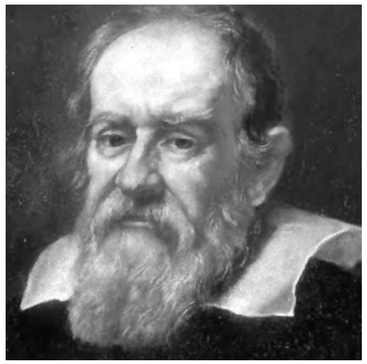
Who Is the Best Scholar Ever?

Who Is the Best Scholar Ever?



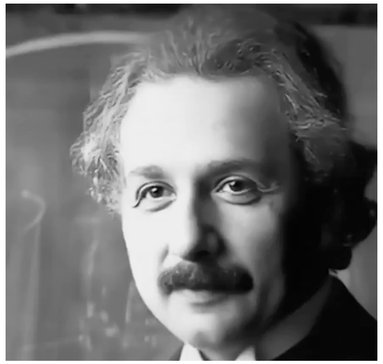
Michael Faraday

Marie Sklodowska-Curie



Galileo Galilei

Louis Pasteur



Albert Einstein

Gregor Mendel

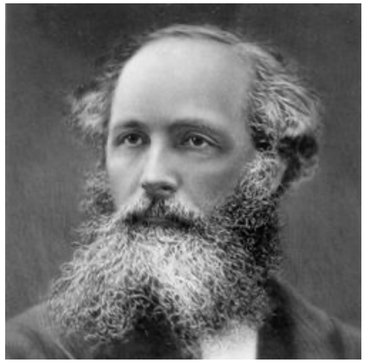
Charles Darwin

Leonhard Euler

Ibn al-Haytham

Isaac Newton

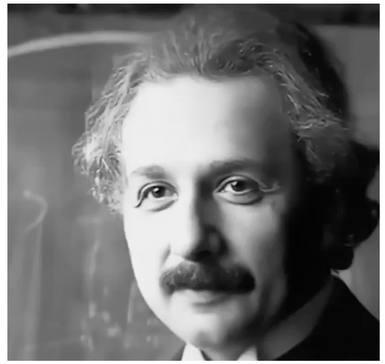
Gottfried von Leibniz



James Clerk Maxwell

Who Is the Best Scholar Ever?

Pasteur



Albert Einstein

Gregor Mendel

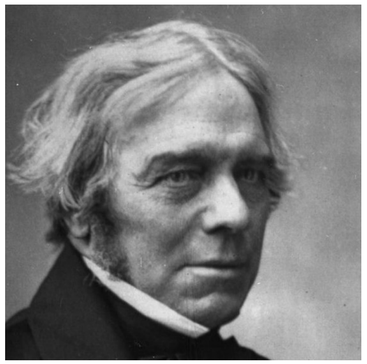
Newton

Gottfried von Leibniz

James Clerk Maxwell

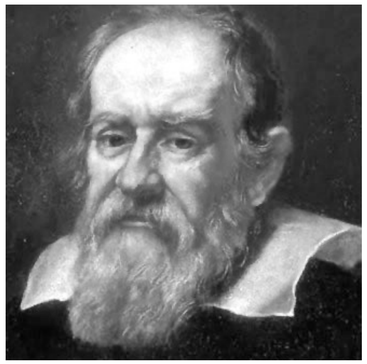
“We had sent you our manuscript for publication and had not authorised you to show it to specialists before it is printed. I see no reason to address the – in any case erroneous – comments of your anonymous expert. On the basis of this incident I prefer to publish the paper elsewhere.”

Who Is the Best Scholar Ever?



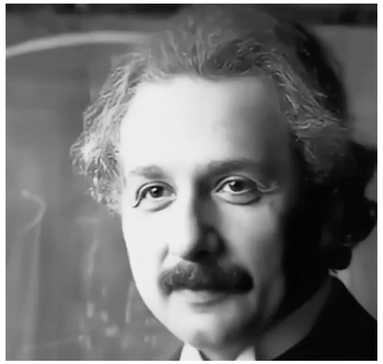
Michael Faraday

Marie Sklodowska-Curie



Galileo Galilei

Louis Pasteur



Albert Einstein

Gregor Mendel

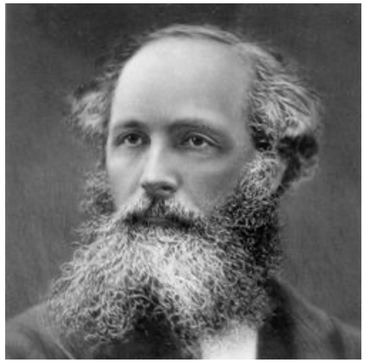
Charles Darwin

Leonhard Euler

Ibn al-Haytham

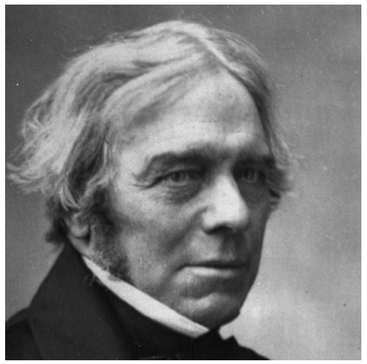
Isaac Newton

Gottfried von Leibniz



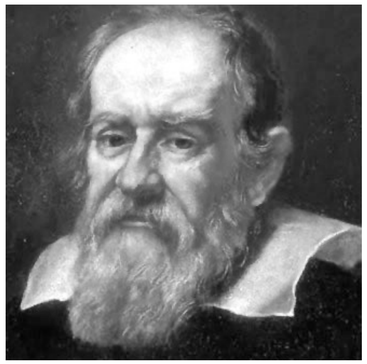
James Clerk Maxwell

Who Is the Best Scholar Ever?



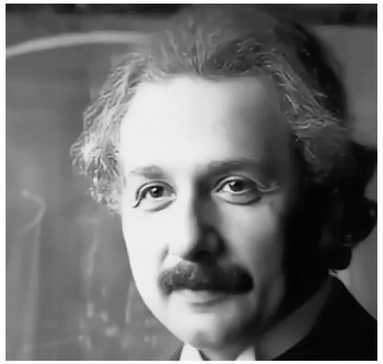
Michael Faraday

Marie Sklodowska-Curie



Galileo Galilei

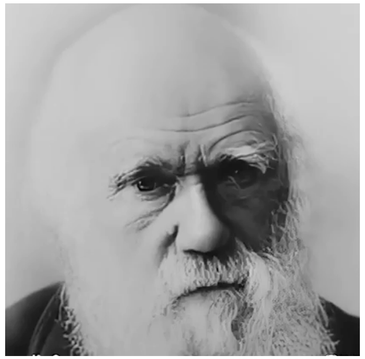
Louis Pasteur



Albert Einstein

Gregor Mendel

h-index = 1



Charles Darwin

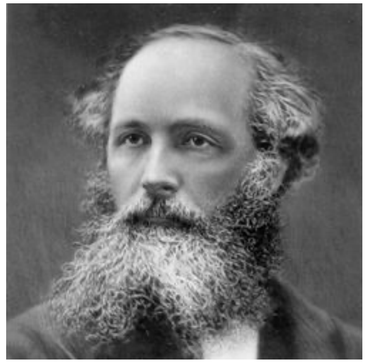
Leonhard Euler

Ibn al-Haytham

Isaac Newton

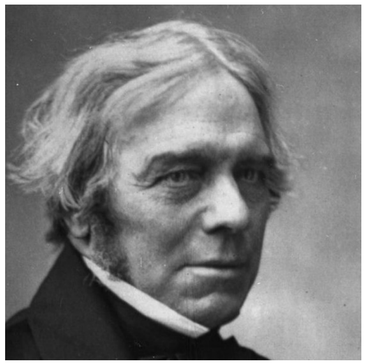
h-index = 4

Gottfried von Leibniz



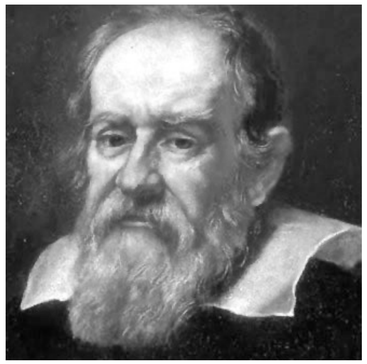
James Clerk Maxwell

Who Is the Best Scholar Ever?



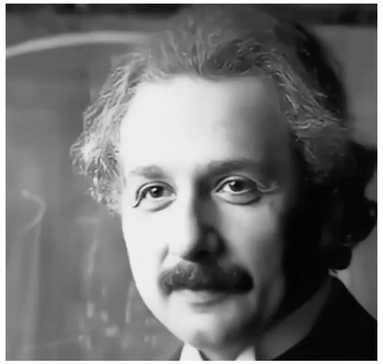
Michael Faraday

Marie Sklodowska-Curie



Galileo Galilei

Louis Pasteur



Albert Einstein

Gregor Mendel

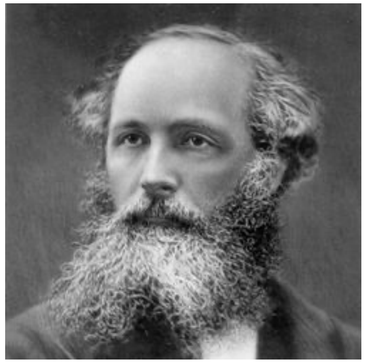
Charles Darwin

Leonhard Euler

Ibn al-Haytham

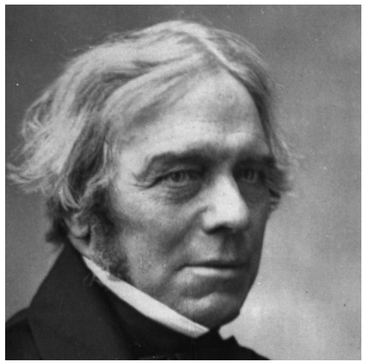
Isaac Newton

Gottfried von Leibniz



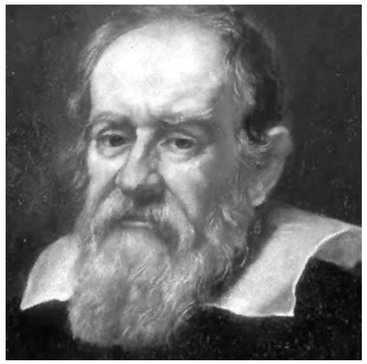
James Clerk Maxwell

Who Is the Best Scholar Ever?



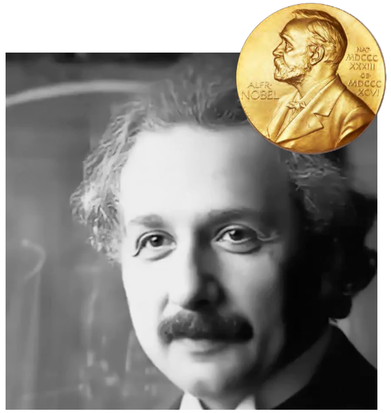
Michael Faraday

Marie Sklodowska-Curie



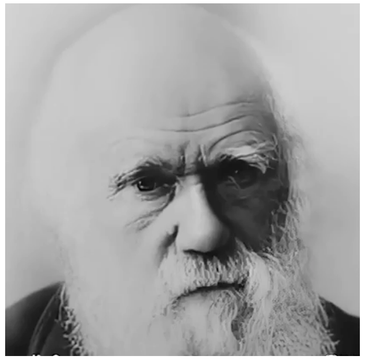
Galileo Galilei

Louis Pasteur



Albert Einstein

Gregor Mendel



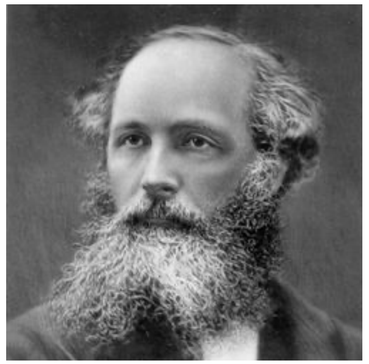
Charles Darwin

Leonhard Euler

Ibn al-Haytham

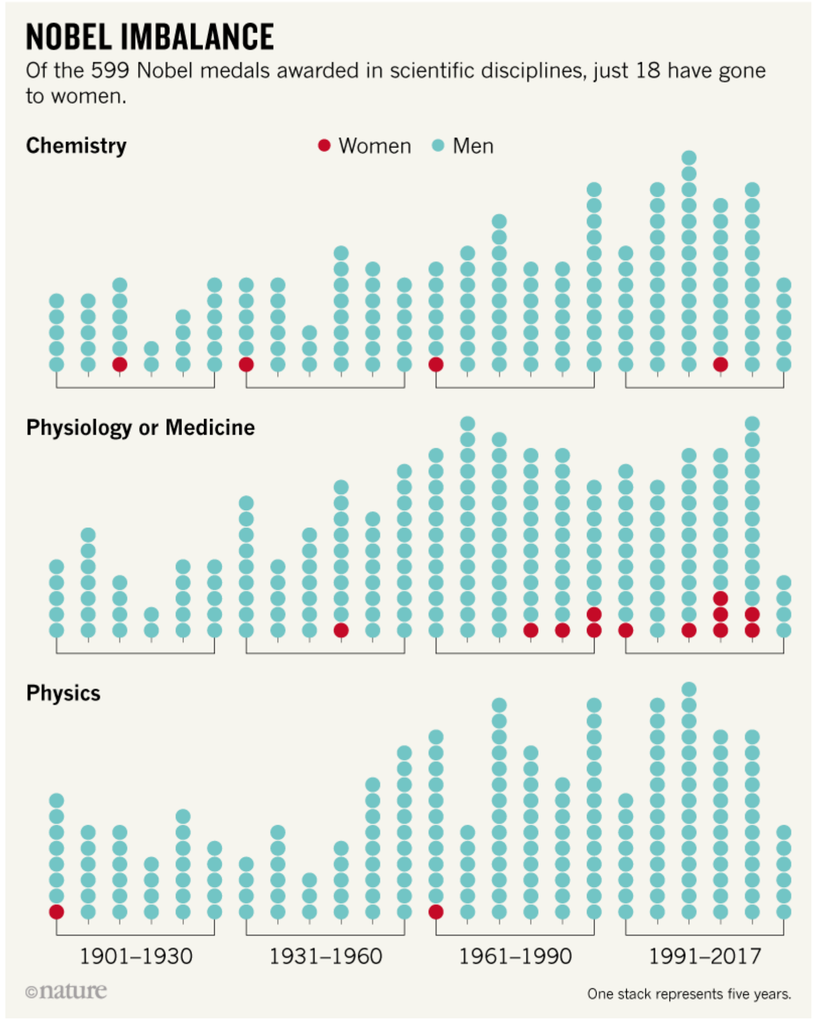
Isaac Newton

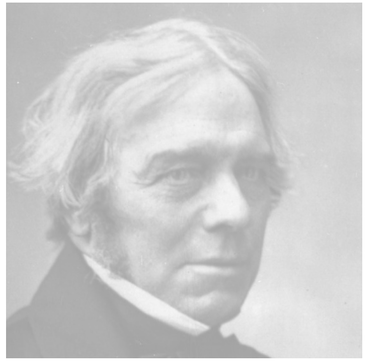
Gottfried von Leibniz



James Clerk Maxwell

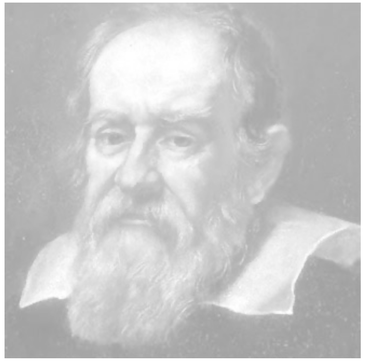
Who Is the Best Scholar Ever?





Michael Faraday

Marie Sklodowska-Curie



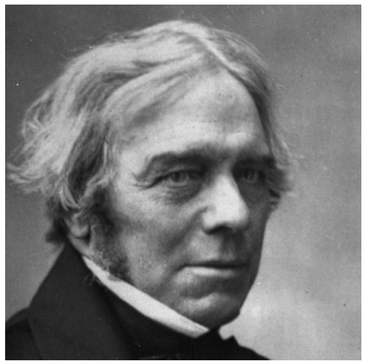
Galileo Galilei

Charles Darwin

Leonhard Euler

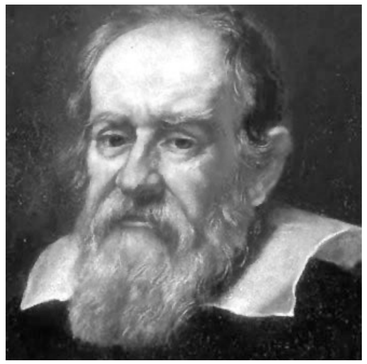
Ibn al-Haytham

Who Is the Best Scholar Ever?



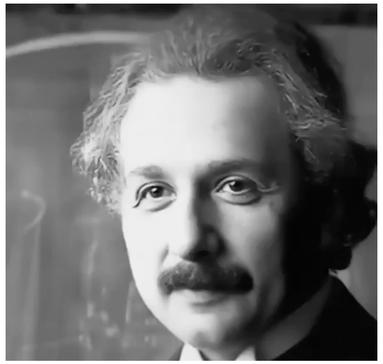
Michael Faraday

Marie Sklodowska-Curie



Galileo Galilei

Louis Pasteur



Albert Einstein

Gregor Mendel

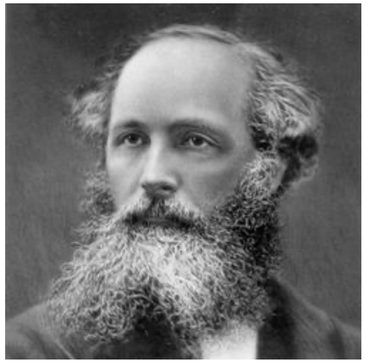
Charles Darwin

Leonhard Euler

Ibn al-Haytham

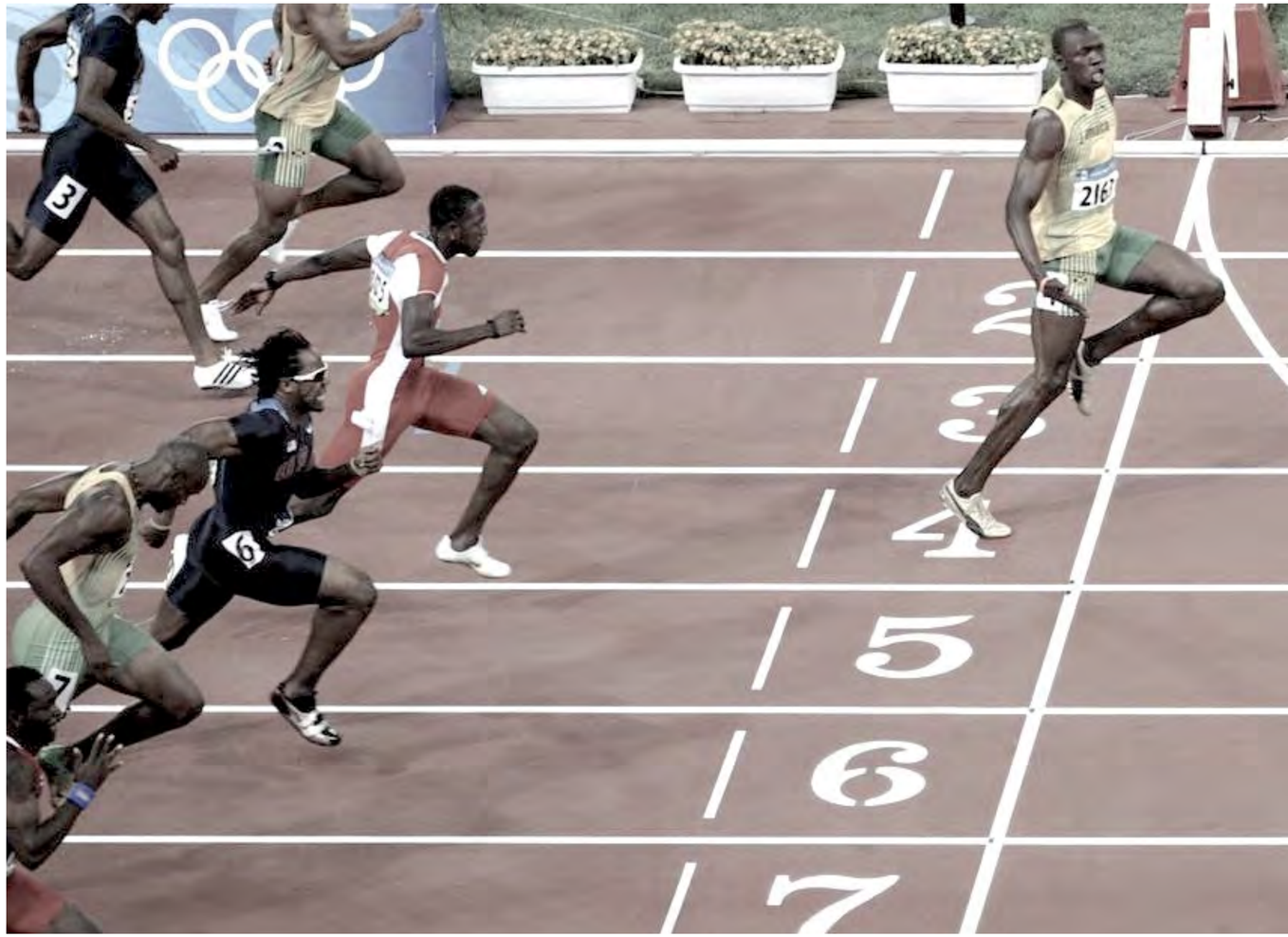
Isaac Newton

Gottfried von Leibniz

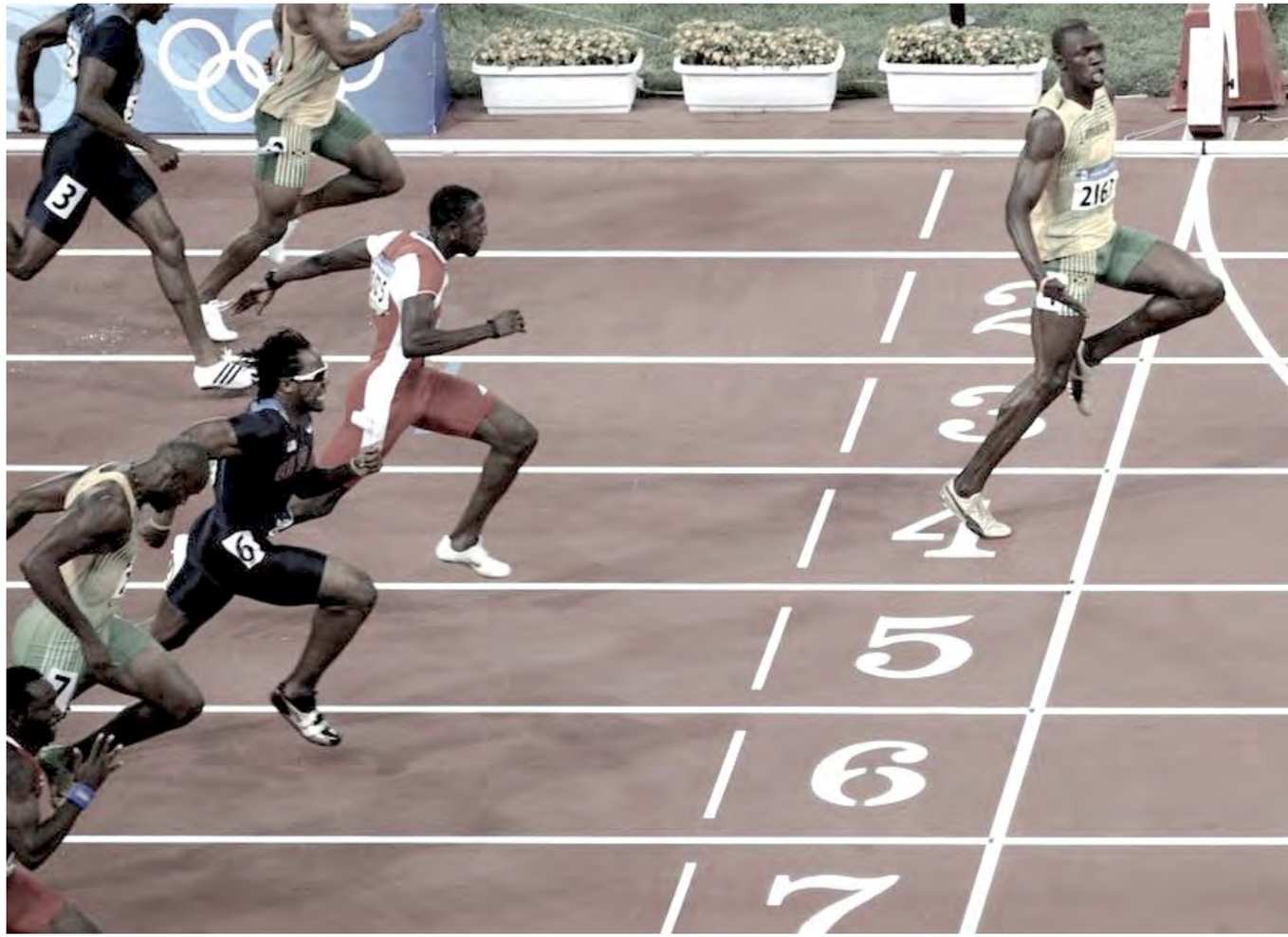


James Clerk Maxwell

Who Is the Best Scholar?



Who Do We Want to Support?



Trial by Jury

- ~12 Jury members as “peers of the accused”
- Jury only judges guilt or a verdict of not guilty, the penalty is set by the judge
- Anonymous voting (e.g. ancient Greece)
- Unanimous vote (or sometimes high level of agreement)
- Certain information is withheld from a jury (e.g. previous convictions).
- Seeking information from external sources, undermines the integrity of a jury trial. The breaking of the rules can lead to a prison sentence for a juror.
- Verdict based upon rational deliberation, step-wise establishment of argument, logical deduction, structured argumentation

Three Guiding Principles

1. Research evaluation is an active decision-making process. It is not the description of some objective ground truth by onlookers. The evaluation proceedings need to be structured to handle the complexity of the evaluation task appropriately.

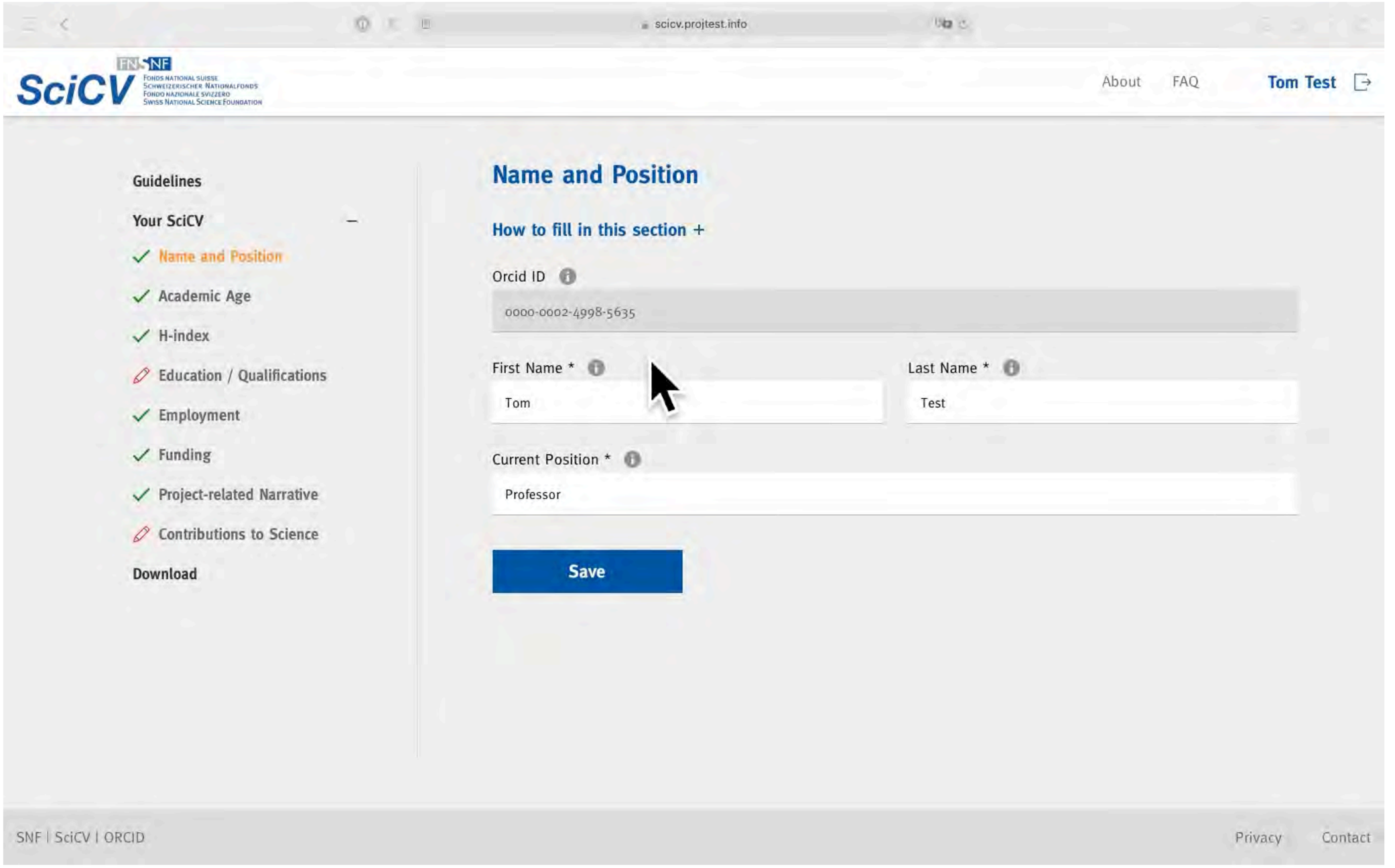
2. Evaluation and the documents under scrutiny should comprise of clearly delineated individual parts such that the verdict can be synthesised from the sum of many individual smaller steps. Assessment should not consist of unstructured, open-ended discussions that try to simultaneously consider all aspects of monolithic evaluation documents.

3. Each step of the evaluation procedure must be transparent and well-defined, easy to understand with a clearly formulated aim and comprehensible outcome, which in turn should form the basis of the next step of the evaluation and/or feed directly into the final verdict.

SciCV

Overview of SciCV

- H-Group
- Narrative(s) and “lists”
- Omitted the full publication list
- Included Academic Age
- Limited to two metrics: H-index and RCR
- Interactive online platform
- Developed with Research Council Members
- Piloted in Biology and Medicine in April 2020
- 346 applications (495 applicants), of which 129 applications received funding


scicv.projtest.info
SciCV
FONDS NATIONAL SUISSE
SCHWEIZERISCHER NATIONALFONDS
FONDO NAZIONALE SVIZZERO
SWISS NATIONAL SCIENCE FOUNDATION
About
FAQ
Tom Test
Guidelines
Your SciCV
Name and Position
Academic Age
H-index
Education / Qualifications
Employment
Funding
Project-related Narrative
Contributions to Science
Download
Name and Position
How to fill in this section +
Orcid ID
0000-0002-4998-5635
First Name *
Tom
Last Name *
Test
Current Position *
Professor
Save
SNF | SciCV | ORCID
Privacy
Contact

SciCV

FONDS NATIONAL SUISSE
SCHWEIZERISCHER NATIONALFONDS
FONDO NAZIONALE SVIZZERO
SWISS NATIONAL SCIENCE FOUNDATION

Vornamen
Nachnamen

Professor of Neurobiology, University of Zürich
ORCiD: 0000-0002-4998-5635, Academic Age: 22*, H-index: 4

Education & Qualifications

MSc Student, Linear Algebra, Harvard Medical School, MA, US
11.2006 — 12.2008; 1 year, 1 month

PhD Student, Systems Biology, Behaviour and Neurscience, Eidgenössische Technische Hochschule , Zürich, Switzerland
11.2000 — 12.2005; 5 years, 11 months

MSc Student, Linear Algebra, Harvard Medical School, MA, US
11.2006 — 12.2008; 2 years, 1 month

PostDoc, Geography, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
12.2012 — 12.2014; 2 years

Full Professor, Computational Sciences, California Institute of Technology Division of Physics Mathematics and Astronomy, Pasadena, USA
06.2015 — 02.2020; 4 years, 8 months (still ongoing)

Employment

MSc Student, Linear Algebra, Harvard Medical School, MA, US
11.2006 — 12.2008; 1 year, 1 month

PhD Student, Systems Biology, Behaviour and Neurscience, Eidgenössische Technische Hochschule , Zürich, Switzerland
11.2000 — 12.2005; 5 years, 11 months

MSc Student, Linear Algebra, Harvard Medical School, MA, US
11.2006 — 12.2008; 2 years, 1 month

PostDoc, Geography, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
12.2012 — 12.2014; 2 years

Funding

Funding (1) | To SciCV or not to SciCV, Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Bern, Switzerland. Grant Identifier 986298
Principal Investigator; 11.2000 — 12.2005; 5 years, 11 months
Total funded amount: CHF 10'000'000 Funding allocated to my group: CHF 5'000'000

Funding (2) | To SciCV or not to SciCV, Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Bern, Switzerland. Grant Identifier 986298
Principal Investigator; 11.2000 — 12.2005; 5 years, 11 months
Total funded amount: CHF 10'000'000 Funding allocated to my group: CHF 5'000'000

Funding (3) | To SciCV or not to SciCV, Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Bern, Switzerland. Grant Identifier 986298
Principal Investigator; 11.2000 — 12.2005; 5 years, 11 months
Total funded amount: CHF 10'000'000 Funding allocated to my group: CHF 5'000'000

Funding (4) | To SciCV or not to SciCV, Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Bern, Switzerland. Grant Identifier 986298
Principal Investigator; 11.2000 — 12.2005; 5 years, 11 months
Total funded amount: CHF 10'000'000 Funding allocated to my group: CHF 5'000'000

Funding (5) | To SciCV or not to SciCV, Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung, Bern, Switzerland. Grant Identifier 986298
Principal Investigator; 11.2000 — 12.2005; 5 years, 11 months
Total funded amount: CHF 10'000'000 Funding allocated to my group: CHF 5'000'000

* The fields "*Citation of your first peer reviewed publication (or equivalent)*" and "*Activities and context beyond academia*" are not included in the SciCV PDF, as they are used for administrative purposes only and do not form part of the evaluation.

Project-Related Narrative

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed aliquam justo orci, ac scelerisque nulla ullamcorper non. Suspendisse nunc sem, laoreet sed urna eu, mollis lacinia mi [1]. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed a enim tellus. Duis vitae ex vitae lorem scelerisque varius. Etiam rhoncus in leo nec tincidunt [2]. Donec faucibus sapien luctus orci fringilla, ac faucibus tortor dictum. Nunc feugiat dapibus nibh a tempor. Interdum et malesuada fames ac ante ipsum primis in faucibus. Quisque mi dolor, malesuada eu leo mattis, scelerisque dapibus diam. Nunc feugiat fermentum libero, a condimentum neque faucibus at. Suspendisse quis iaculis dui. Proin eleifend risus at orci ultricies pharetra. Nulla eget consectetur libero, a vestibulum sapien. Vivamus condimentum fringilla diam ut imperdiet. Nunc ex felis, feugiat et placerat non, blandit at nunc. Vestibulum a ullamcorper quam, in pulvinar lacus [3, 4]. Cras et luctus neque. Donec luctus quam erat, vitae lacinia nisl porttitor vitae. Cras commodo semper purus nec elementum. Praesent id ornare mi, eget convallis ipsum. In et commodo felis. In hac habitasse platea dictumst. Nunc accumsan egestas convallis. Donec pretium metus et lectus pretium posuere. Fusce nec eros feugiat, hendrerit risus nec, lobortis ante [1 - 3]. Mauris ornare tellus ac nulla aliquam imperdiet. Donec malesuada porttitor scelerisque. Cras posuere libero in ipsum rhoncus molestie. Cras auctor varius diam et mollis. Ut sed vulputate erat, in varius lectus. In euismod, ipsum eu porta cursus, leo libero fringilla purus, non malesuada erat tortor quis tortor. Donec ipsum est, rhoncus non lacus quis, mollis ultrices lectus. Nunc efficitur mauris gravida, egestas quam quis, sodales massa. Donec faucibus, nisl id vestibulum fringilla, lorem magna viverra urna, in mattis felis lacus at diam [5].

[1] Journal Article. Kiefer, E., Hoover, D., Shi, Q., Dusingize, J., Sinayobye, J., & Anastos, K. (2018). Longitudinal evaluation of markers of inflammation in HIV-positive and HIV- negative Rwandan women. HIV Medicine,19(10), 734–744. https://doi.org/10.1038/ncomms12722. RCR: 1.2. Dimensions Link, Open Access Link.

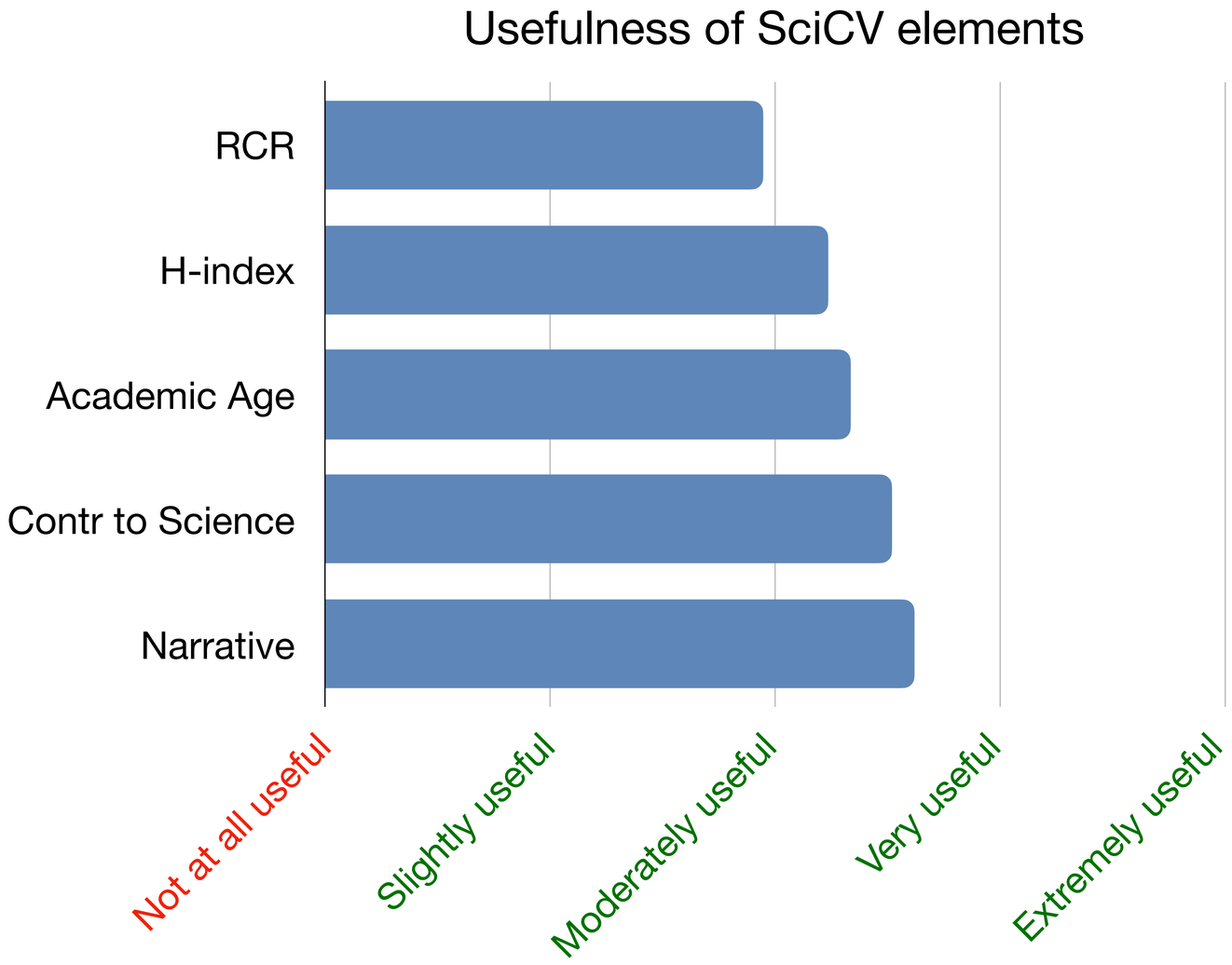
[2] Journal Article. Kiefer, E., Hoover, D., Shi, Q., Dusingize, J., Sinayobye, J., & Anastos, K. (2018). Longitudinal evaluation of markers of inflammation in HIV-positive and HIV- negative Rwandan women. HIV Medicine,19(10), 734–744. https://doi.org/10.1038/ncomms12722. RCR: 1.2. Dimensions Link, Open Access Link.

[3] Journal Article. Kiefer, E., Hoover, D., Shi, Q., Dusingize, J., Sinayobye, J., & Anastos, K. (2018). Longitudinal evaluation of markers of inflammation in HIV-positive and HIV- negative Rwandan women. HIV Medicine,19(10), 734–744. https://doi.org/10.1038/ncomms12722. RCR: 1.2. Dimensions Link, Open Access Link.

Analysis

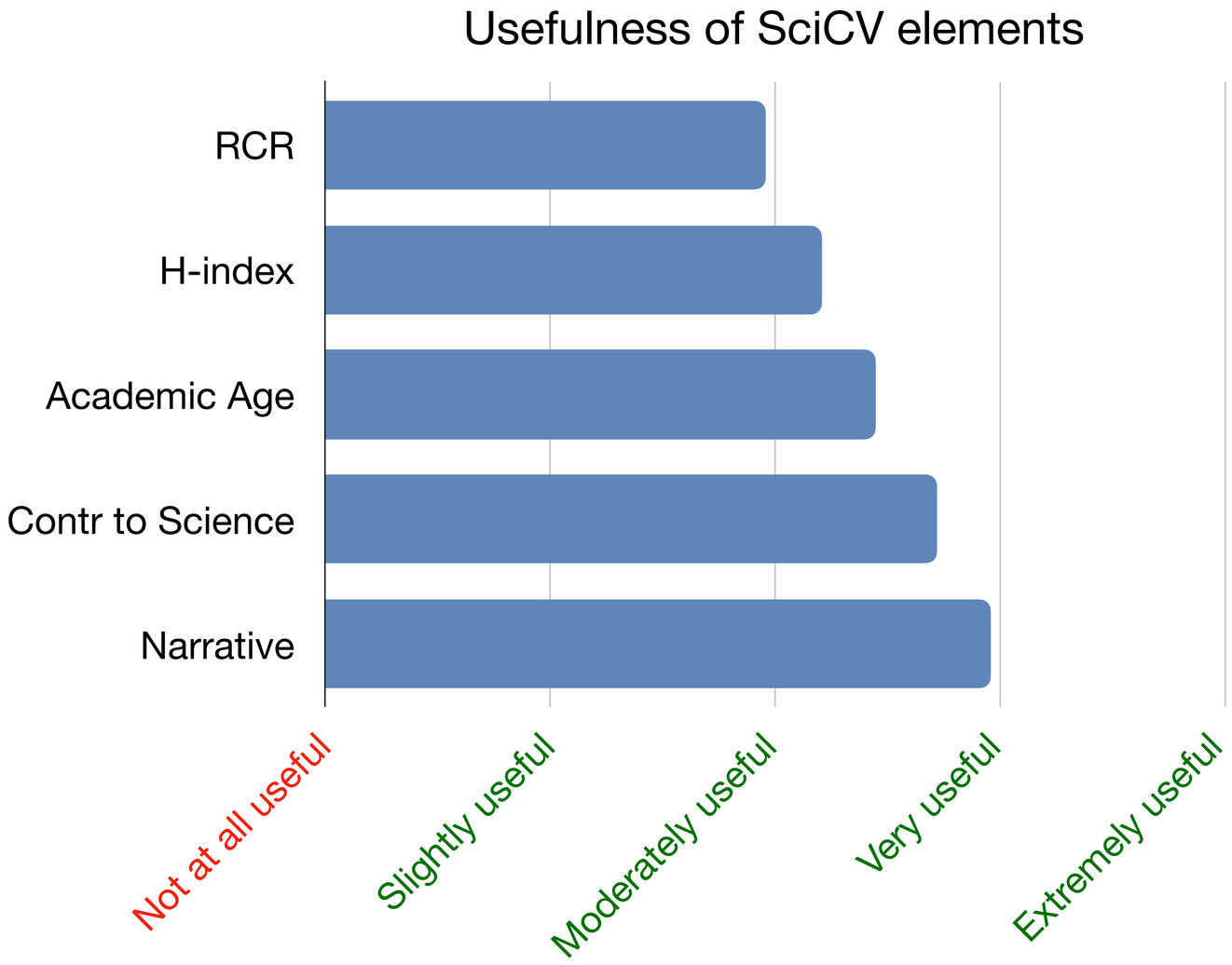
- Survey among applicants (response rate 24.8%)
- Semi-structured interviews with 10 applicants
- Text mining of the narrative elements of all 495 submitted SciCVs
- Survey among external reviewers, panel members, research council members (response rate 12.4%)
- Semi-structured interviews with 10 reviewers (4 external, 2 regular panel members, 4 research council members)
- Data on the practical use of the SciCV in the 10 review panel meetings, collected through participant observation

Applicants



Applicants with less than 3 previous applications were more positive about narratives (3.80 vs 3.44 and 3.79 vs 3.34) and academic age (3.57 vs 3.17) than more experienced applicants.

Evaluators & Reviewers



SciCV was perceived as very to extremely useful by 70% of reviewers

Junior evaluators were more positive than senior evaluators

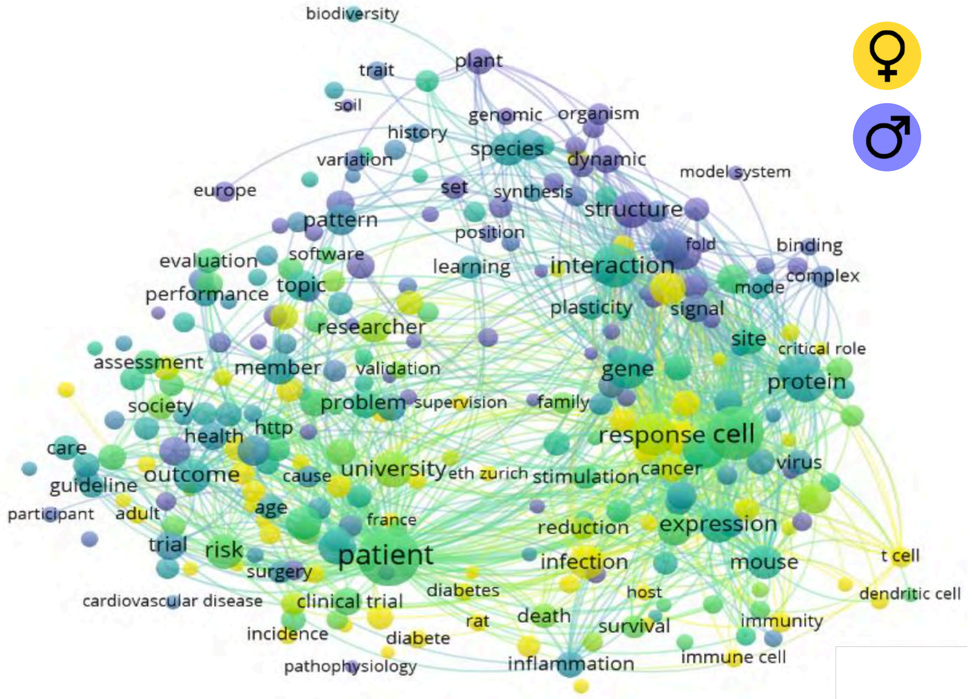
External reviewers were more positive than members of the Research Council about *narratives* and the omission of a *publication lists*

Gender Effects in Narratives

Occurrence of Terms in Narratives

Terms	Total occurrence female applicants	Occurrence female applicants in %	% occurrence among female applicants	Total occurrence female applicants
expert	232	70	30.172	51.47
lead	161	48	29.814	35.29
success	115	38	33.043	27.94
the first	95	28	29.474	20.59
publication	88	25	28.409	18.38
grant	86	23	26.744	16.91
novel	83	22	26.506	16.18
leading	70	21	30	15.44
unique	62	18	29.032	13.24
ERC	59	17	28.814	12.5
head	55	20	36.364	14.71
article	45	7	15.556	5.147
paper	39	6	15.385	4.412
discovery	33	11	33.333	8.088
innovative	27	7	25.926	5.147
fellowship	26	8	30.769	5.882
award	26	7	26.923	5.147
specialist	25	3	12	2.206
recognized	25	9	36	6.618
cited	23	4	17.391	2.941
pioneer	22	6	27.273	4.412
director	21	5	23.81	3.676
excellent	18	4	22.222	2.941
peer-reviewed	18	4	22.222	2.941
Nature (journal)	12	2	16.667	1.471
breakthrough	7	5	71.429	3.676
Science (journal)	7	2	28.571	1.471
independent research	6	3	50	2.206
citation	4	1	25	<1%

We found no significant difference in how men and women present themselves in narratives



Panel Meetings

(participant observations)

- Novel elements of the SciCV broadened the information base
- Narrative elements were effectively used to supplement publication-centric decision-making
- Many evaluators routinely consulted information beyond the SciCV (e.g. full publication lists and biological age)
- Repeated attempts to enforce adherence to the processual regulations laid out by SNSF by administrators and individual panel members

Overview of SciCV

- Blended CV (narratives and “lists”)
- Omitted full publication list
- Included Academic Age
- Limited to two metrics: H-index and RCR
- Interactive online platform
- Developed with Research Council Members

SciCV 2.0

Possible Future Directions (TBD):

- Reduction of Metrics
- Even stronger ORCID integration
- Less focus on publications
- Less focus on standing in community
- Better integration of narrative Elements

Marcel Benoist Prize

Overview

- Awarded annually by the Marcel Benoist Foundation since 1920
- For “[…] *the most useful discovery or study in the sciences that is of particular relevance to human life*”
- Chaired by Federal Councillor Guy Parmelin
- The SNSF was mandated as an independent organisation to design and conduct the evaluation
- Unique opportunity to design new evaluation procedures (2018)

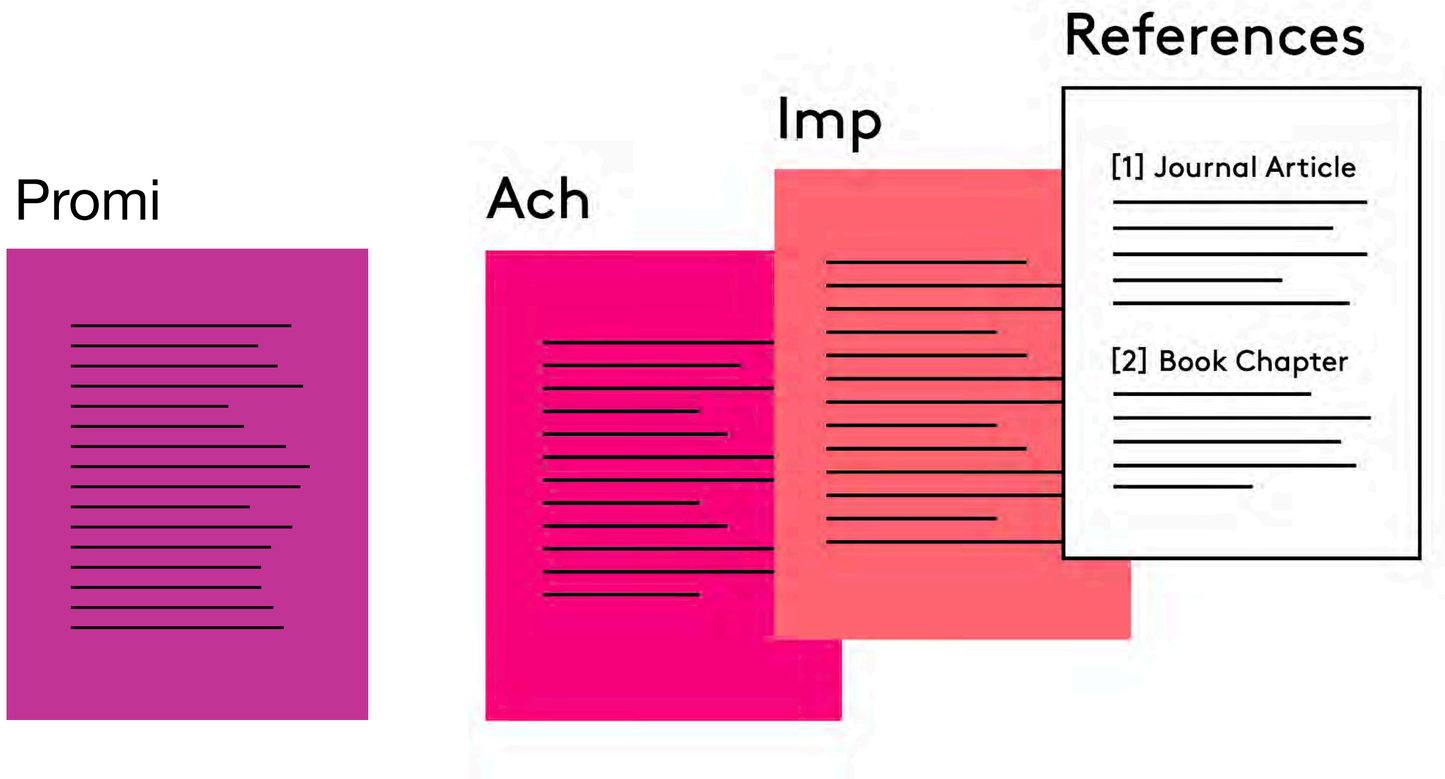
—Swiss Science—Prize Marcel—Benoist
Experience Excellence

Overview

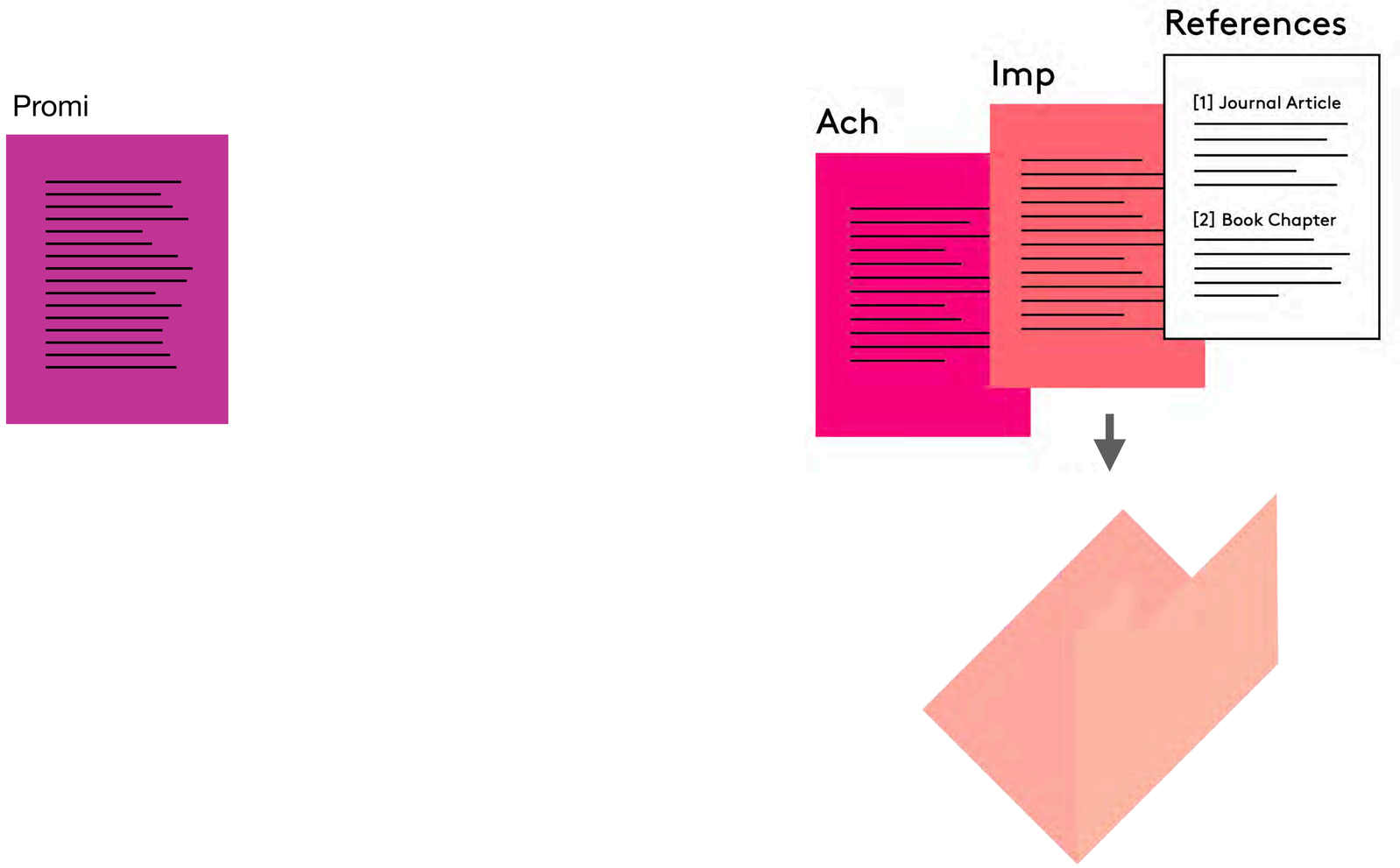
- Highly structured and transparent procedure
- Anonymous, electronic voting (now fully online)
- Non-academic evaluators
- Anonymised nominations
- Network evaluation
- Pre-evaluation
- Ranking instead of rating
- Data supported Discussions

—Swiss Science—Prize Marcel—Benoist
Experience Excellence

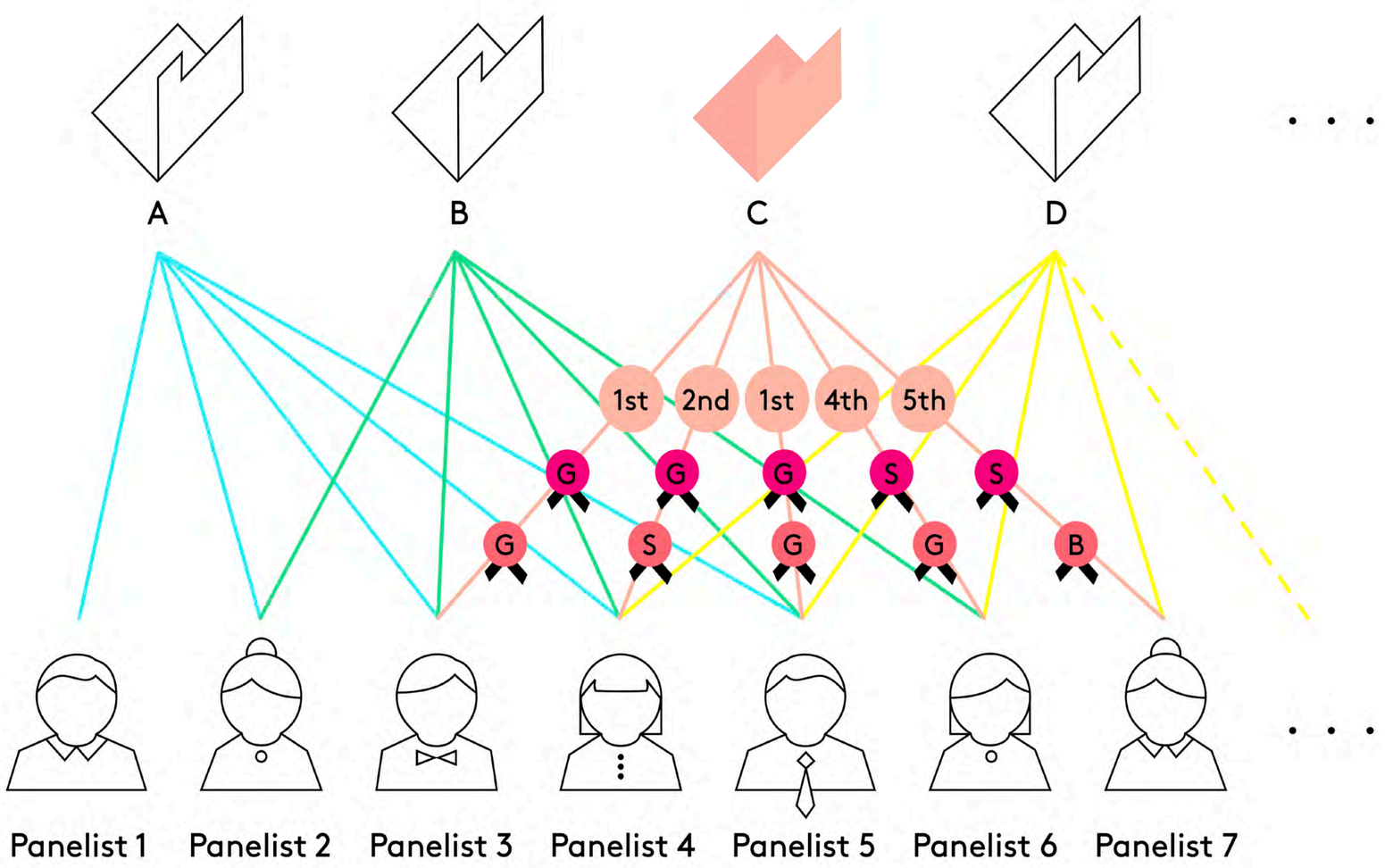
Anonymisation



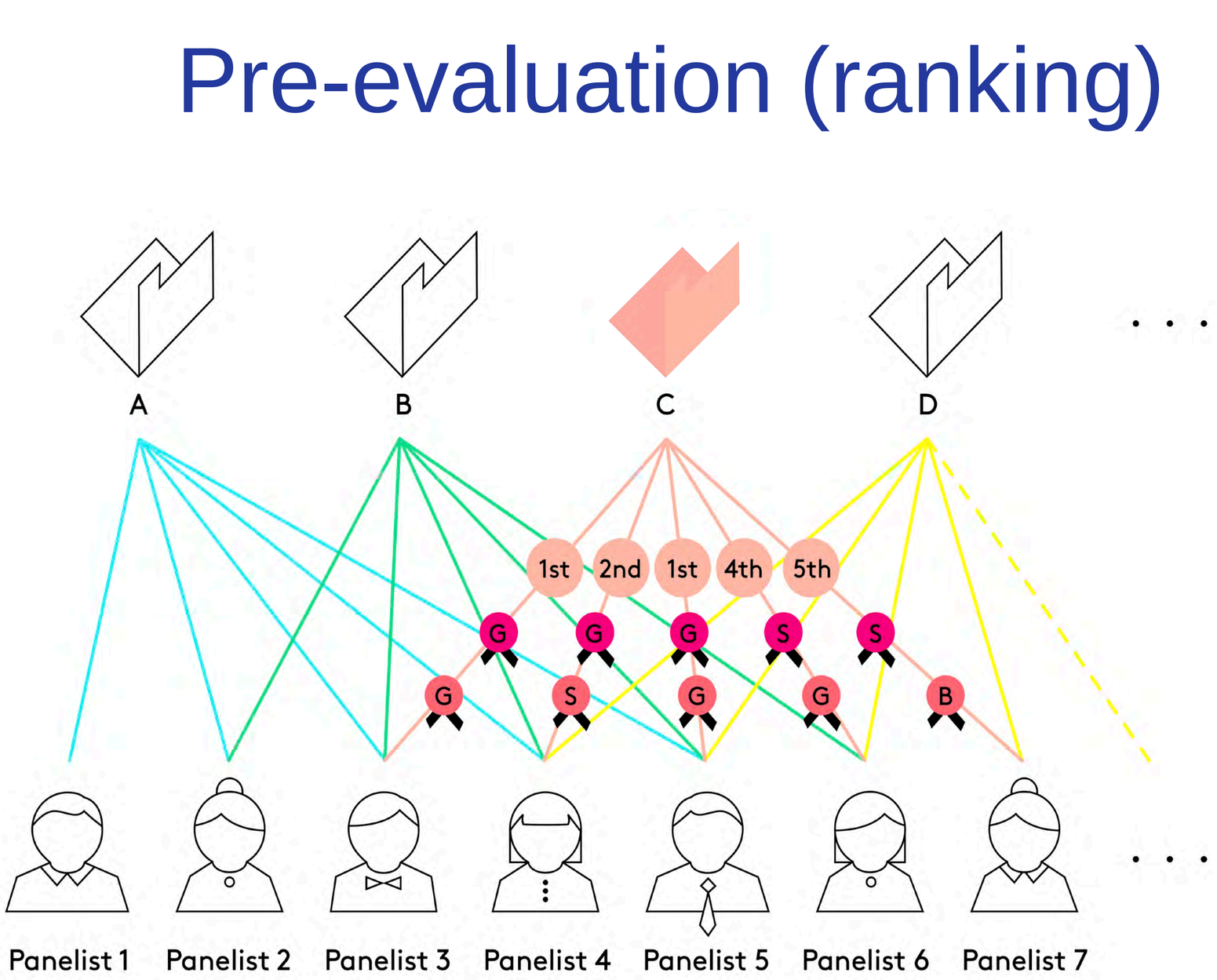
Anonymisation

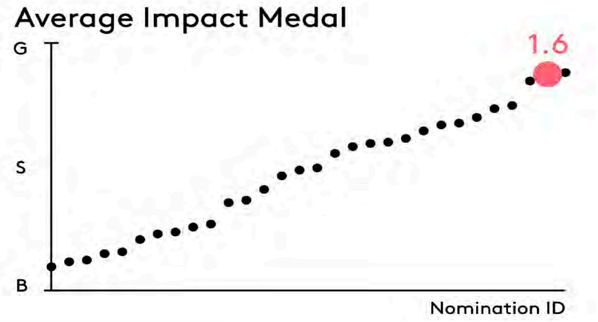


Network Evaluation



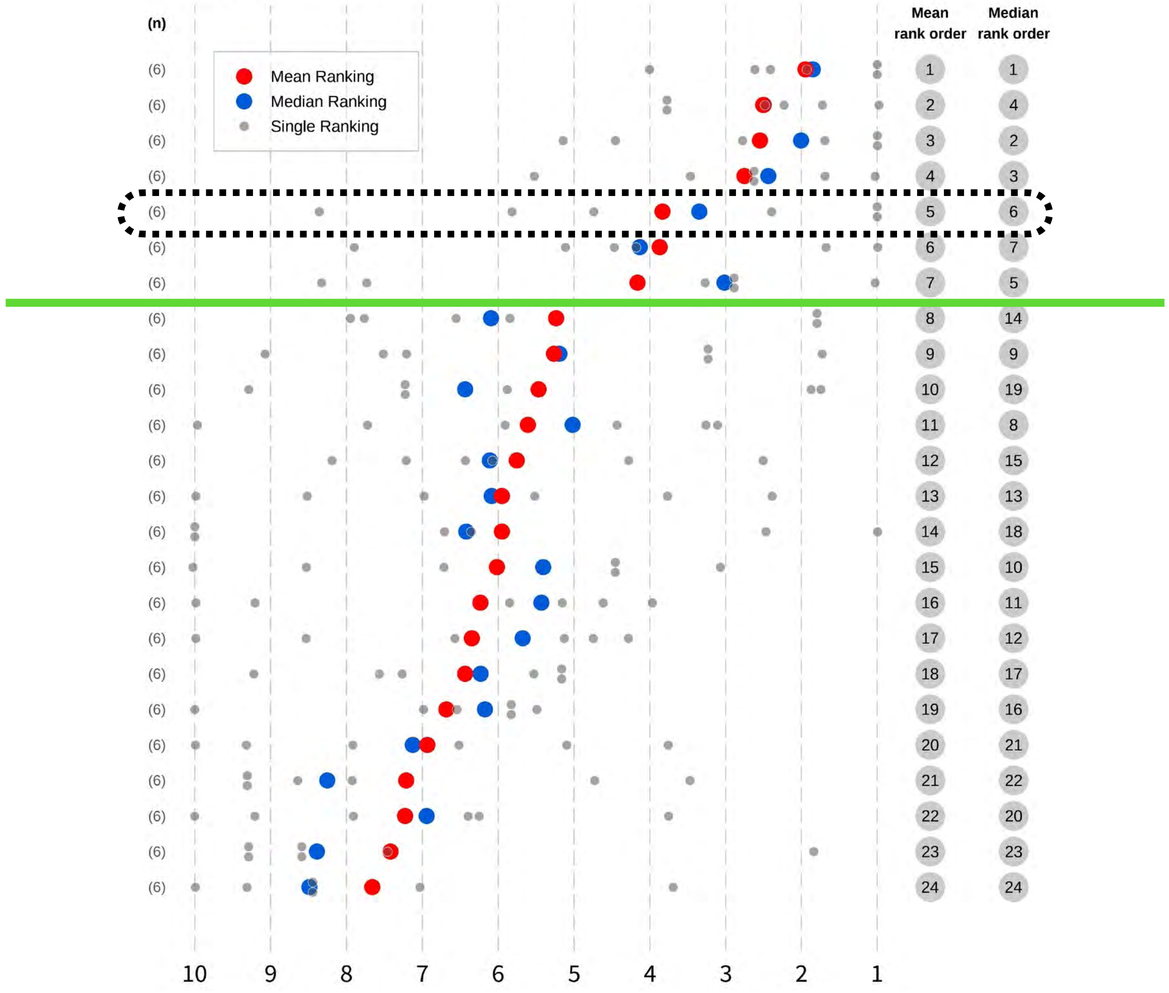
Pre-evaluation (ranking)

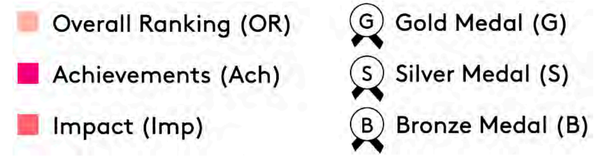


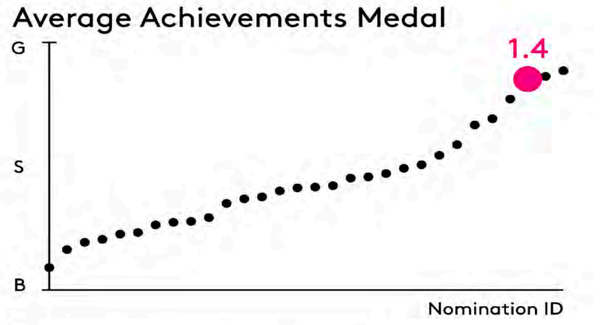


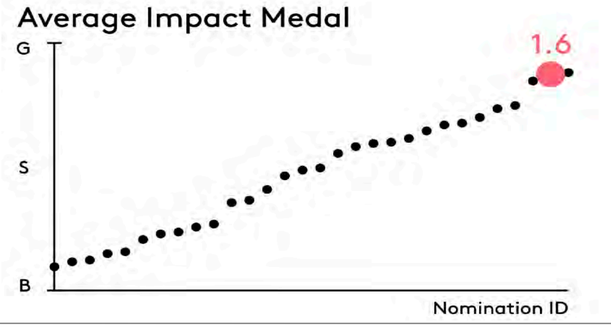
Thresholding

(non-anonymous)



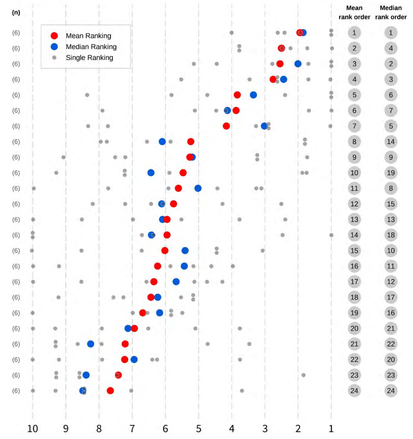




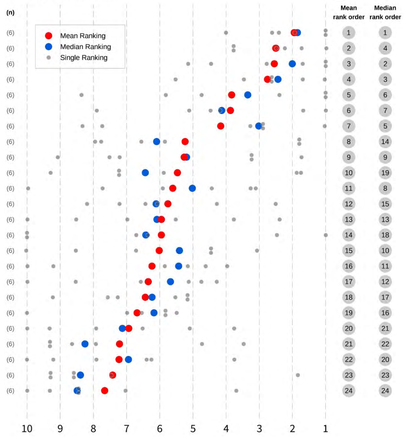


Data-supported Evaluation

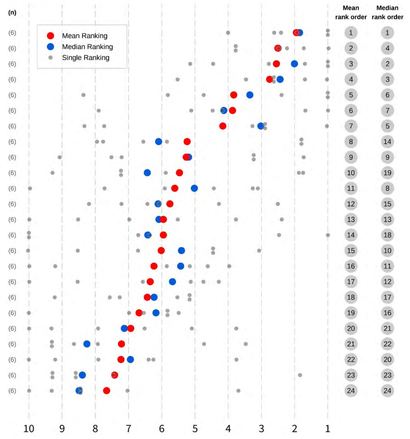
1st Ranking



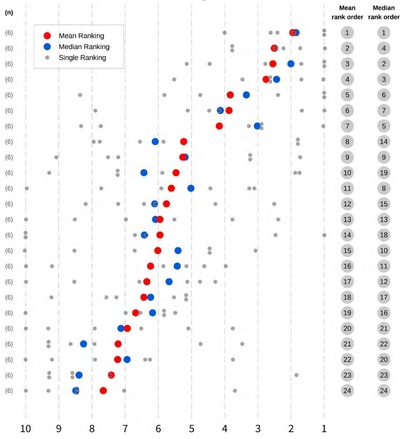
2nd Ranking



Achievements



Impact



Theoretical Physics

Research Topics:

- By analysing the motion of tiny particles suspended in still water, they could calculate the size of the jostling atoms and Avogadro's number
- By applying quantum theory to light they could explain the photoelectric effect
- Developed the mathematical theory of special relativity
- They showed that relativity theory leads to the equation $E = mc^2$

Ranking

	Rank	Ach	Imp	X
Rev 1	1	1	1	✗
Rev 2	1	1	1	
Rev 3	1	2	1	
Rev 4	4	1	1	
Rev 5	8	2	1	
Rev 6	11	3	3	✗

COI

- Rev 10
- Rev 11

RH9

Overview

- Highly structured and transparent procedure
- Anonymous, electronic voting (now fully online)
- Non-academic evaluators
- Anonymised nominations
- Network evaluation
- Pre-evaluation
- Ranking instead of rating
- Data supported Discussions

—Swiss Science—Prize Marcel—Benoist
Experience Excellence

Laureates

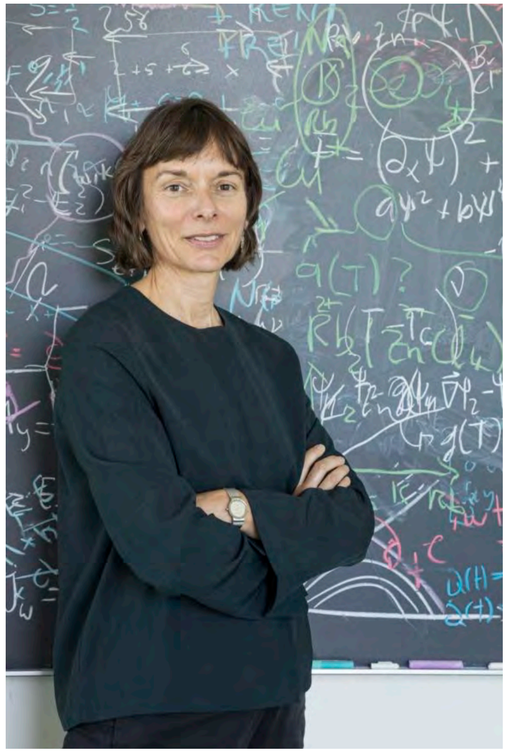
2021

Thomas Berger
(Uni Bern)

2020

Rudolf Aebersold
(UZH, ETHZ)

2019



Nicola Spaldin
(ETHZ)

2018

Lars-Erik Cederman
(ETHZ)

The Structure of Research Evaluation

- Evaluation is more like active decision-making and less like the revelation of a ground truth
- Formalised processes like a trial by jury can provide valuable insights and inspiration
- SciCV successfully piloted a blended CV with the support of change management and independent analysis
- The Marcel Benoist Prize Evaluation combines many innovations including: structured process, non-academic evaluators, anonymisation, pre-evaluation, network evaluation, ranking, data-supported discussions

Thank you!

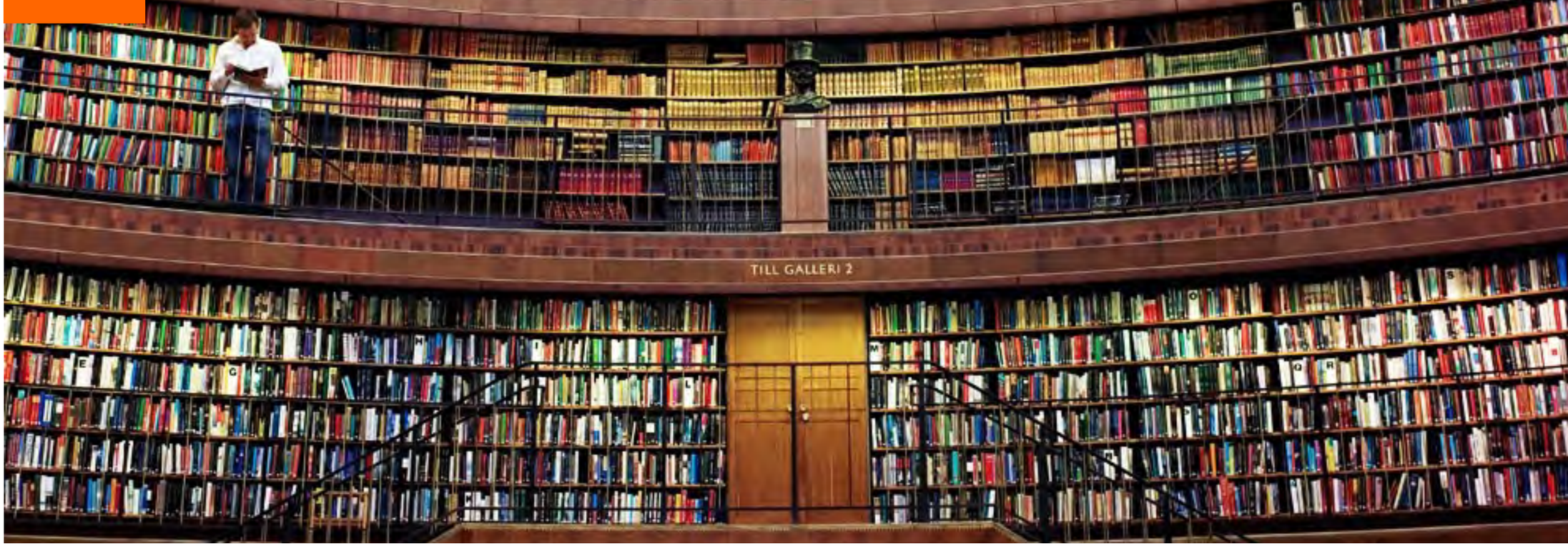
The work presented here involved many people at the SNSF administrative offices and in the National Research Council. In the SciCV and the Marcel Benoist Prize projects these include most notably:

Michaela Strinzel

Strategy

Martin von Arx

Biology and Medicine



The Structure of Research Evaluation

Michael Hill, Online, 27.09.2021

Swiss National
Science Foundation

The use of metascience in the context of funding

Dr. Cassidy R. Sugimoto
Professor + Tom and Marie Patton School Chair
School of Public Policy
@csugimoto

Georgia Tech

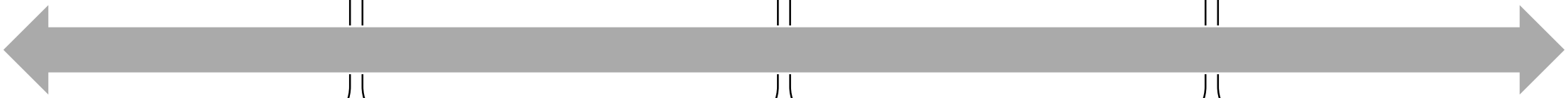
A brief overview

Portfolio management

Process evaluation

Policy evaluation

Outcome evaluation



Georgia Tech

Where am I coming from?

Scientometrics

- Background in information science
- Use of large-scale quantitative data to understand science
- Triangulation with survey data

National Science Foundation

- Science of Science Innovation and Policy Program *(retitled Science of Science: Discovery, Communication, and Impact)*
- Part of the Social, Behavioral, and Economic Sciences
- 2018-2020 (Trump admin.)

School of Public Policy

- 30 full-time tenure/tenure-track faculty
- ST&I, Philosophy of science, Energy & Environment, Cybersecurity
- Joined as head of school in 2021

Georgia Tech

How should metascience approaches be employed?

An **indicator** is a measure of a concept.

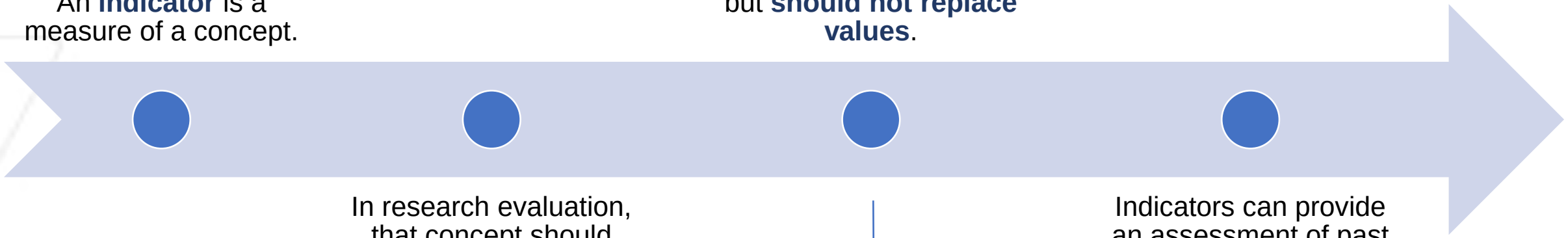
In research evaluation, that concept should **represent values**.

Interdisciplinarity
Diversity
Collaboration

The indicators, therefore, provides evidence of values, but **should not replace values**.

Citations
H-indices
JIFs

Indicators can provide an assessment of past achievements and be **used to motivate future decisions and policies**.

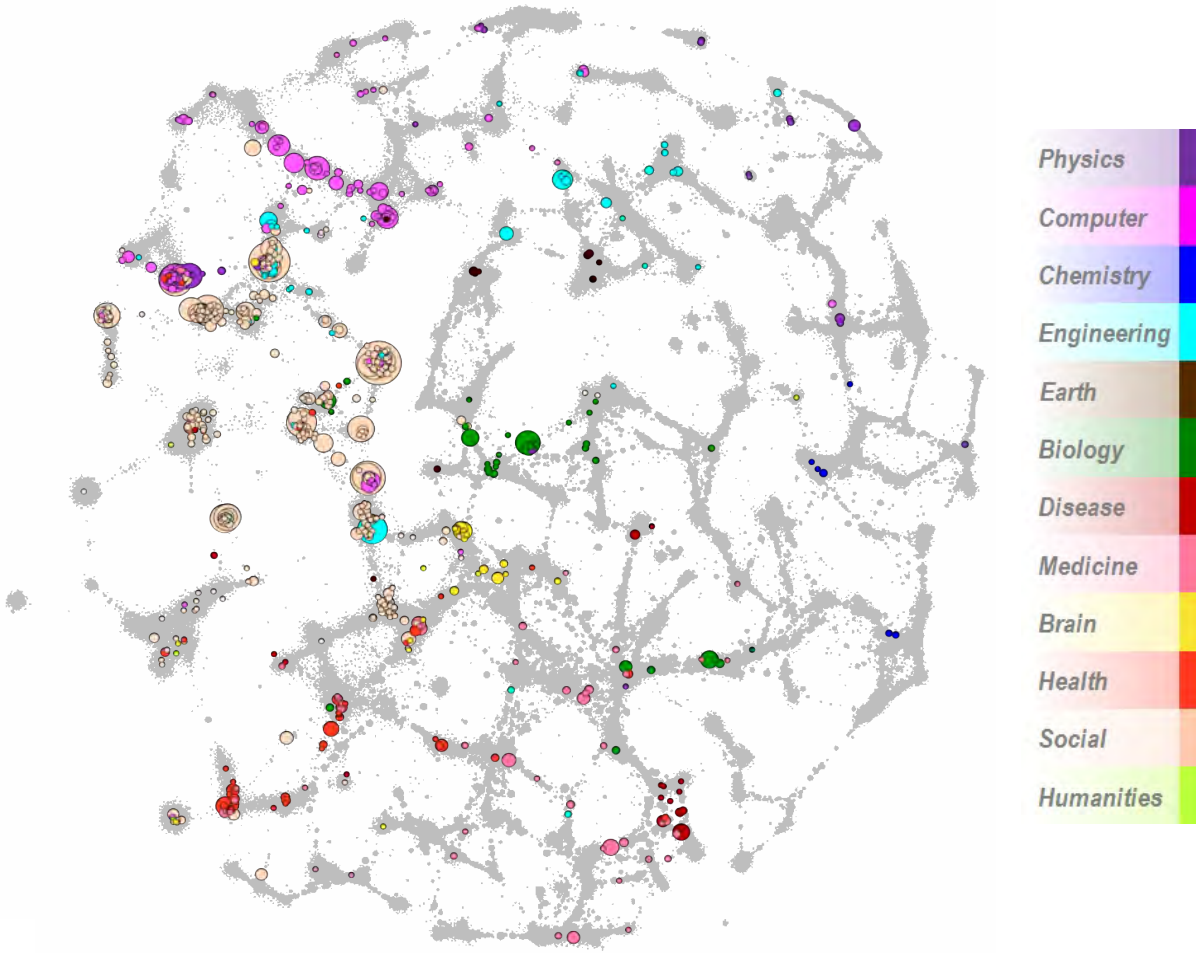


Georgia Tech

PORTFOLIO MANAGEMENT

Georgia Tech

Science mapping *(Boyack, SciTech Strategies)*



Science mapping can distill large amounts of information into easily accessible visualizations for assessment and decision-making

Georgia Tech

Scientometrics can be a tool to evaluate the effects of concentration

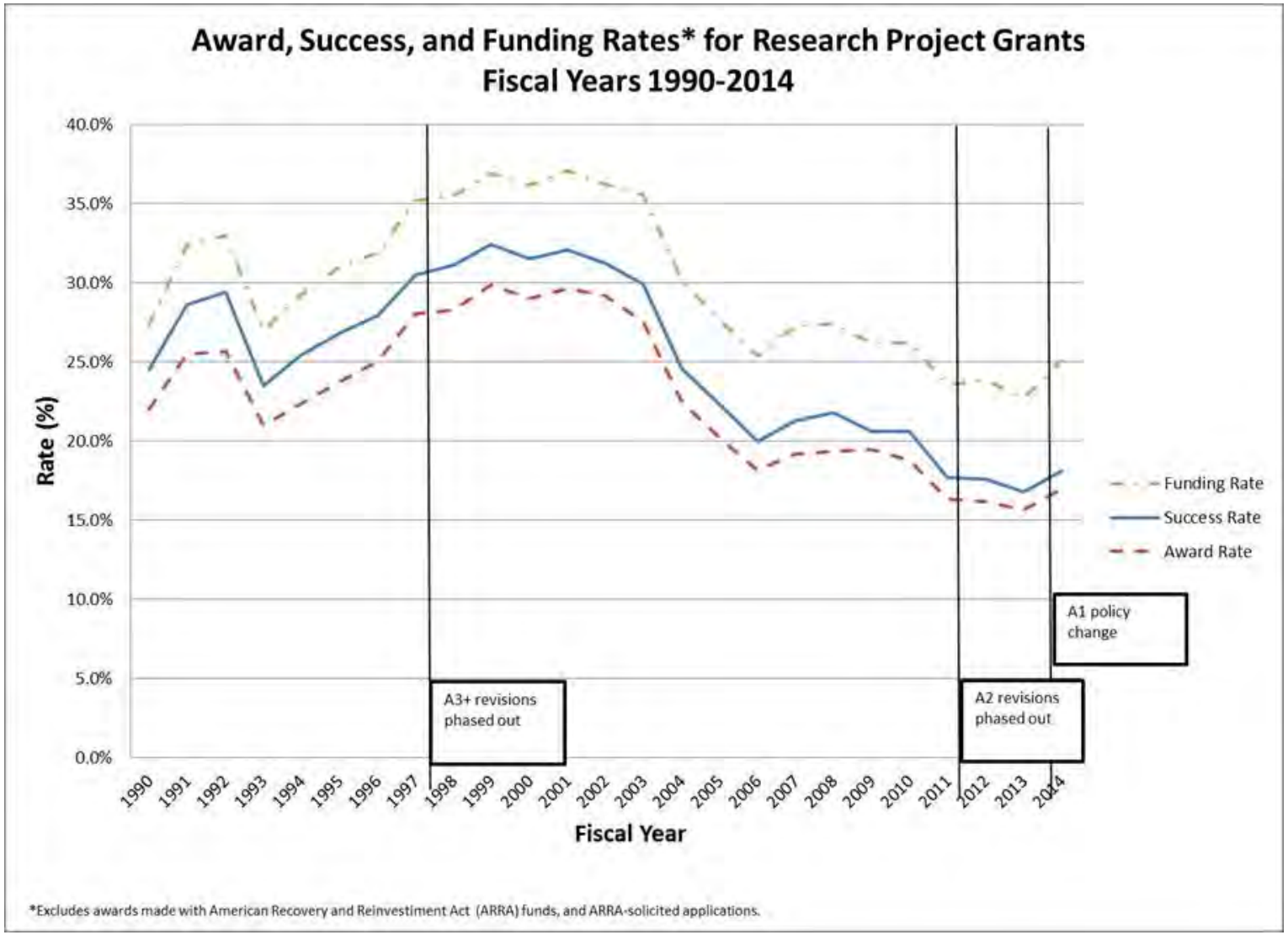
TABLE 1 Grant application success rates

Agency	Success rate	Year	Average annual grant	Source
NSERC	70.2	2007	$30,000	(NSERC, 2007a)
CIHR	16.3	2005	$109,700	(CIHR, 2007)
SHHRC	33.1	2008	$28,245	(Taylor and Yasmeen, 2008)
US NIH (R01)	16.3	2006	$359,030	(NIH, 2006a,b)
US NSF	20	2005	$140,000	(Tornow, 2006, 2007)
UK MRC	25	2006		(Tornow, 2007)

Note: NSERC = Natural Sciences & Engineering Research Council, Canada; CIHR = Canadian Institutes of Health Research; SSHRC = Social Sciences and Humanities Research Council, Canada; US NIH (R01) = United States National Institutes of Health Research Project Grant Program; US NSF = United States National Science Foundation; UK MRC = United Kingdom Medical Research Council.

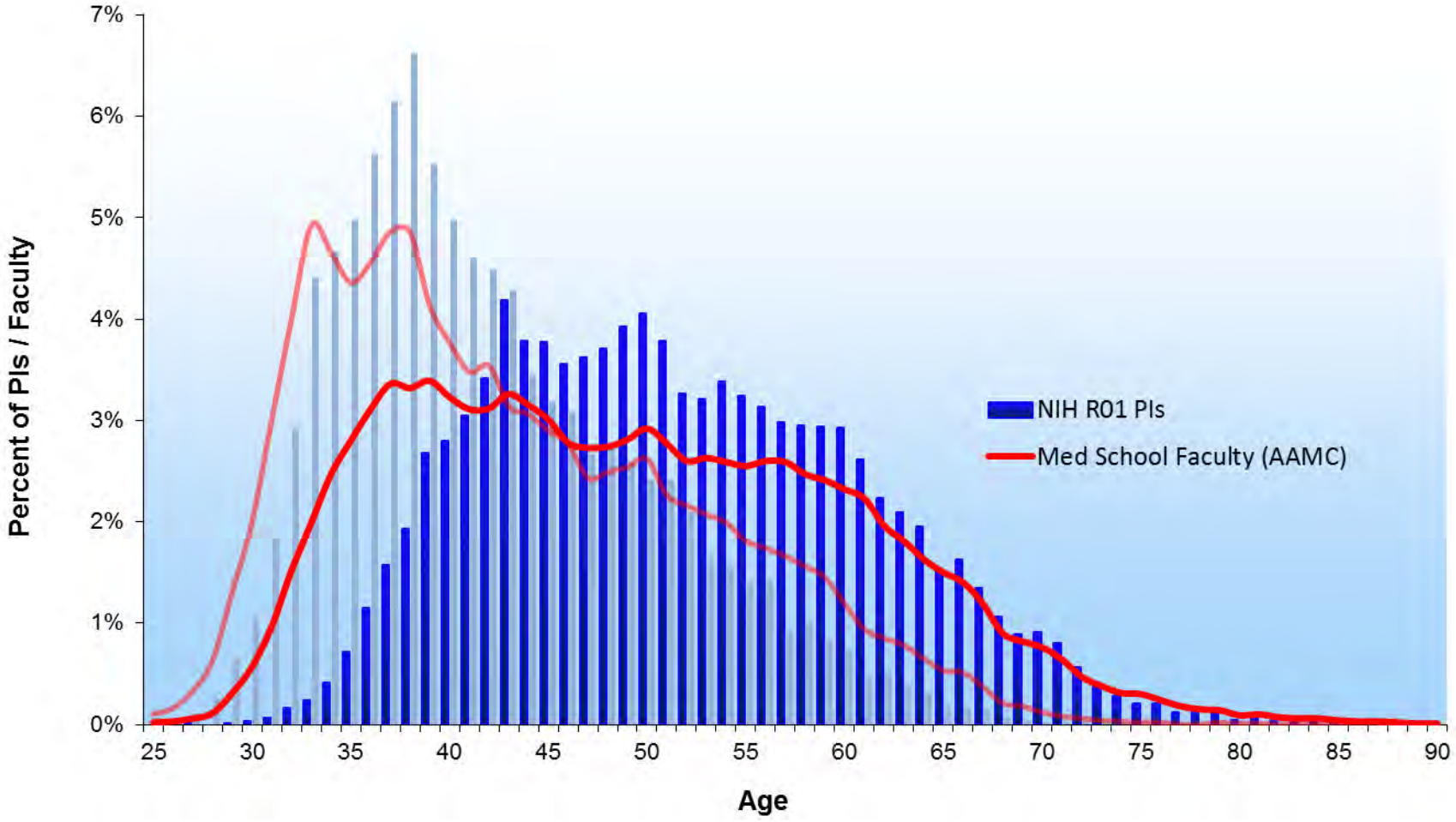
Georgia Tech

Decline in acceptance rates



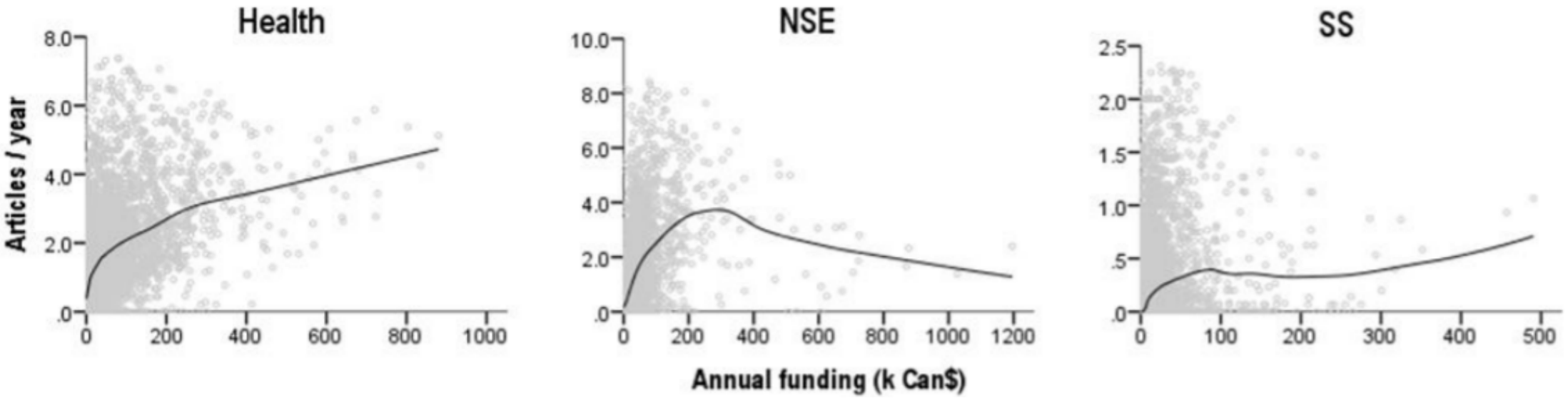
Georgia Tech

Extending the age of funded researchers



Georgia Tech

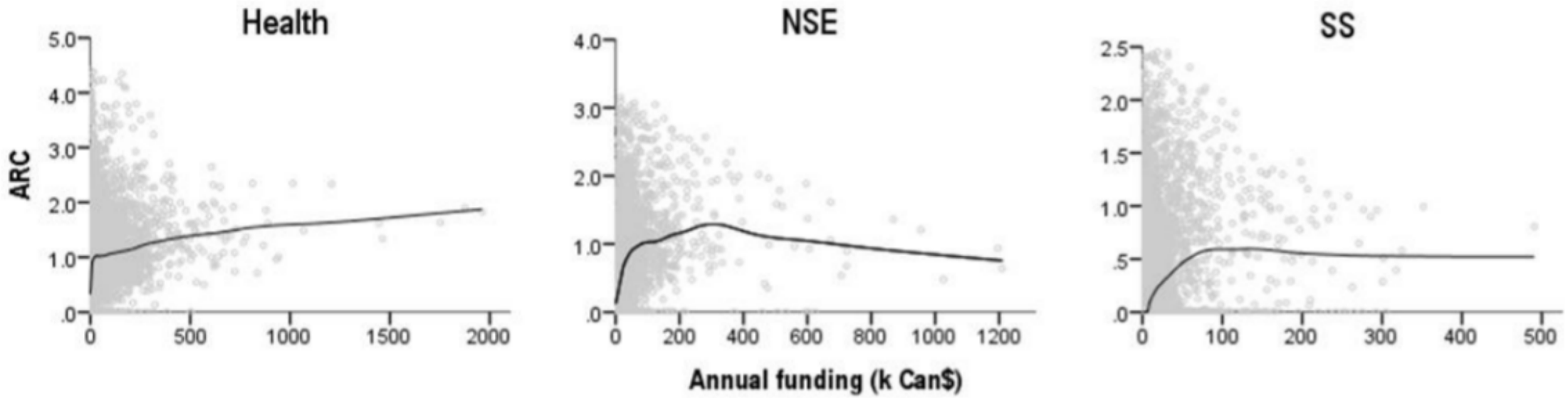
Decreasing returns to scale in funding (n. articles)



https://arxiv.org/ftp/arxiv/papers/1602/1602.07396.pdf

Georgia Tech

Decreasing returns to scale in funding (impact)



https://arxiv.org/ftp/arxiv/papers/1602/1602.07396.pdf

Georgia Tech

Using government surveys + bibliometrics

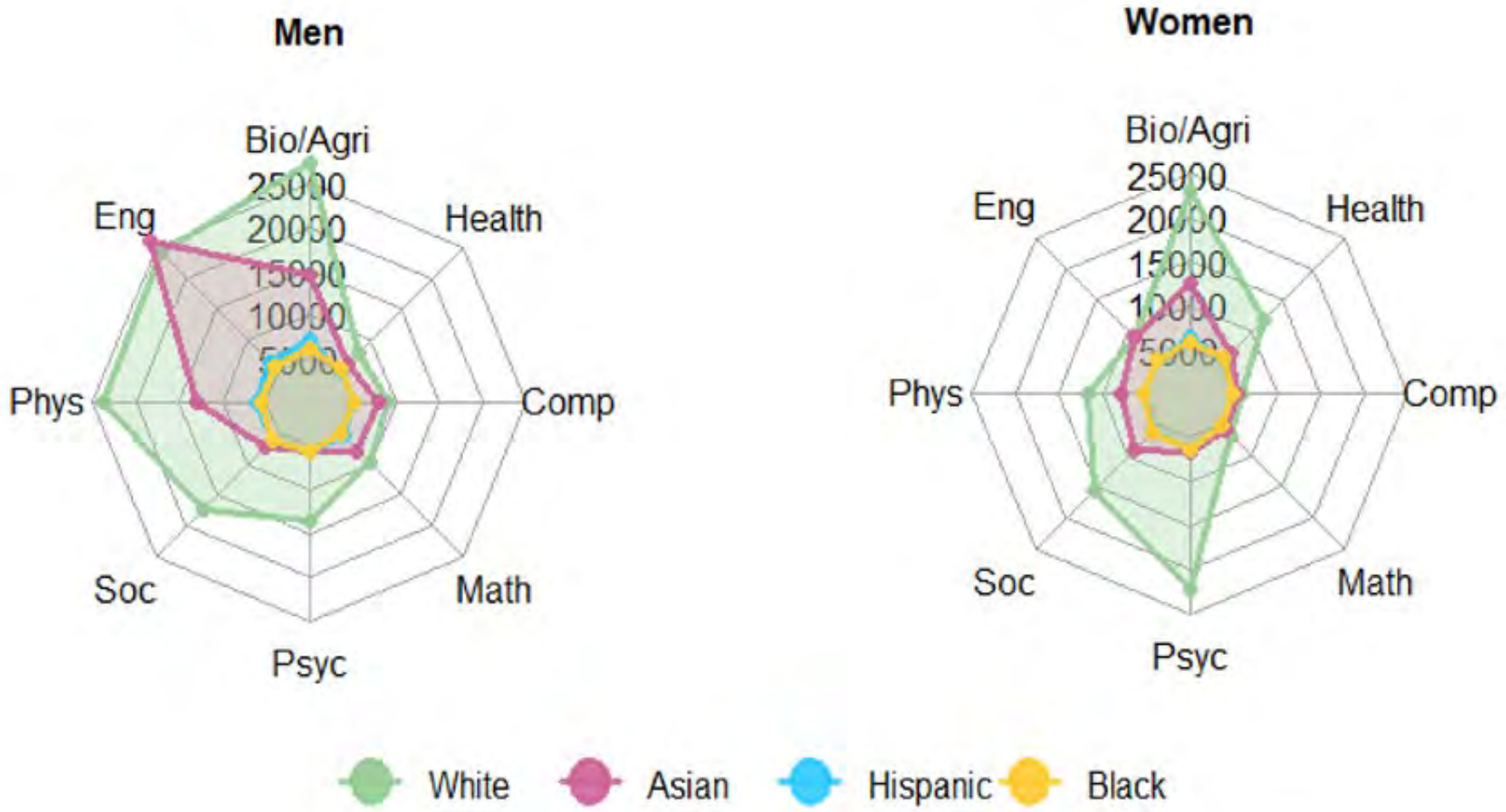
- **Survey of Earned Doctorates (SED):** annual census of all individuals receiving a doctorate from an accredited US institution

- **Survey of Doctoral Recipients (SDR):** cross-sectional data collected biennially since 1973 surveying all those under 76 in the DRF (from the SED)

- **Web of Science:** 1990-2012 for matches to SDR (1995-2013)
  - 12,997 respondents with 114,411 publications
  - Last name/first initial; Random Forest models; inclusion of survey data; emails as exact matches

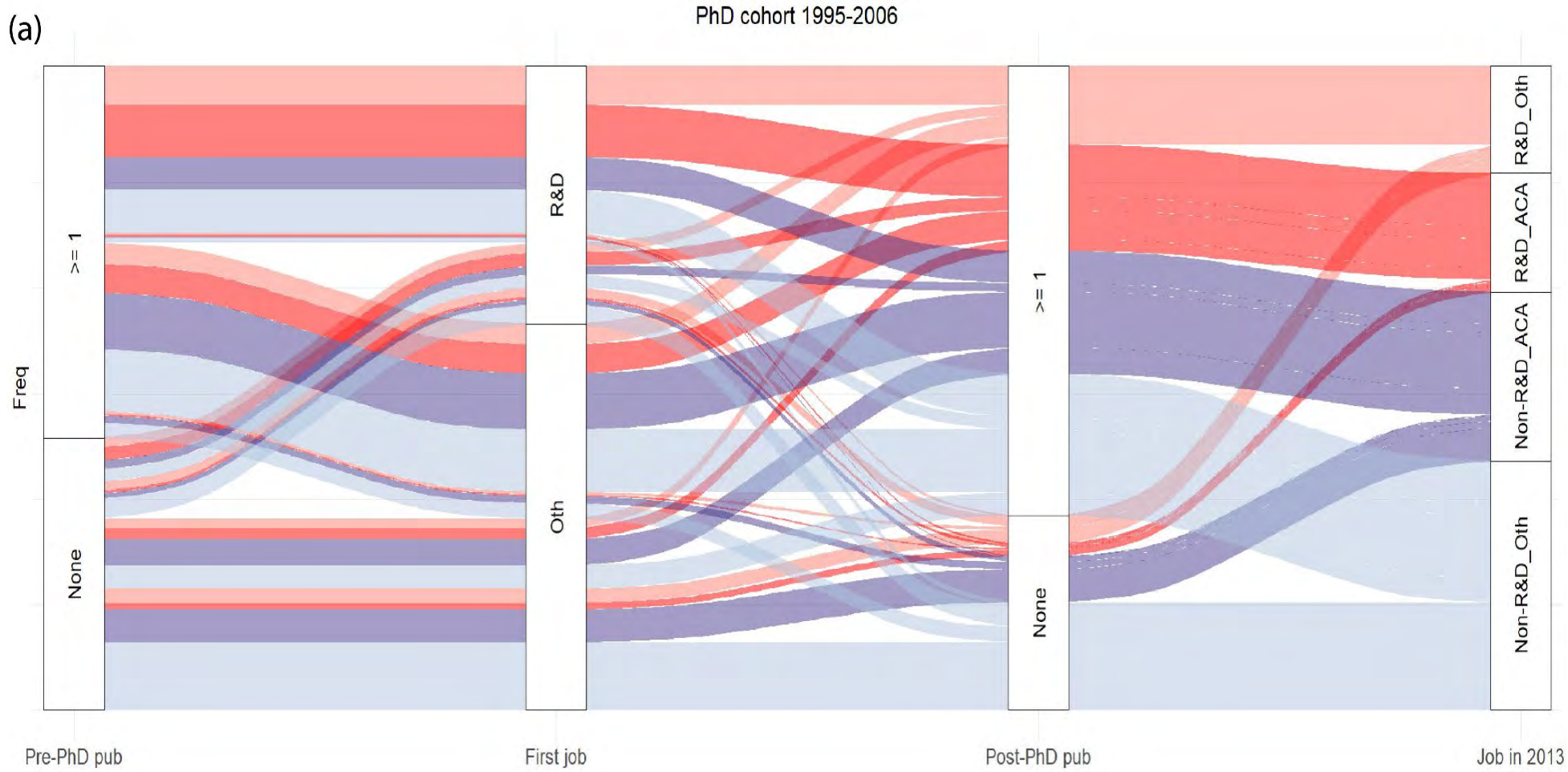
Georgia Tech

Disparities in doctoral graduates



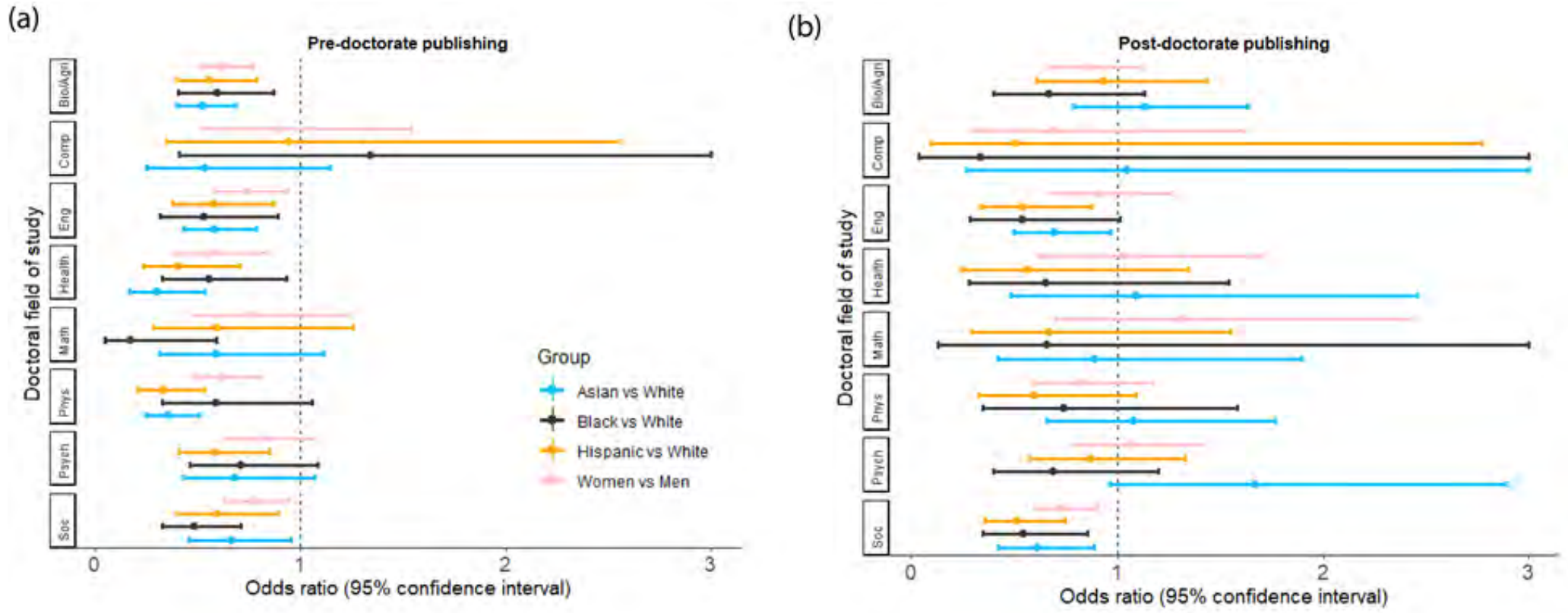
Georgia Tech

Career trajectories based on publications



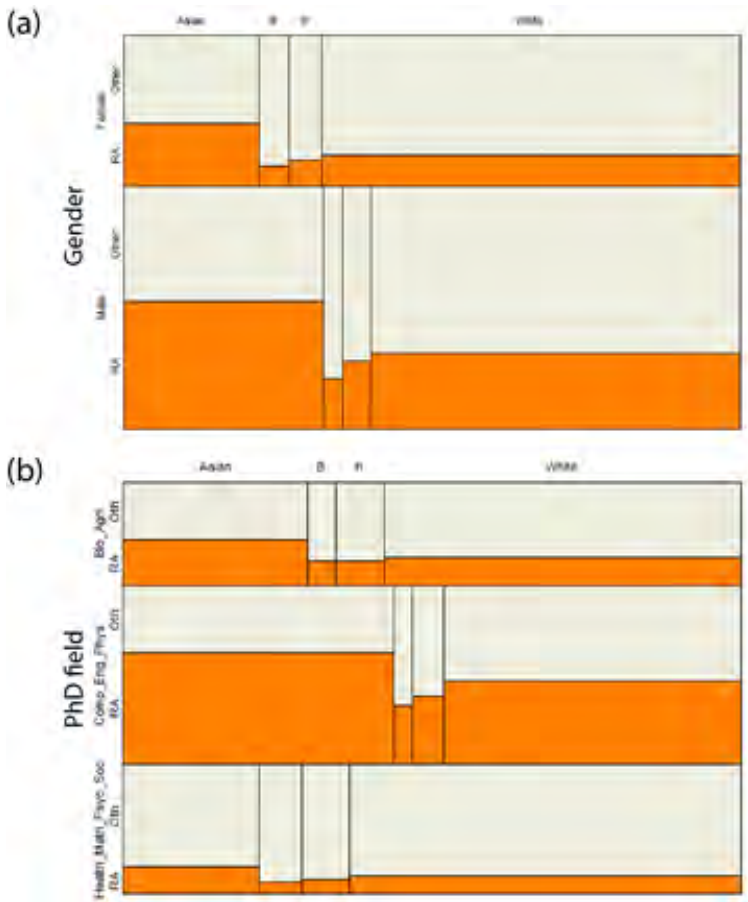
Georgia Tech

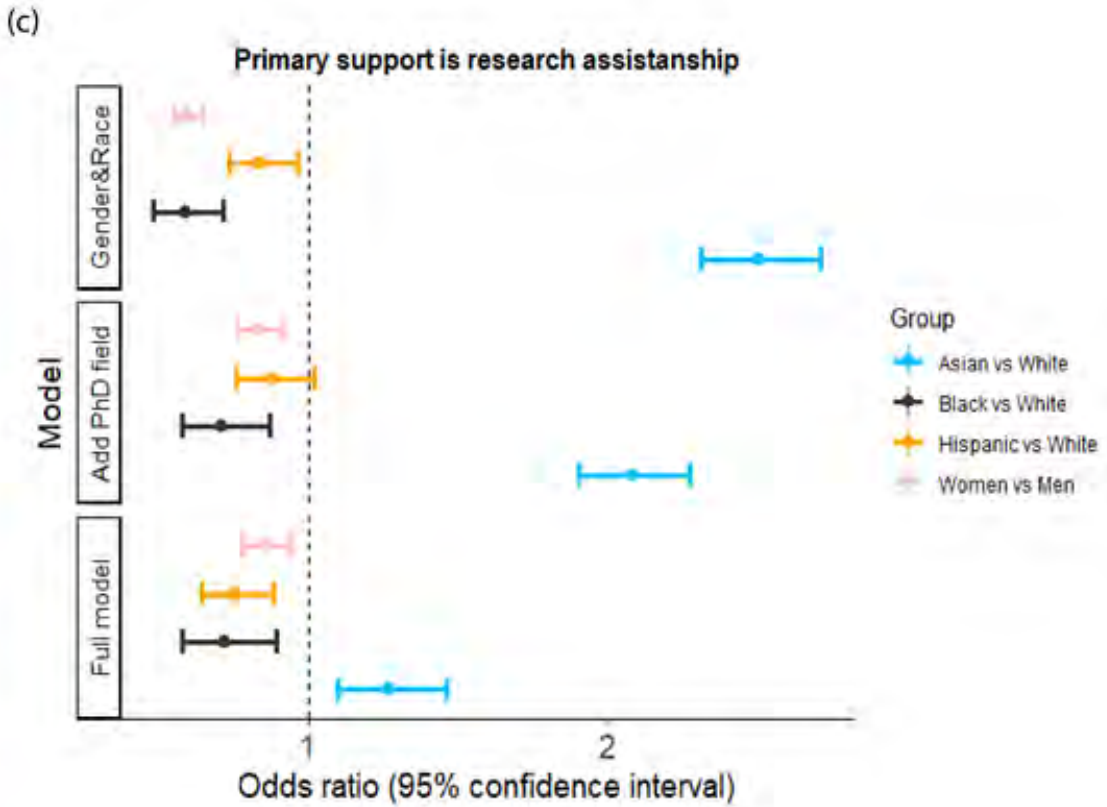
Estimated odds ratio of publishing



Georgia Tech

Receipt of research assistantships





Georgia Tech

Metascience can help funding institutions with portfolio management by:

…mapping the current landscape of funding by variables of interest (e.g., topic, institution, status);

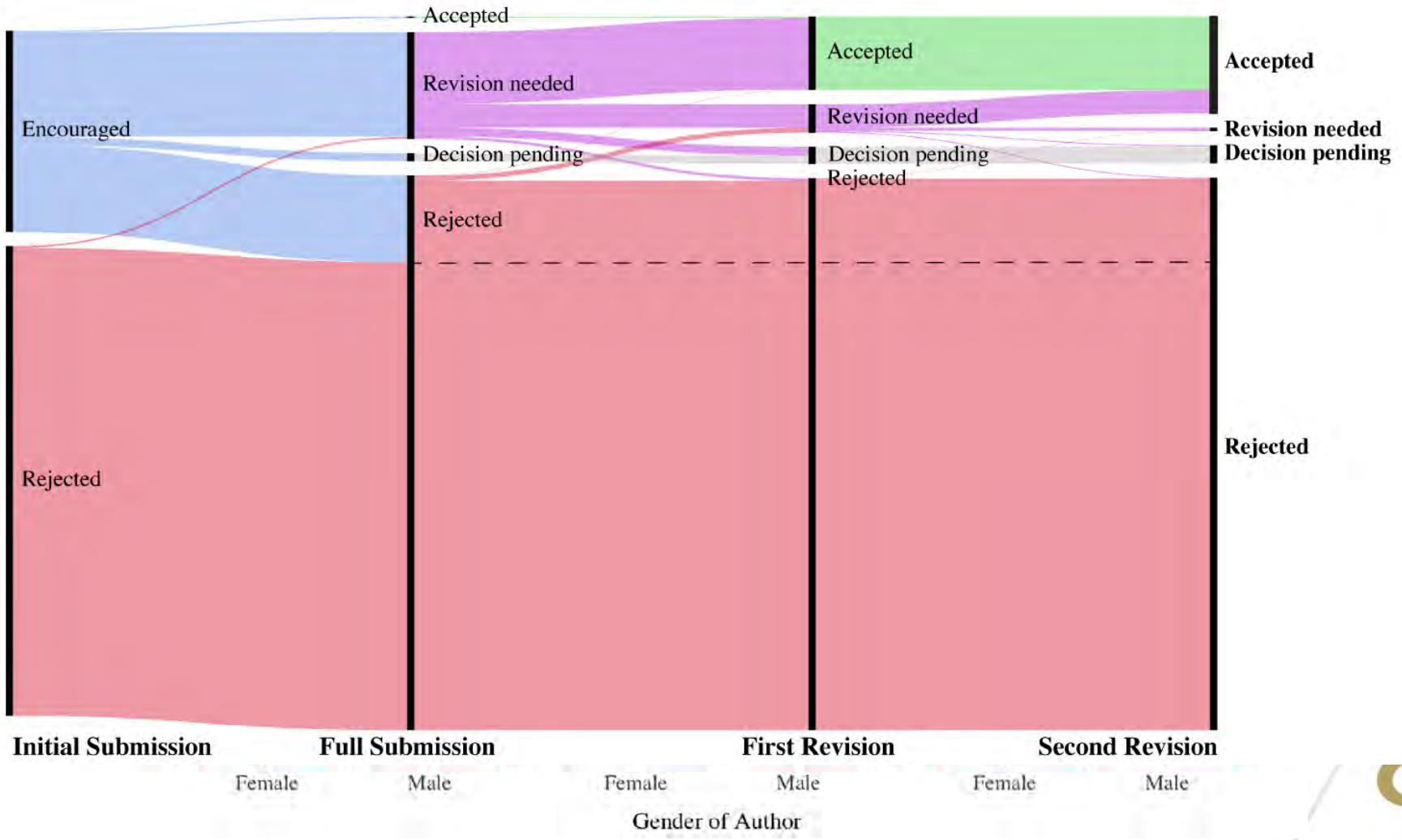
…providing evidence of consequences of funding;

…making decisions about concentration or dispersion.

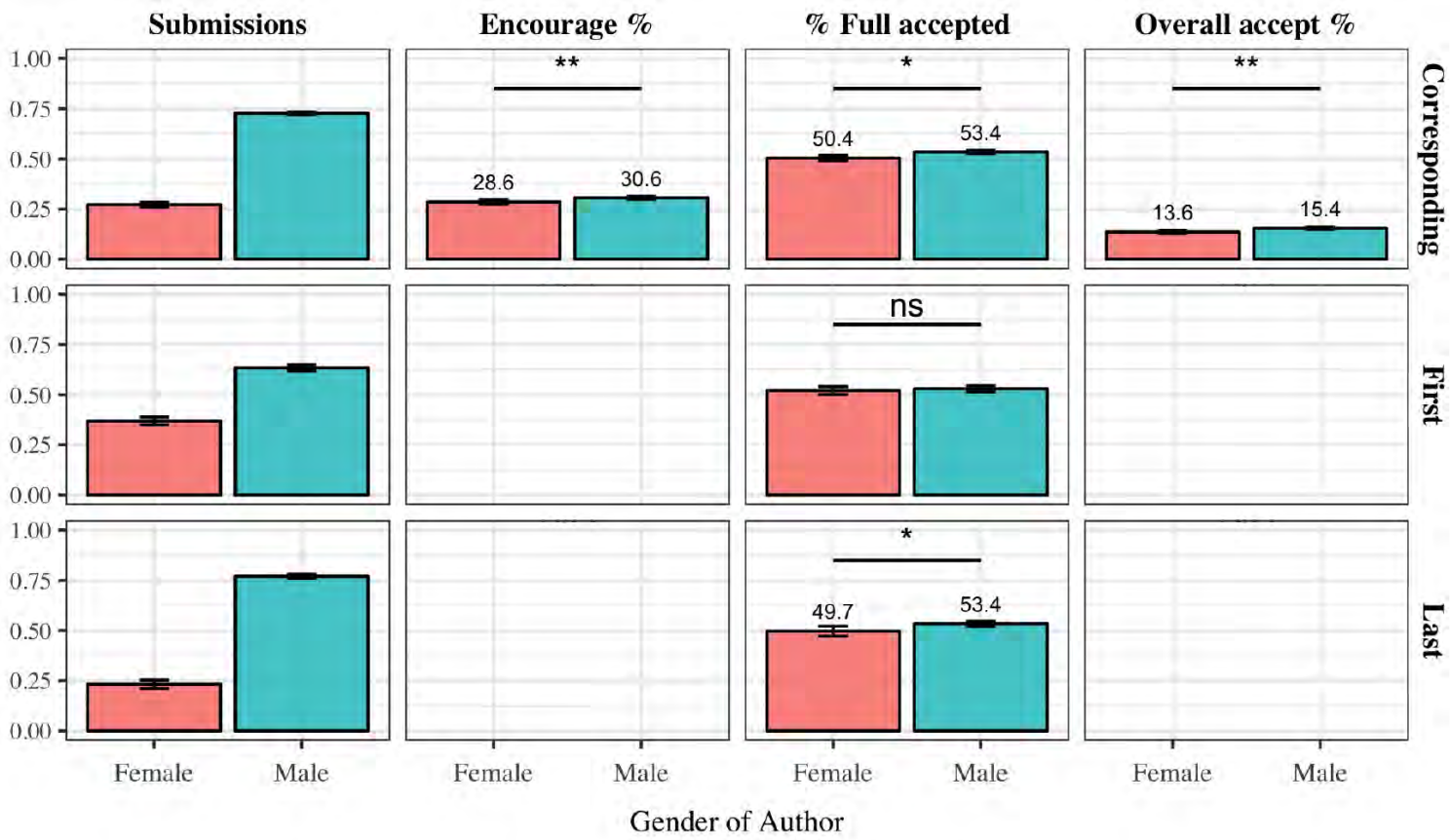
Georgia Tech

PROCESS EVALUATION

eLife as a case of consultative peer review *(2012-2017)*

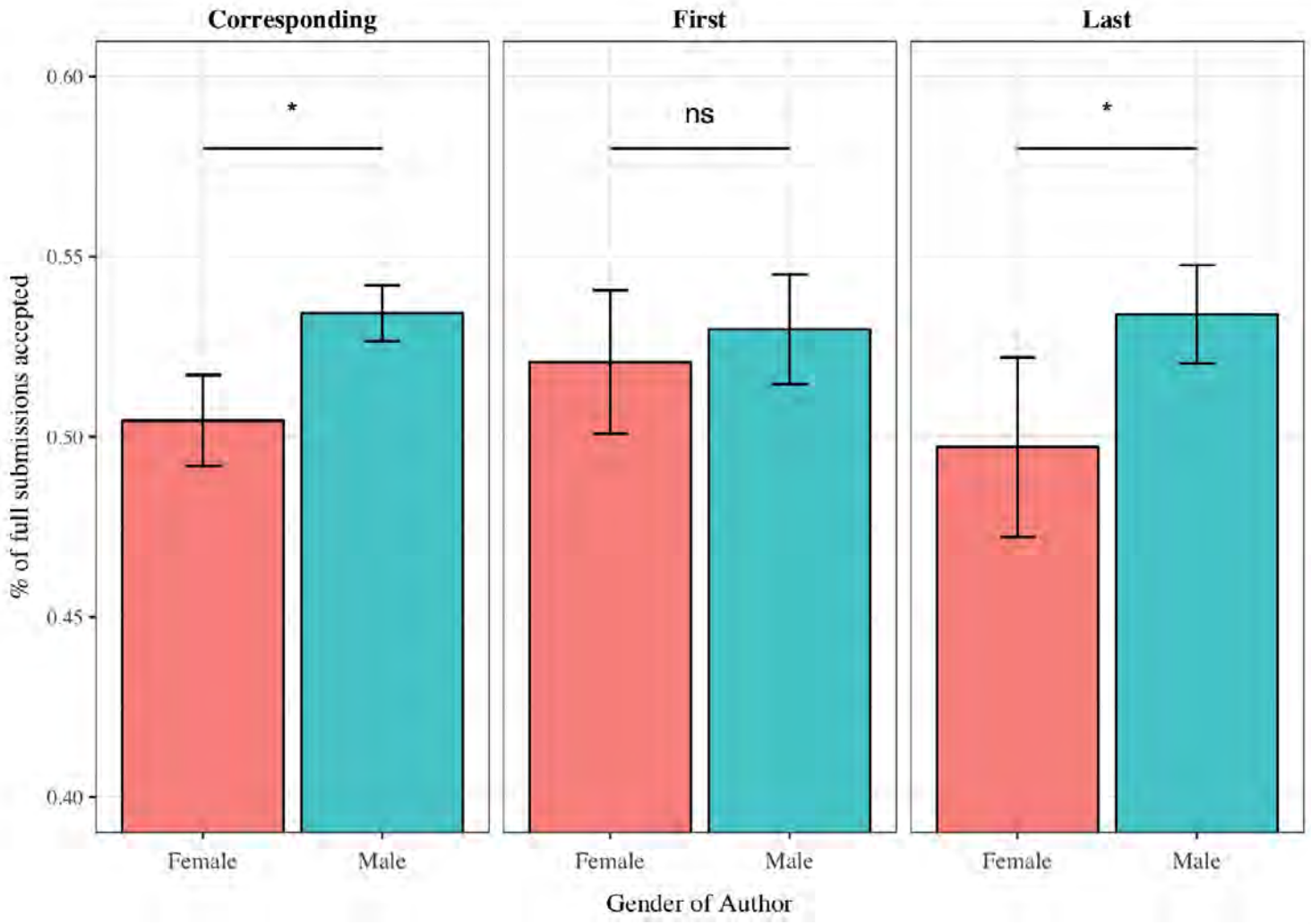


Outcomes by gender



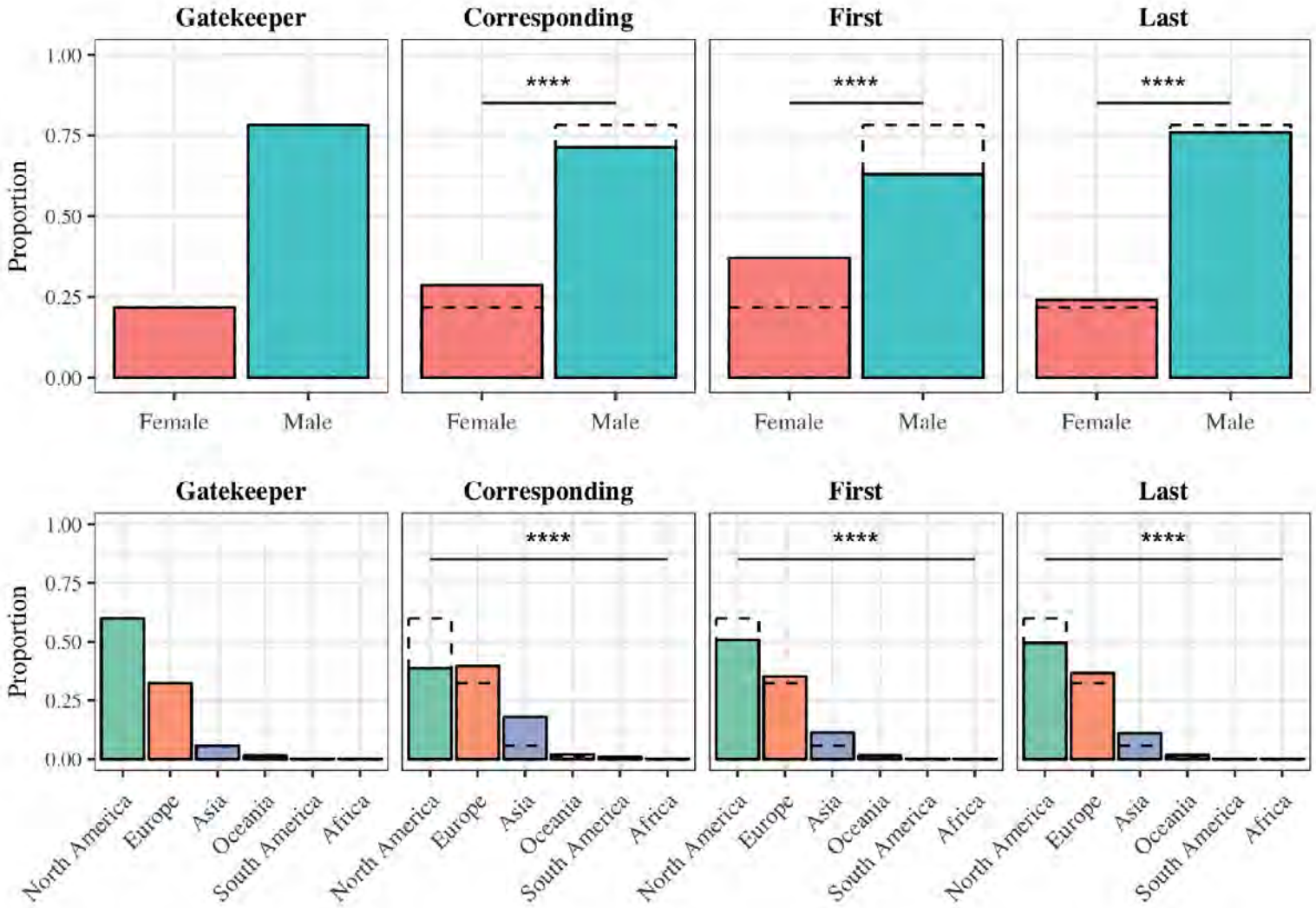
Georgia Tech

Outcomes by author order

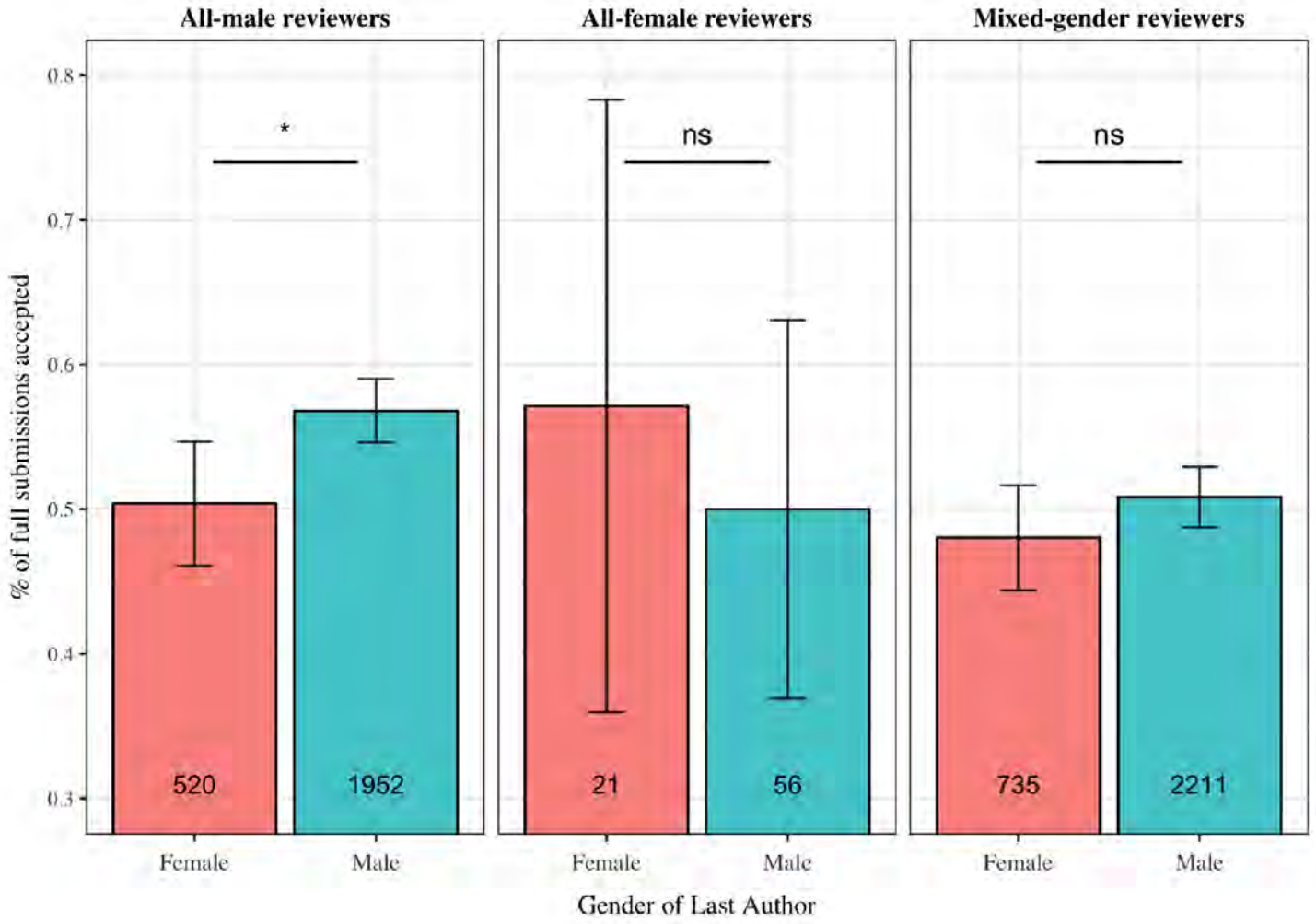


Georgia Tech

Do the “peers” in “peer review” matter?

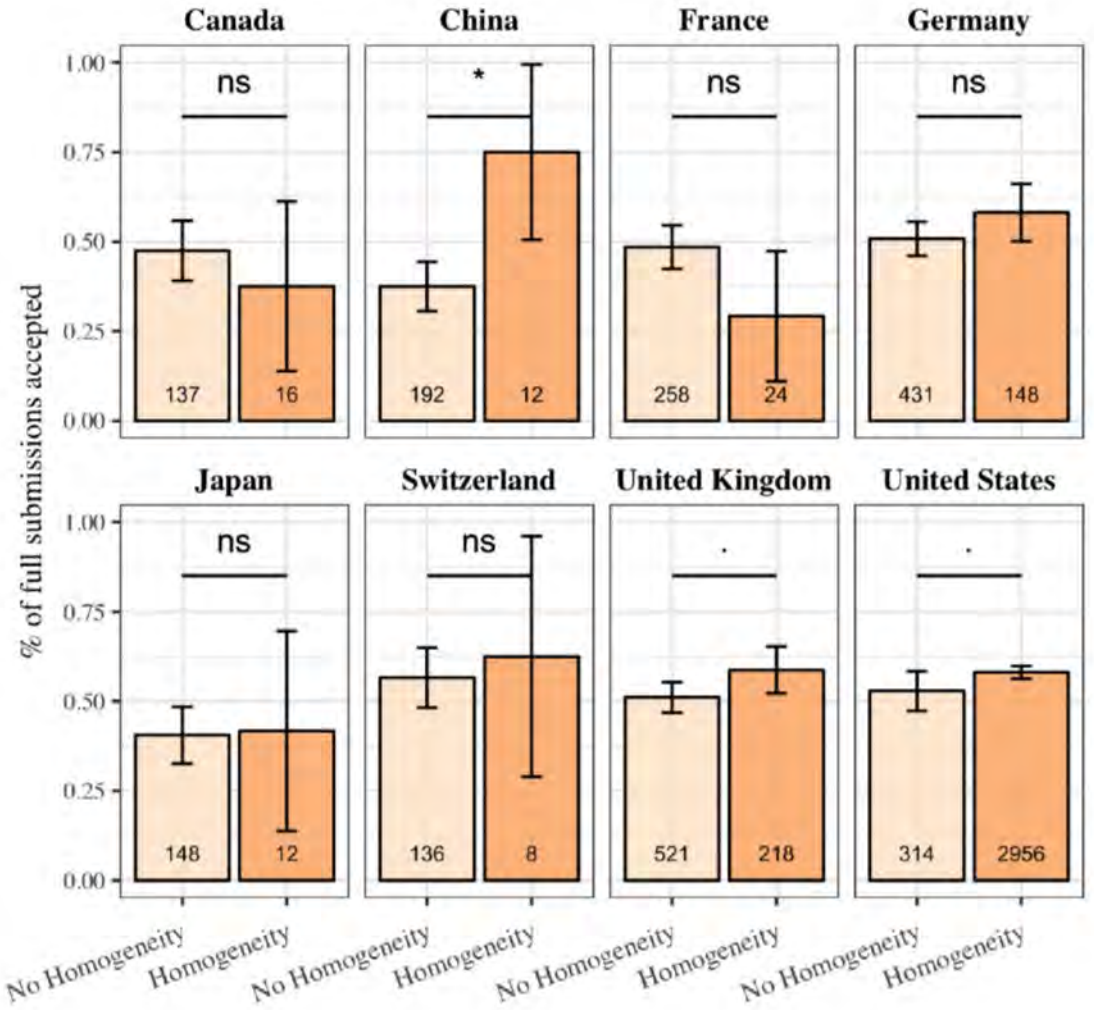


Outcomes by review team composition



Georgia Tech

Country homophily

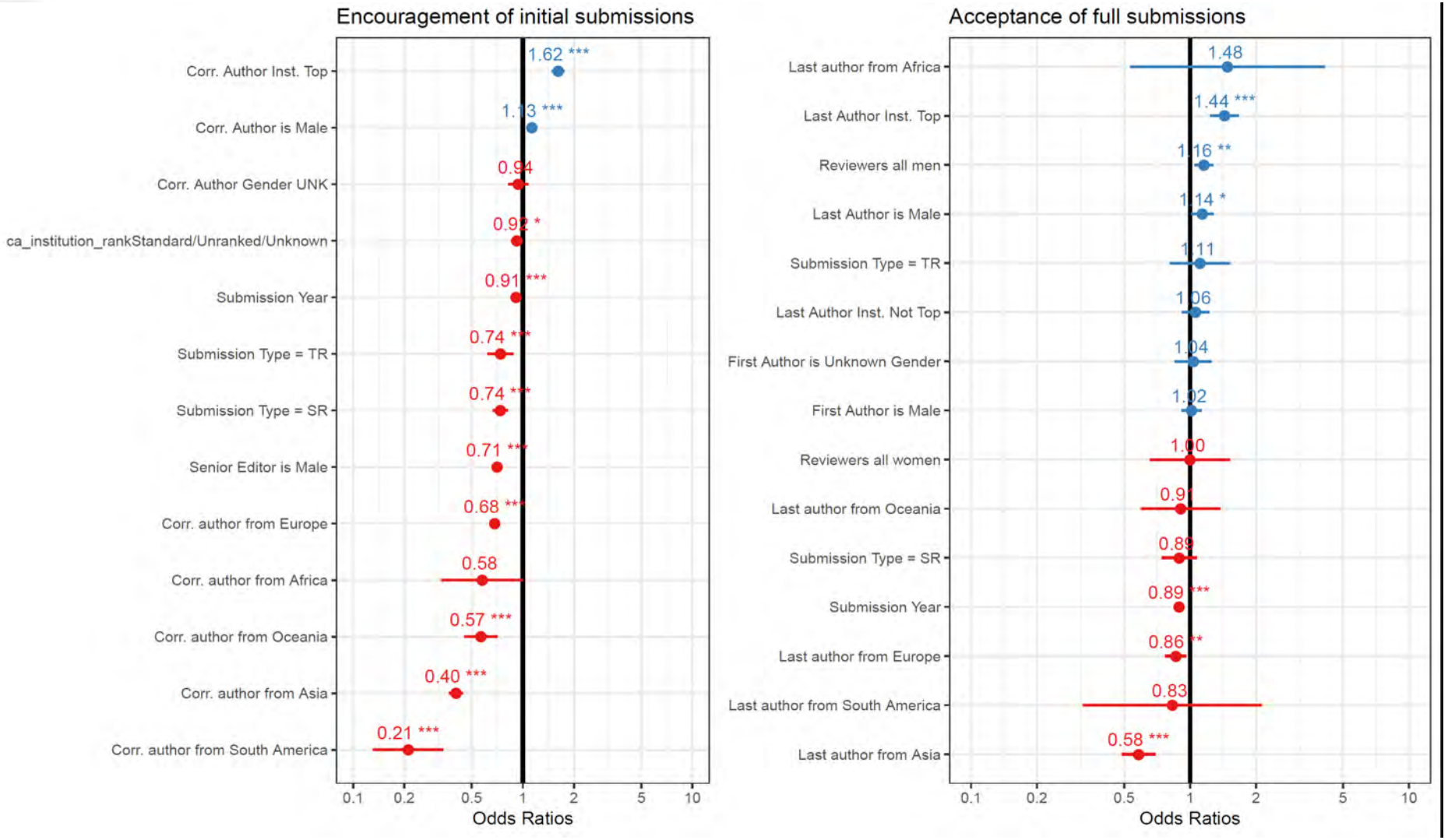


Probability of homophily

Corr. Author Country	# Submissions	Proportion Homogeneity
United States	3,605	0.91
United Kingdom	803	0.3
Germany	641	0.25
Canada	176	0.11
South Korea	45	0.11
South Africa	11	0.09
France	310	0.08
Japan	184	0.08
Australia	101	0.07
China	233	0.06
Switzerland	163	0.06
India	59	0.05
Sweden	70	0.04
Israel	127	0.04
Spain	91	0.03
Denmark	32	0.03
Italy	79	0.03
Belgium	41	0.02
Austria	58	0.02
Netherlands	100	0.01

Georgia Tech

Factors leading to acceptance



Georgia Tech

Metascience can help funding institutions with process evaluation by:

…identifying barriers to achieving values.

Georgia Tech

POLICY EVALUATION

Georgia Tech

Funder mandates

Georgia Tech

Funders included in the analysis

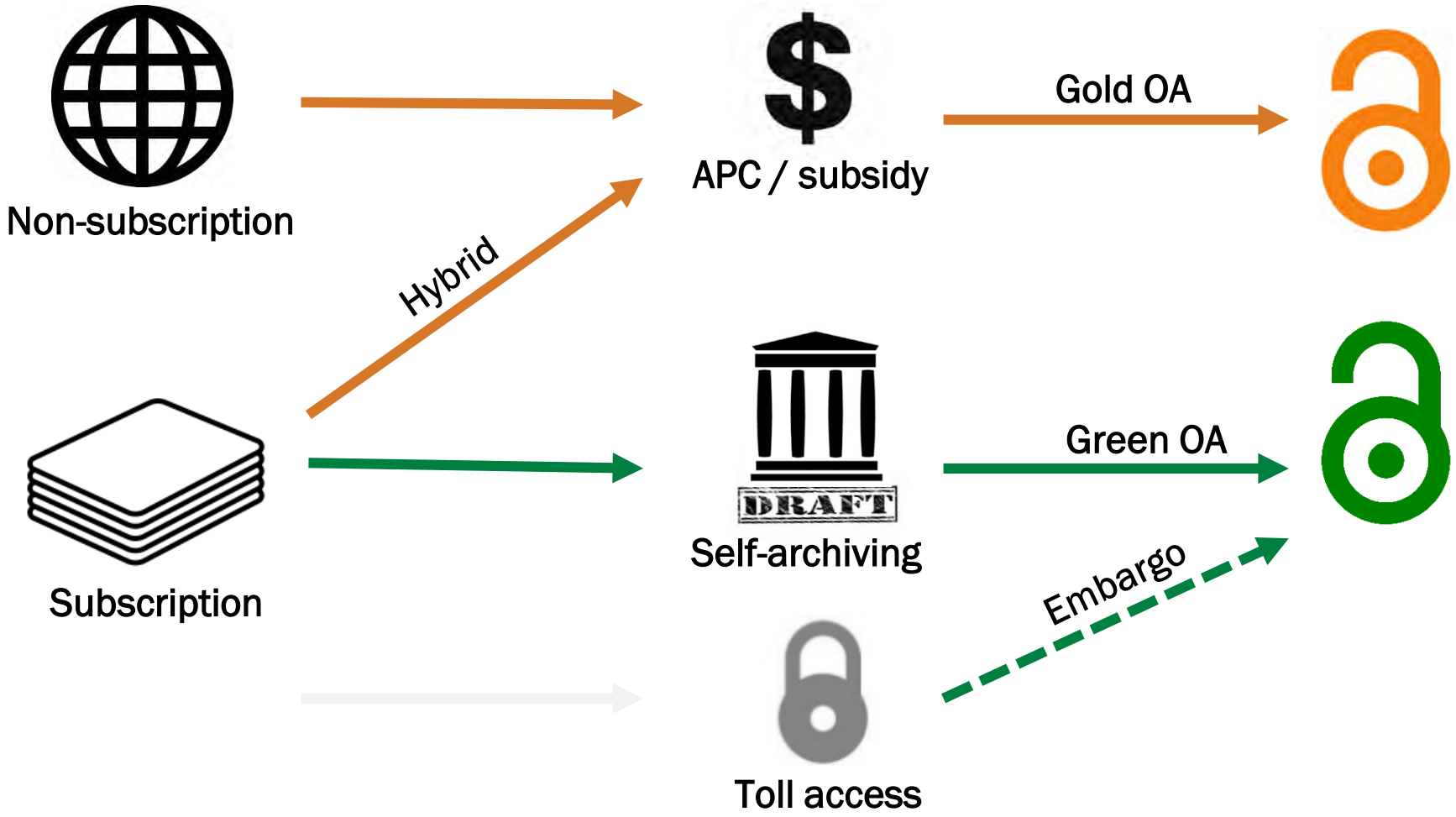
BILL & MELINDA GATES foundation

SSHRC CRSH
Social Sciences and Humanities Research Council of Canada
Conseil de recherches en sciences humaines du Canada

EPSRC
Engineering and Physical Sciences Research Council

Georgia Tech

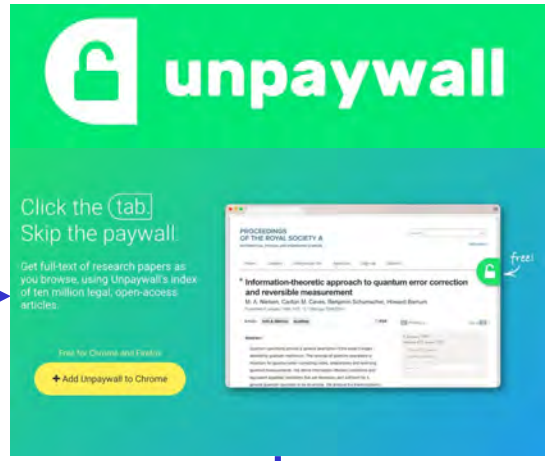
Types of OA



Georgia Tech

Calculating compliance

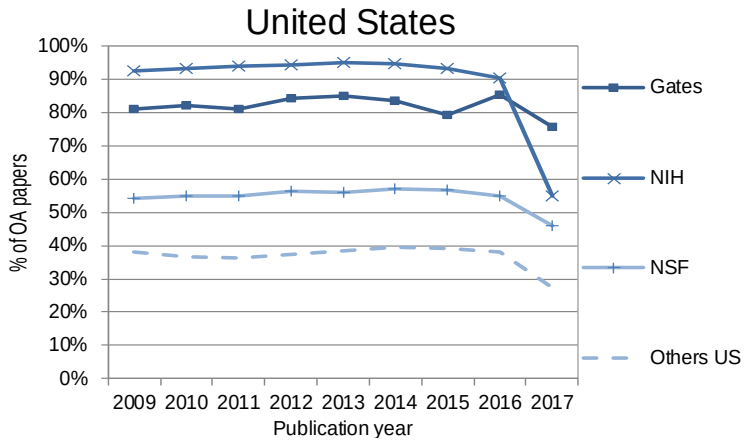
Document object identifier (DOI)

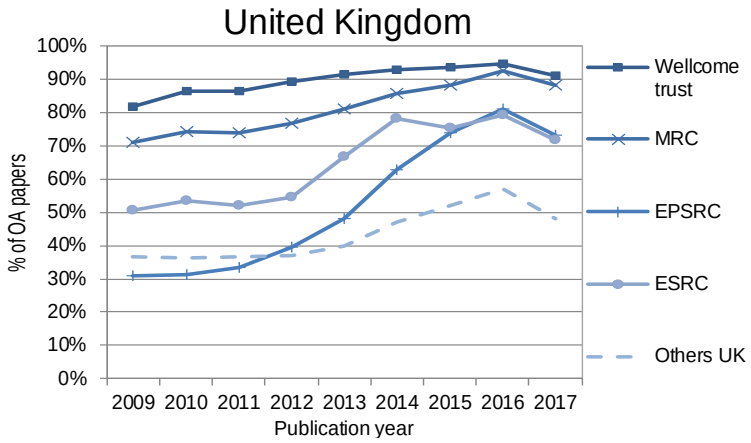


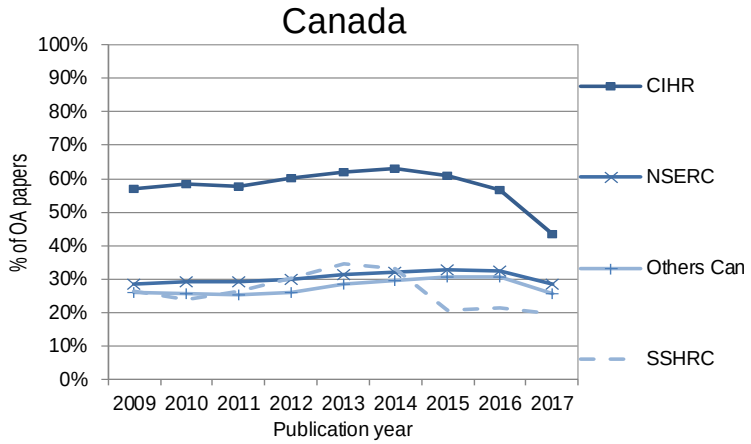
% COMPLIANCE

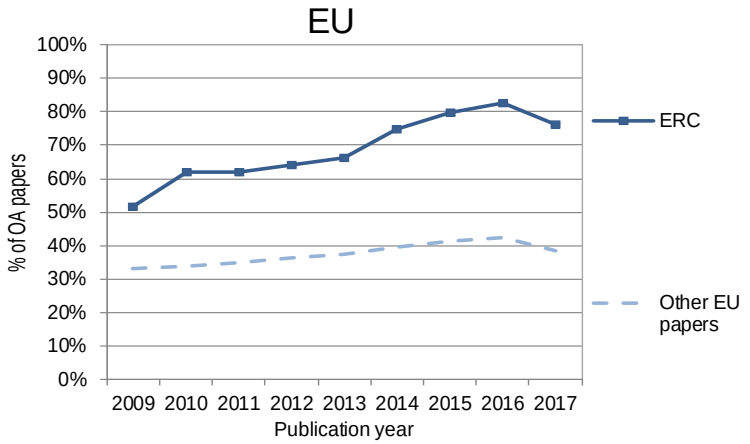
Georgia Tech

Funders over time





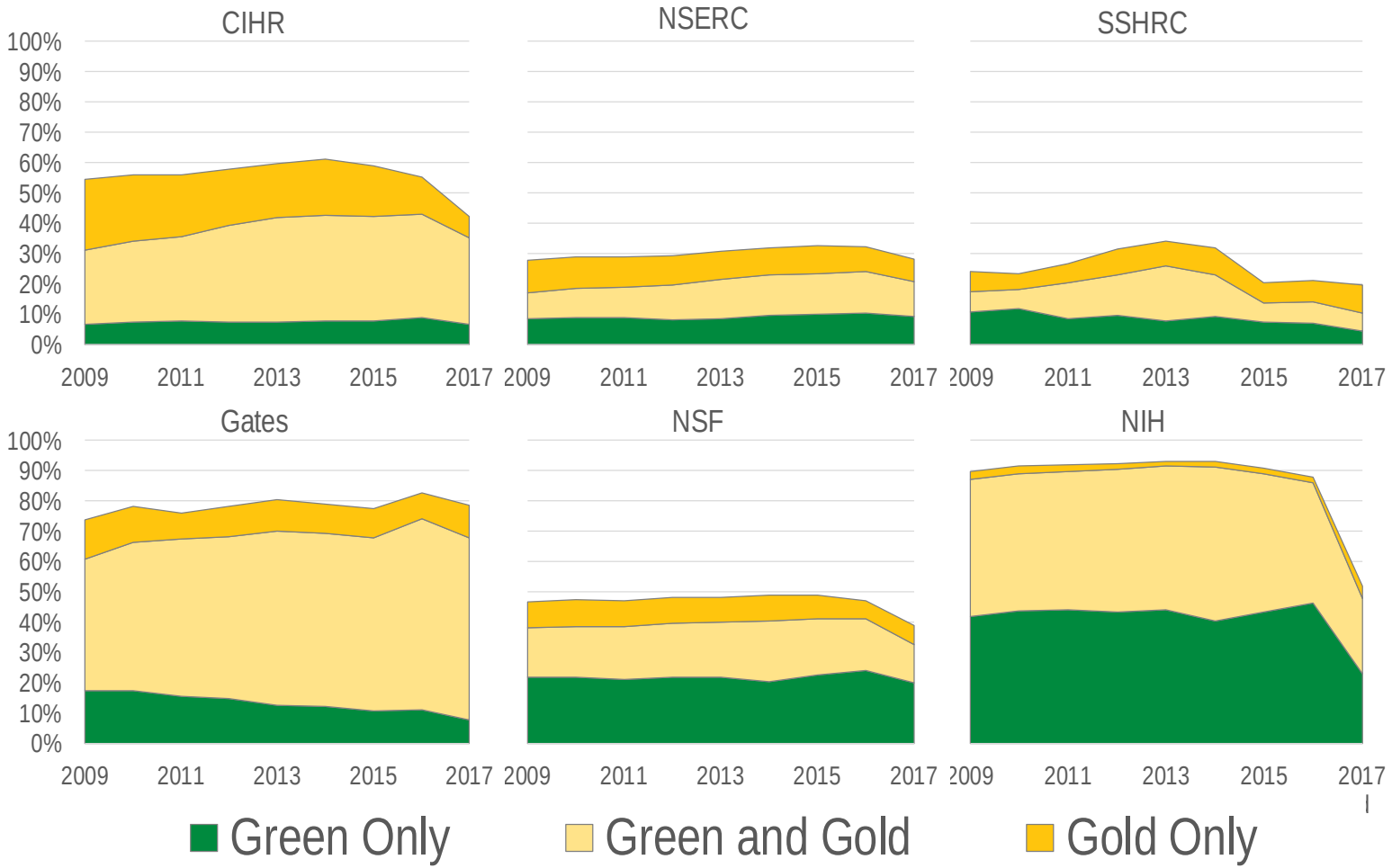




Scientometrics allows you to compare your compliance with others

Georgia Tech

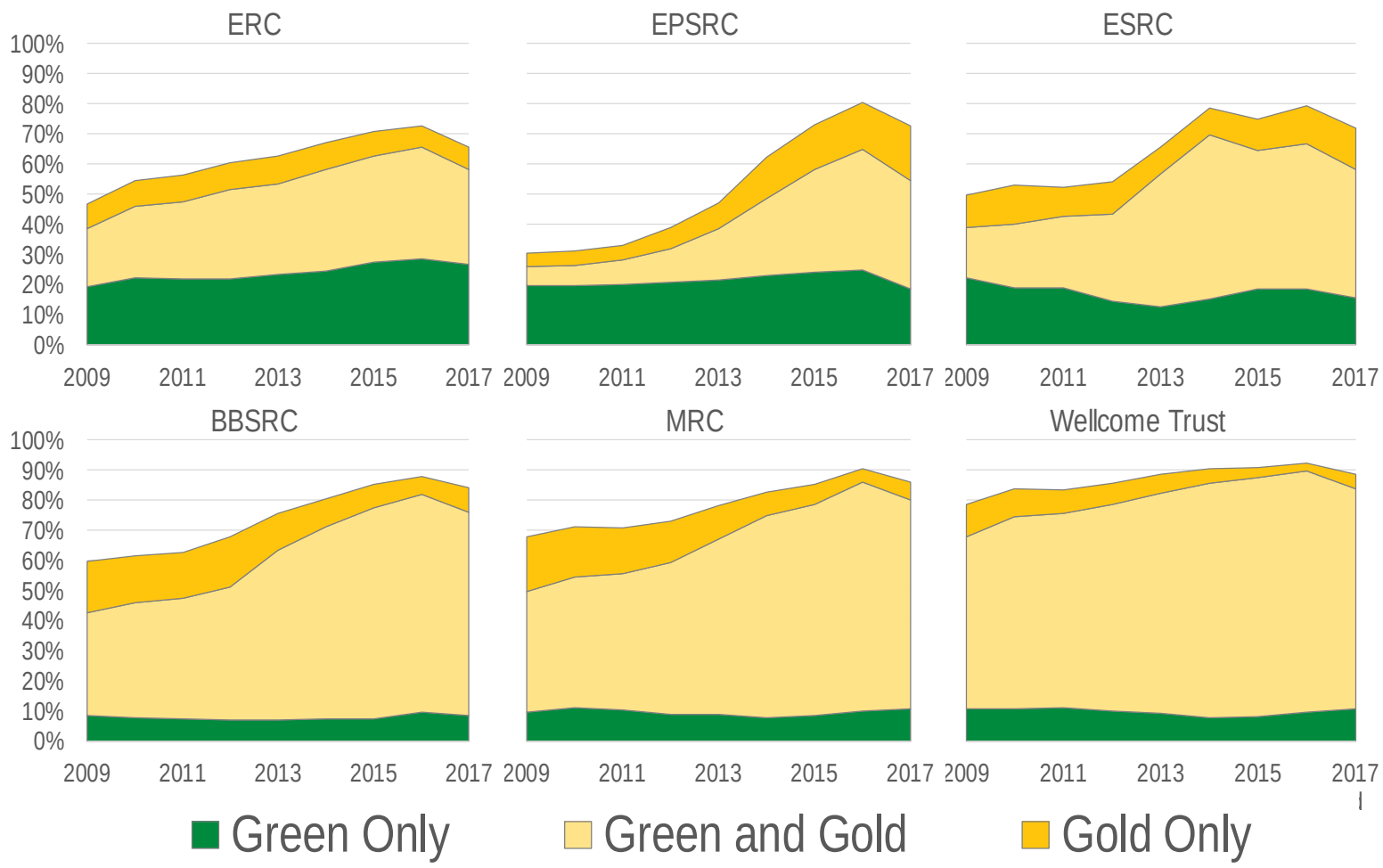
North America



Value check: why are you mandating openness? Who is served? How does this vary by green/gold?

Georgia Tech

UK and Europe



Effect of Finch Report (2012)?

Georgia Tech

Power of mandates and infrastructure

Funder	Biomedical Research	Clinical Medicine	Health	Mathematics	Earth and Space	Psychology	Physics	Biology	Professional Fields	Social Sciences	Chemistry	Engineering and	All Disciplines
Wellcome trust	92%	84%	87%	96%	71%	80%	73%	88%	93%	74%	73%	79%	87%
NIH	93%	86%	79%	87%	73%	75%	84%	76%	74%	59%	81%	71%	87%
MRC	88%	75%	79%	87%	62%	62%	47%	83%	77%	73%	59%	50%	79%
Gates	89%	81%	83%	95%	50%	47%	51%	57%	28%	44%	52%	46%	79%
BBSRC	83%	71%	77%	90%	57%	44%	58%	68%	92%	52%	49%	52%	74%
ESRC	92%	76%	72%	70%	66%	60%	69%	60%	59%	63%	60%	56%	69%
ERC	80%	64%	59%	75%	82%	50%	75%	66%	46%	46%	36%	46%	67%
CIHR	71%	51%	52%	73%	43%	22%	36%	57%	47%	26%	25%	22%	56%
EPSRC	76%	64%	70%	78%	59%	54%	60%	68%	58%	62%	39%	49%	55%
NSF	76%	70%	52%	69%	54%	34%	48%	46%	35%	26%	24%	23%	47%
NSERC	57%	38%	42%	55%	31%	18%	40%	28%	14%	8%	10%	12%	30%
SSHRC	78%	35%	25%	40%	33%	17%	27%	36%	14%	16%	0%	17%	23%
All funded papers	85%	79%	73%	67%	57%	56%	56%	51%	42%	39%	35%	29%	66%

Georgia Tech

Metascience can help funding institutions with policy evaluation by:

…providing the institution with large-scale analyses of the effectiveness of their mandates.

Georgia Tech

OUTCOME EVALUATION

Georgia Tech

Diversity as a value

Individual

Rawls' principles of justice:

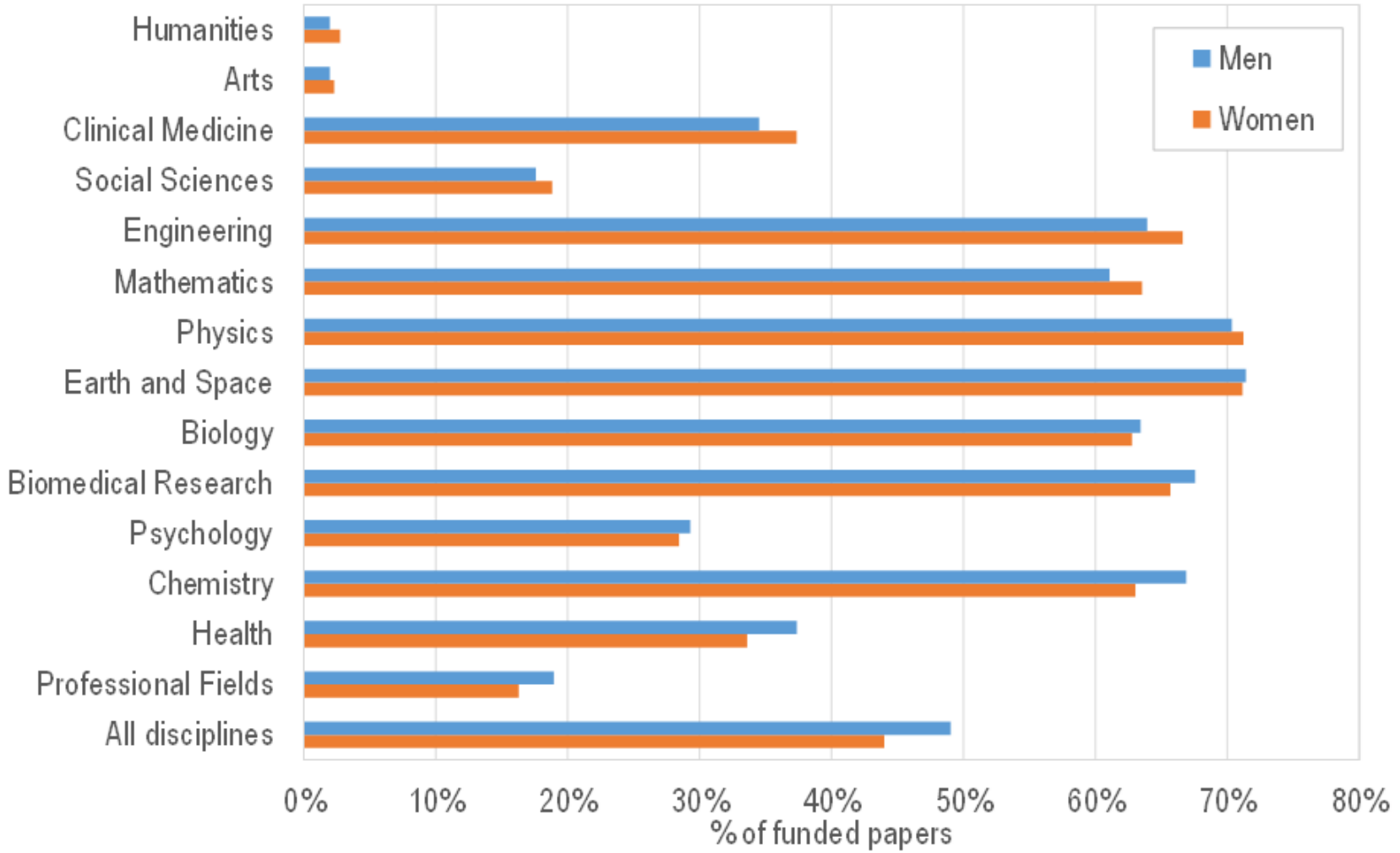
- **Equality**: "each person is to have an equal right to the most extensive total system of equal basic liberties"
- **Fairness**: "greatest benefit of the least advantage"
- **Access**: "fair equality of opportunity"

Collective

- Utilitarian
  - "greatest happiness of the greatest number"

Georgia Tech

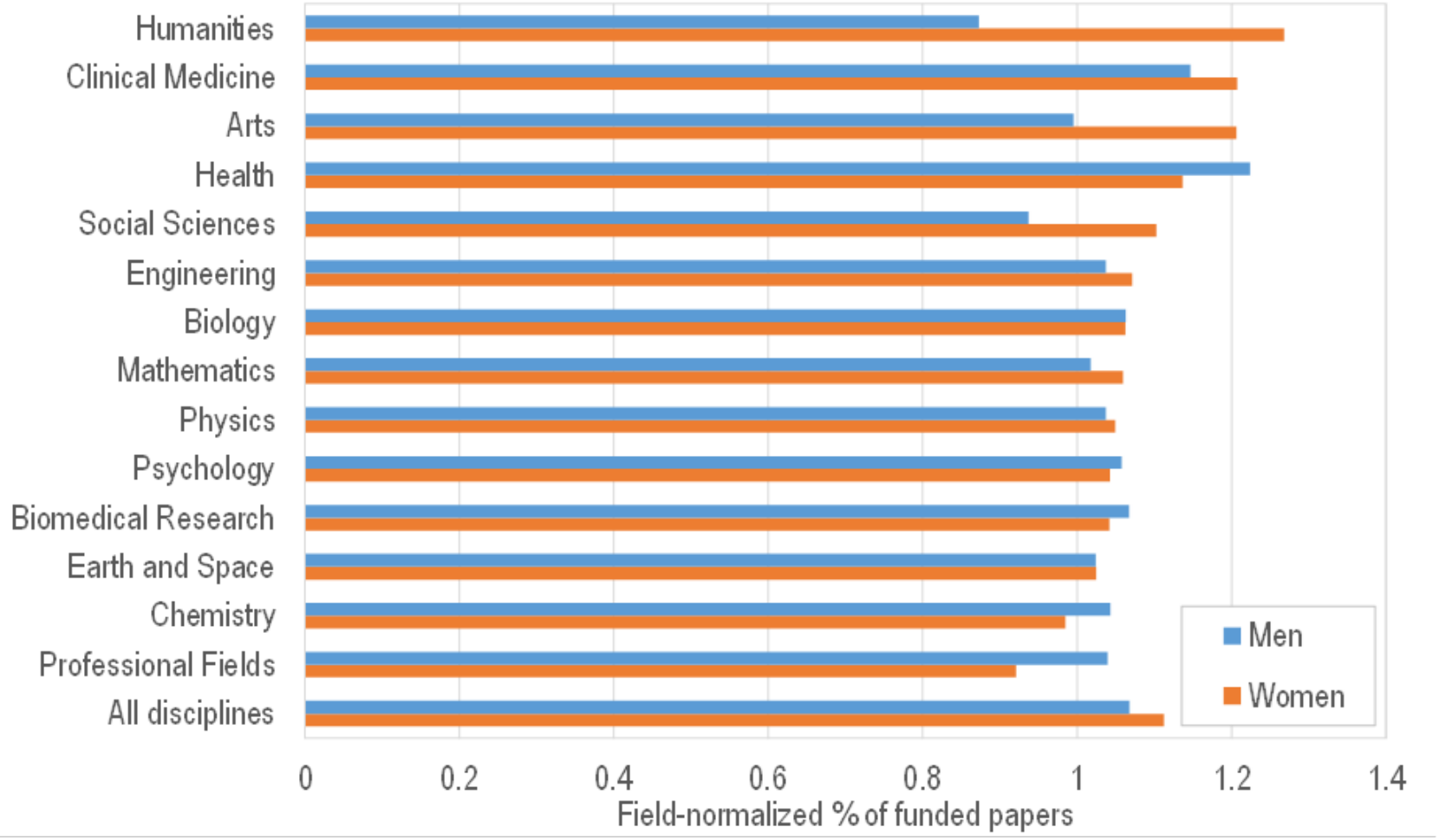
Percentage of papers with funding acknowledgement (WoS)



This is the level of all funders, but could be done as a comparative analysis between funders.

Georgia Tech

Normalized by specialty



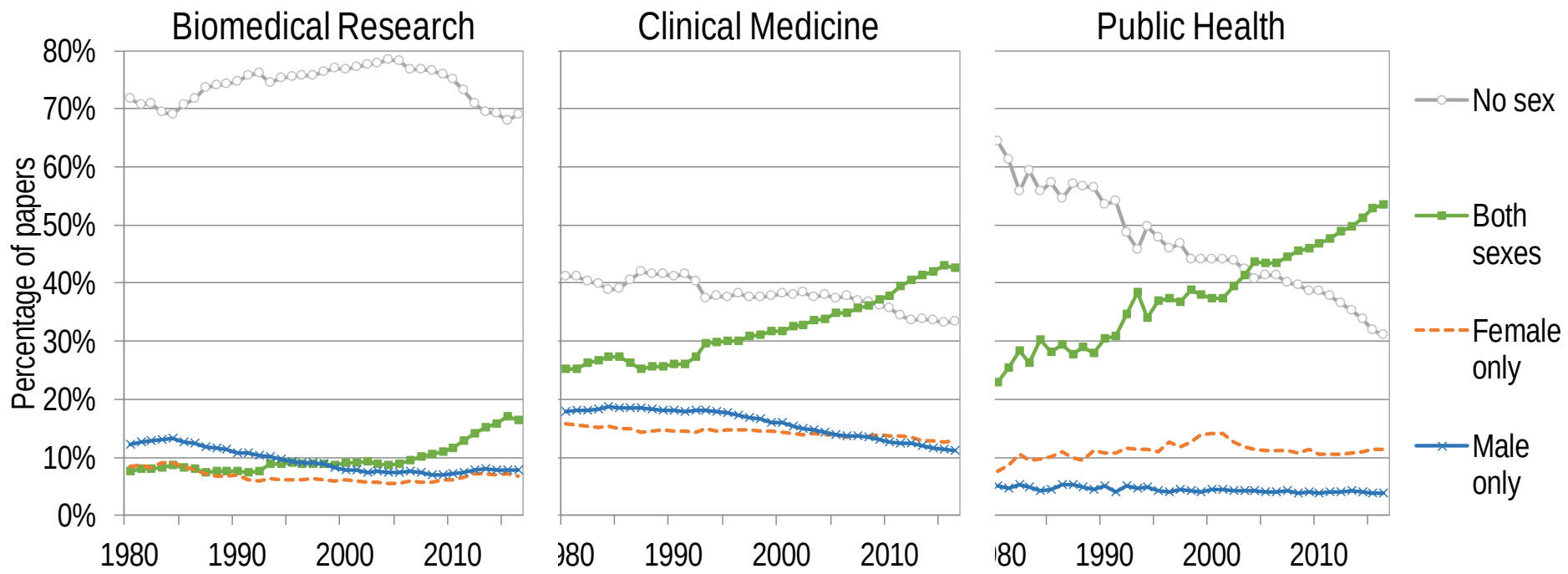
Georgia Tech

Country	Biology	Biomedical Research	Chemistry	Clinical Medicine	Earth and Space	Engineering	Health	Mathematics	Physics	Professional Fields	Psychology	Social Sciences	All Domains
Egypt	51%	37%	30%	-5%	29%	37%	17%	33%	55%	-31%	-65%	29%	27%
Russian Federation	0%	5%	13%	43%	1%	10%	36%	1%	6%	35%	17%	4%	23%
Pakistan	6%	6%	17%	10%	10%	5%	-8%	0%	18%	43%	9%	-1%	16%
Ireland	-5%	-2%	-5%	-5%	-1%	0%	7%	-13%	9%	-18%	-7%	-20%	16%
United States	6%	2%	26%	-6%	0%	-5%	18%	-2%	-2%	20%	0%	-9%	15%
Czechia	1%	9%	6%	29%	1%	3%	61%	-2%	7%	12%	35%	-4%	15%
New Zealand	-3%	1%	-7%	1%	-3%	-8%	10%	24%	5%	-13%	2%	-6%	15%
Canada	3%	2%	3%	-3%	-2%	-6%	5%	-6%	0%	7%	-2%	-3%	14%
United Kingdom	4%	2%	2%	-10%	1%	-4%	-1%	-7%	-5%	-12%	3%	-16%	13%
Israel	5%	-1%	1%	-16%	3%	-2%	1%	5%	-5%	9%	6%	-16%	12%
Australia	0%	0%	-1%	-12%	1%	-9%	4%	-1%	-2%	-4%	11%	-17%	12%
Austria	-2%	-4%	0%	-5%	1%	2%	28%	-4%	-8%	1%	11%	-6%	10%
India	-1%	4%	8%	-3%	2%	5%	11%	3%	2%	14%	32%	28%	10%
Republic of Korea	8%	4%	1%	-2%	4%	1%	10%	1%	2%	19%	9%	6%	8%
South Africa	-2%	1%	-4%	-10%	-4%	-4%	-8%	2%	-8%	-5%	27%	-2%	7%
Singapore	1%	0%	-2%	-10%	-5%	-2%	4%	12%	1%	16%	21%	-4%	5%
Mexico	-4%	2%	1%	-8%	-2%	-4%	17%	1%	-2%	18%	30%	-12%	5%
Romania	-4%	2%	-2%	1%	4%	4%	37%	-5%	12%	16%	-11%	5%	5%
Spain	-3%	1%	1%	-11%	-1%	-1%	9%	-1%	1%	8%	12%	-1%	4%
Germany	-2%	-3%	0%	-13%	0%	-6%	-6%	-4%	-5%	-3%	-2%	-9%	4%
Switzerland	9%	-1%	4%	-11%	-1%	-11%	4%	1%	-7%	1%	-5%	-10%	4%
Greece	-1%	-4%	18%	-23%	4%	2%	-1%	-19%	12%	47%	13%	-16%	4%
Taiwan	4%	0%	1%	-2%	0%	2%	-8%	-3%	5%	-1%	6%	-15%	3%
Denmark	0%	-2%	0%	-6%	-4%	-8%	-4%	-3%	-4%	-11%	-8%	-15%	2%
China	0%	1%	1%	2%	1%	0%	11%	-1%	1%	8%	11%	2%	2%

Comparisons to other countries

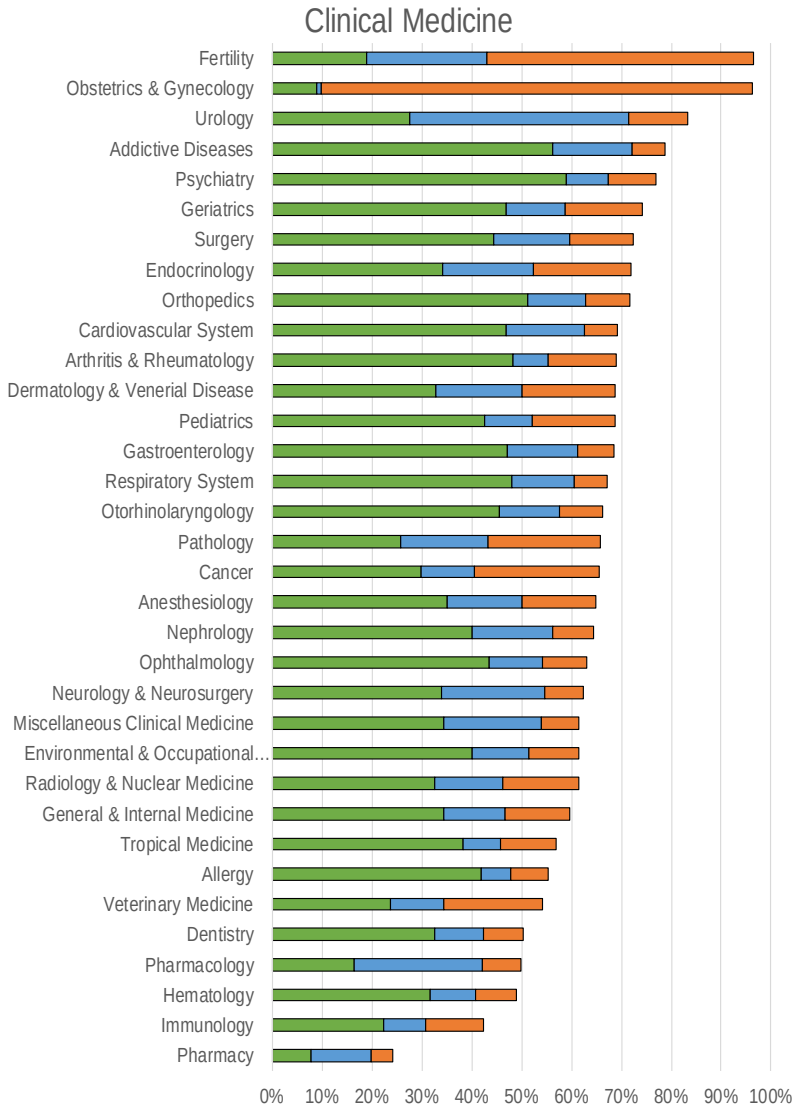
Georgia Tech

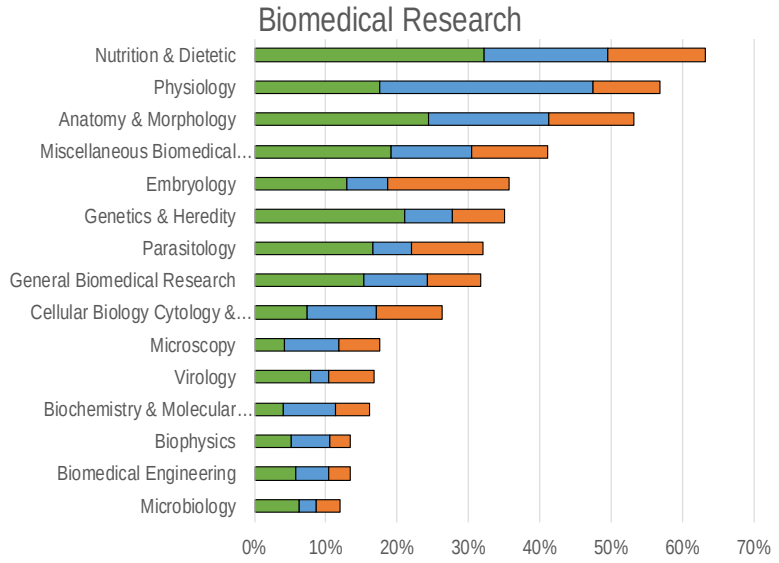
Gender as an object of study

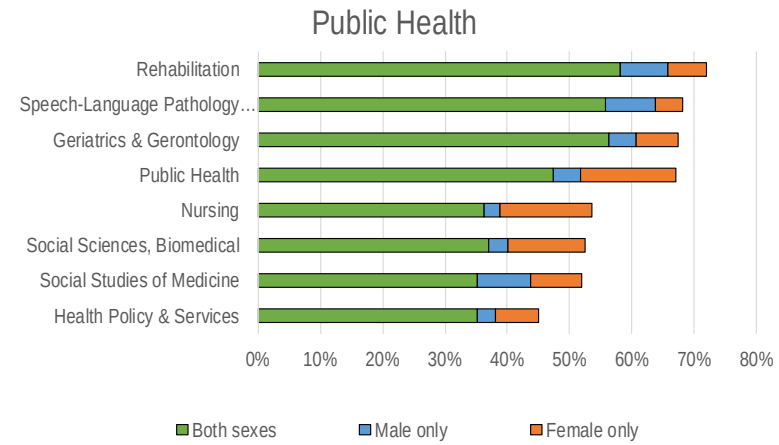


Georgia Tech

Gendered nature of specialties

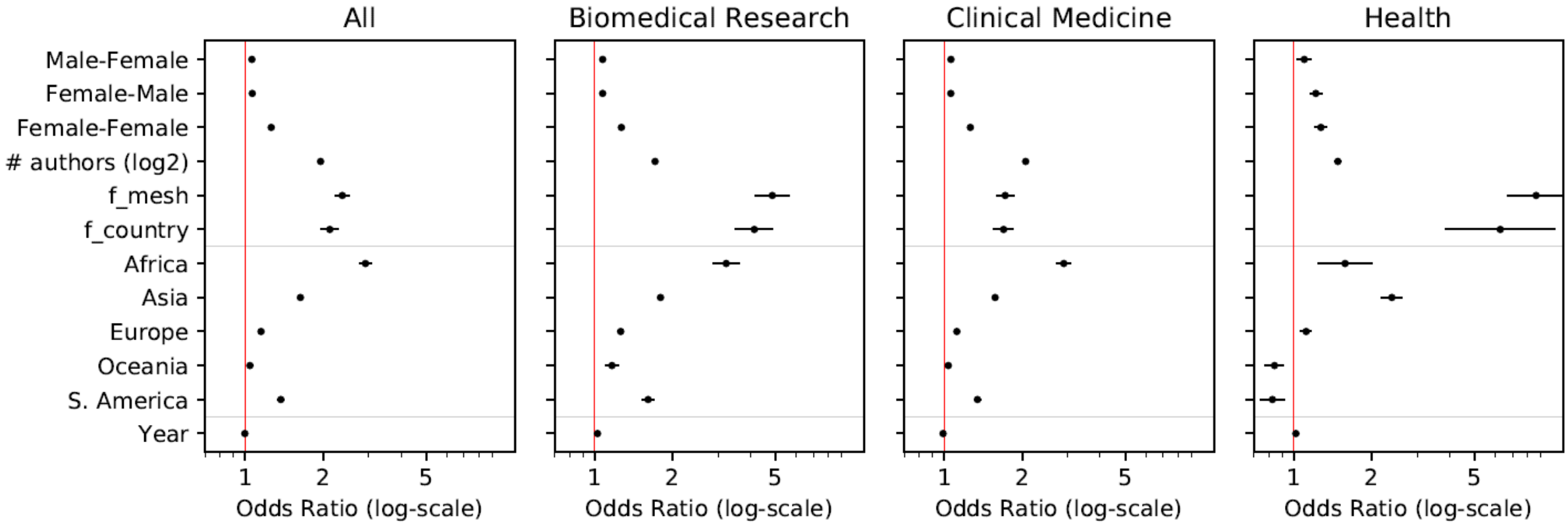






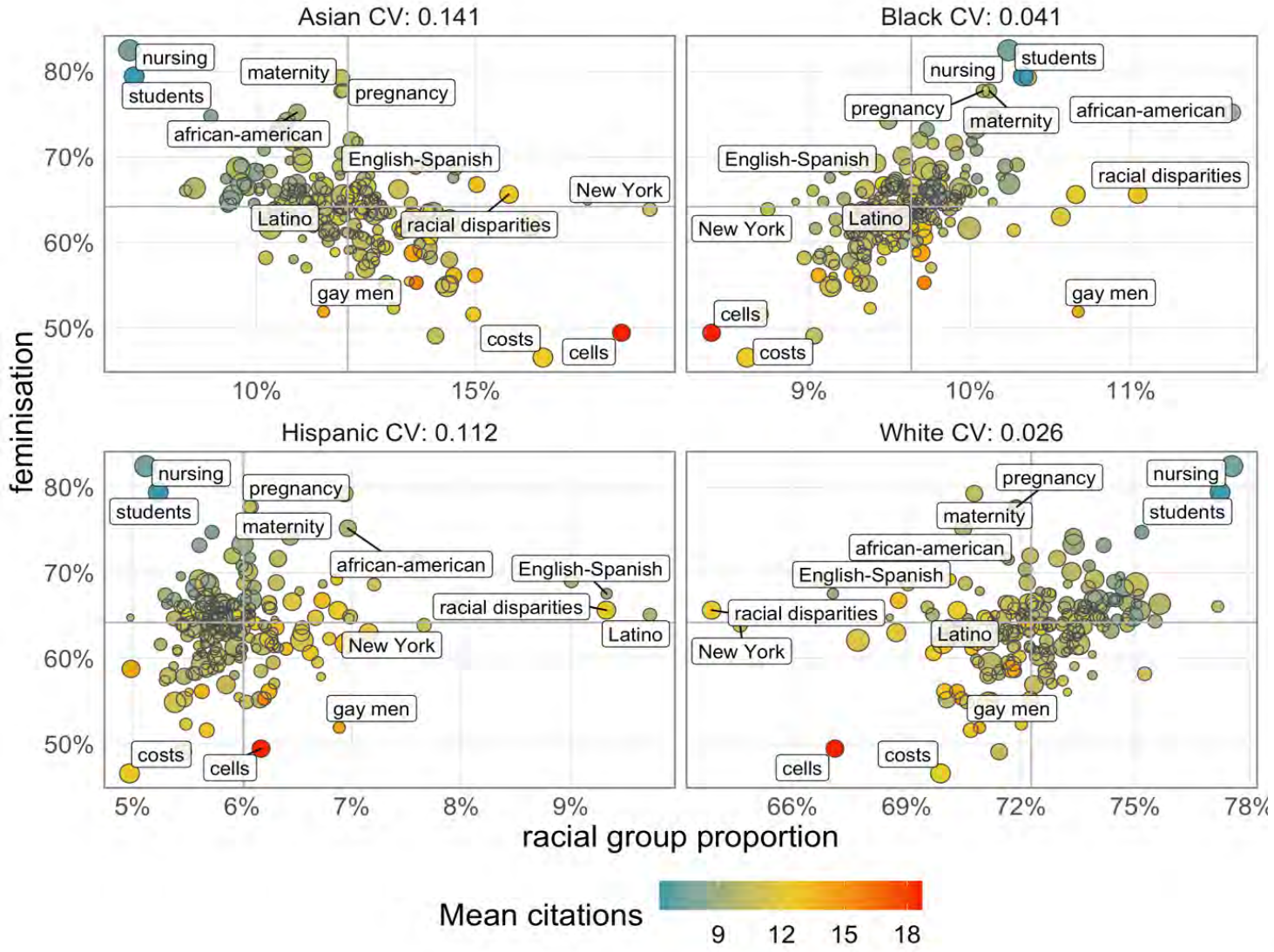
Georgia Tech

Gender homophily between authors and topics



Georgia Tech

Intersectional homophily in topics



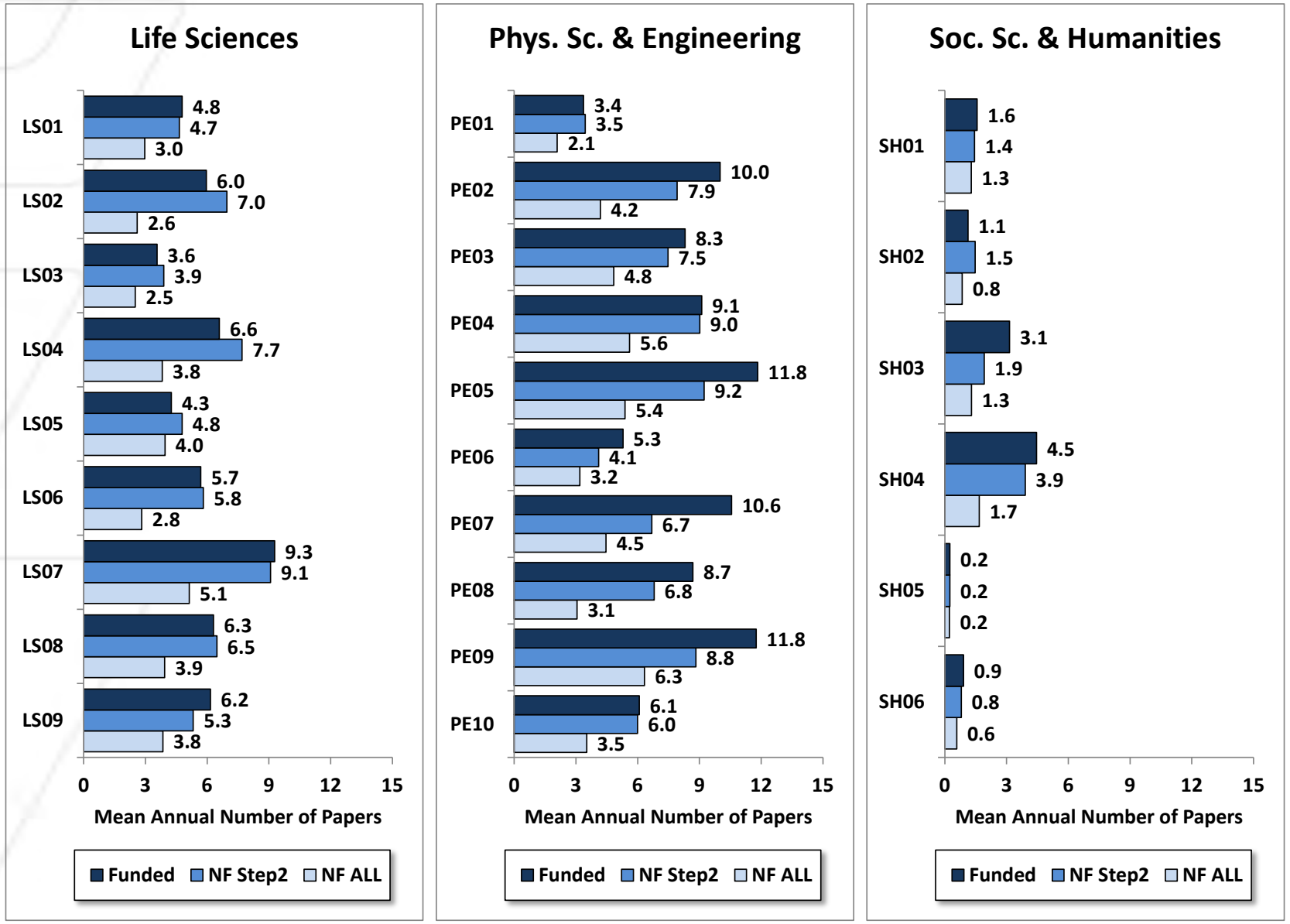
Georgia Tech

Case example from ERC project

Are we funding the “best” candidates? Does our funding have an “impact”?

Georgia Tech

of papers of ERC funded + unfunded researchers

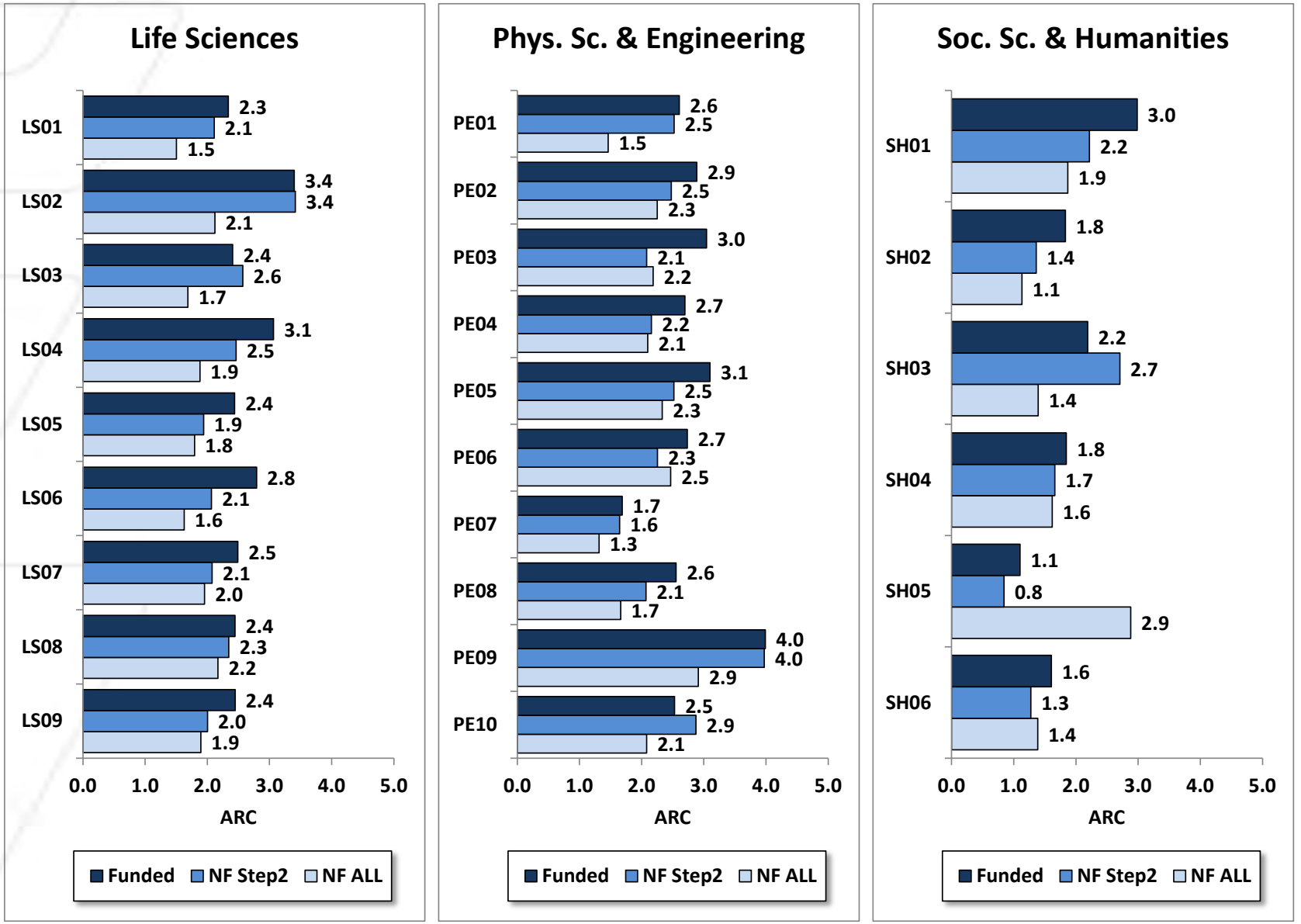


Consider implications:
--interdisciplinarity (control for differences in publication)
--status (junior or senior)

https://www.rand.org/pubs/external_publications/EP67210.html

Georgia Tech

Average relative citations of ERC (un)funded researchers

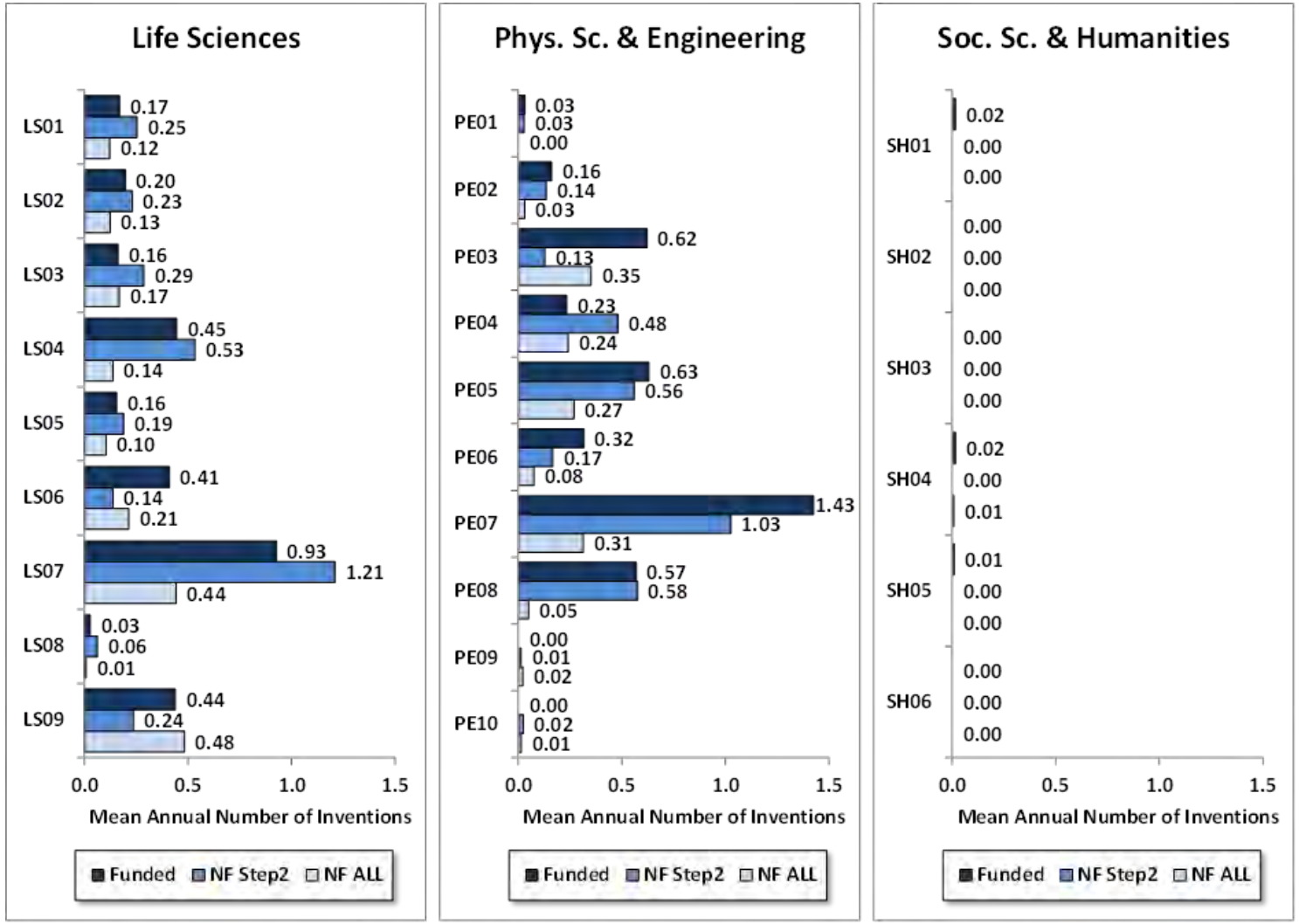


Check your values:
--conservatism (reinforce Matthew effect; risk averse)
--innovation (seek new entrants, higher risk)

https://www.rand.org/pubs/external_publications/EP67210.html

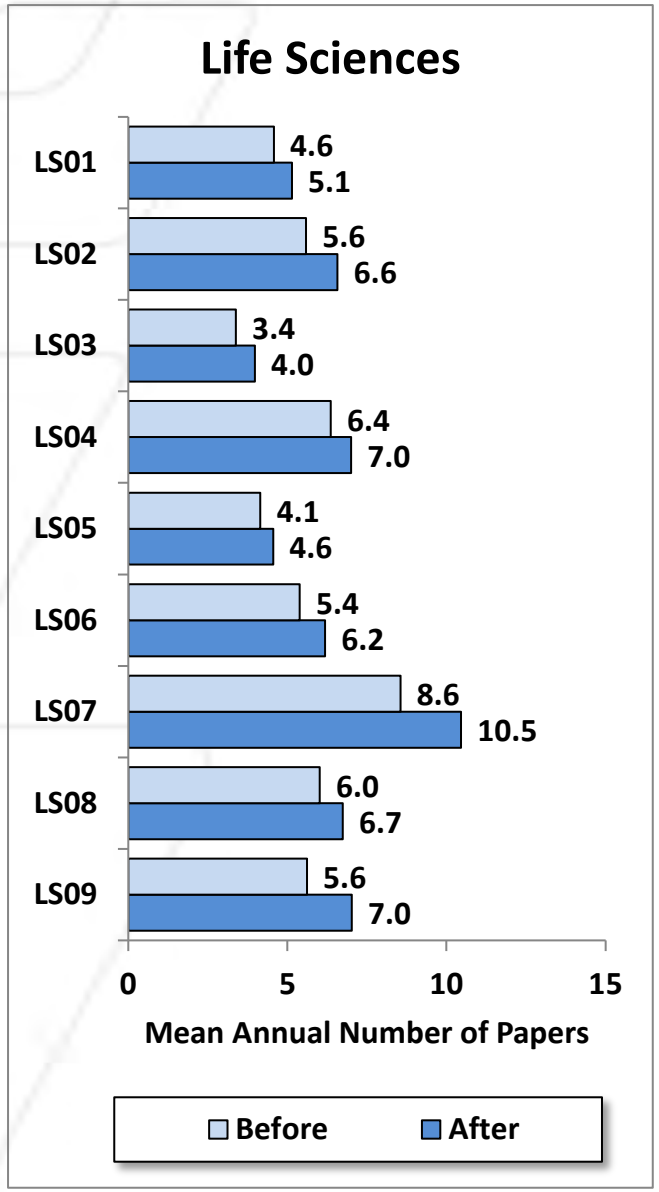
Georgia Tech

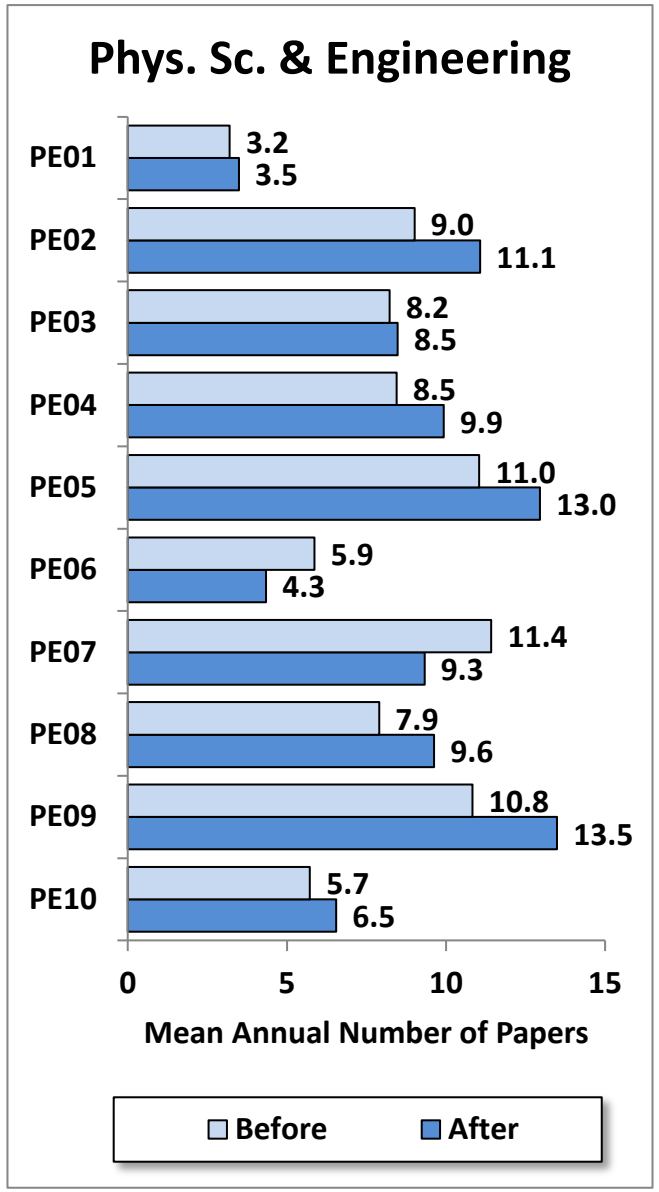
of patents of funded and unfunded researchers

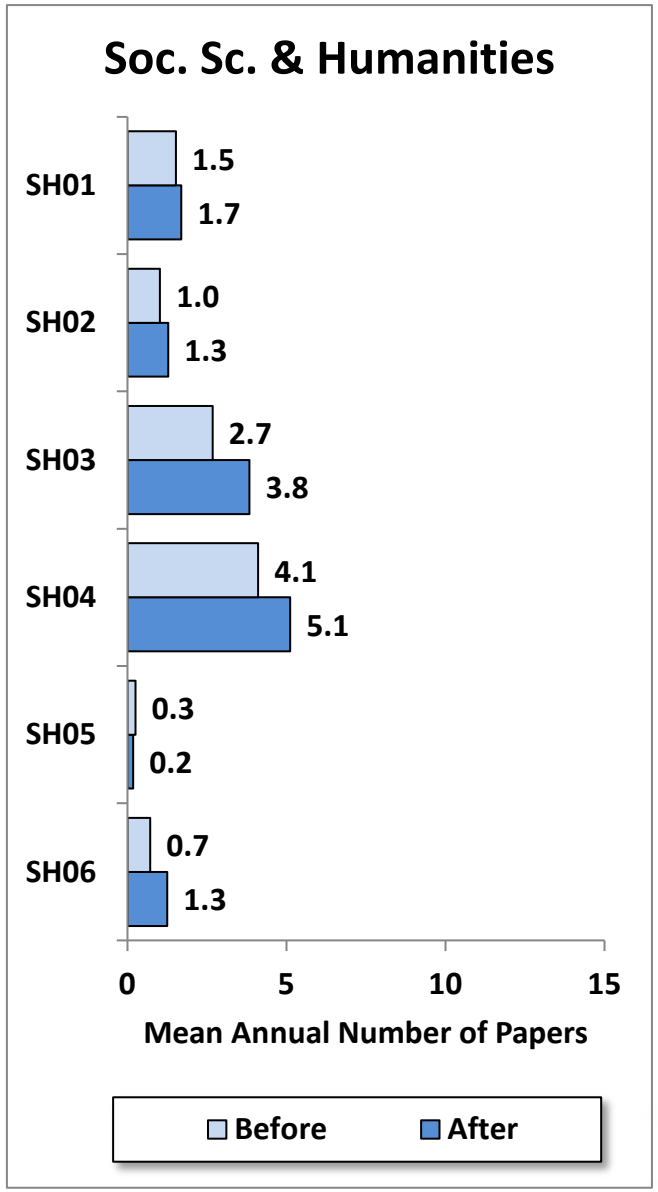


Georgia Tech

of papers of ERC researchers before/after competition





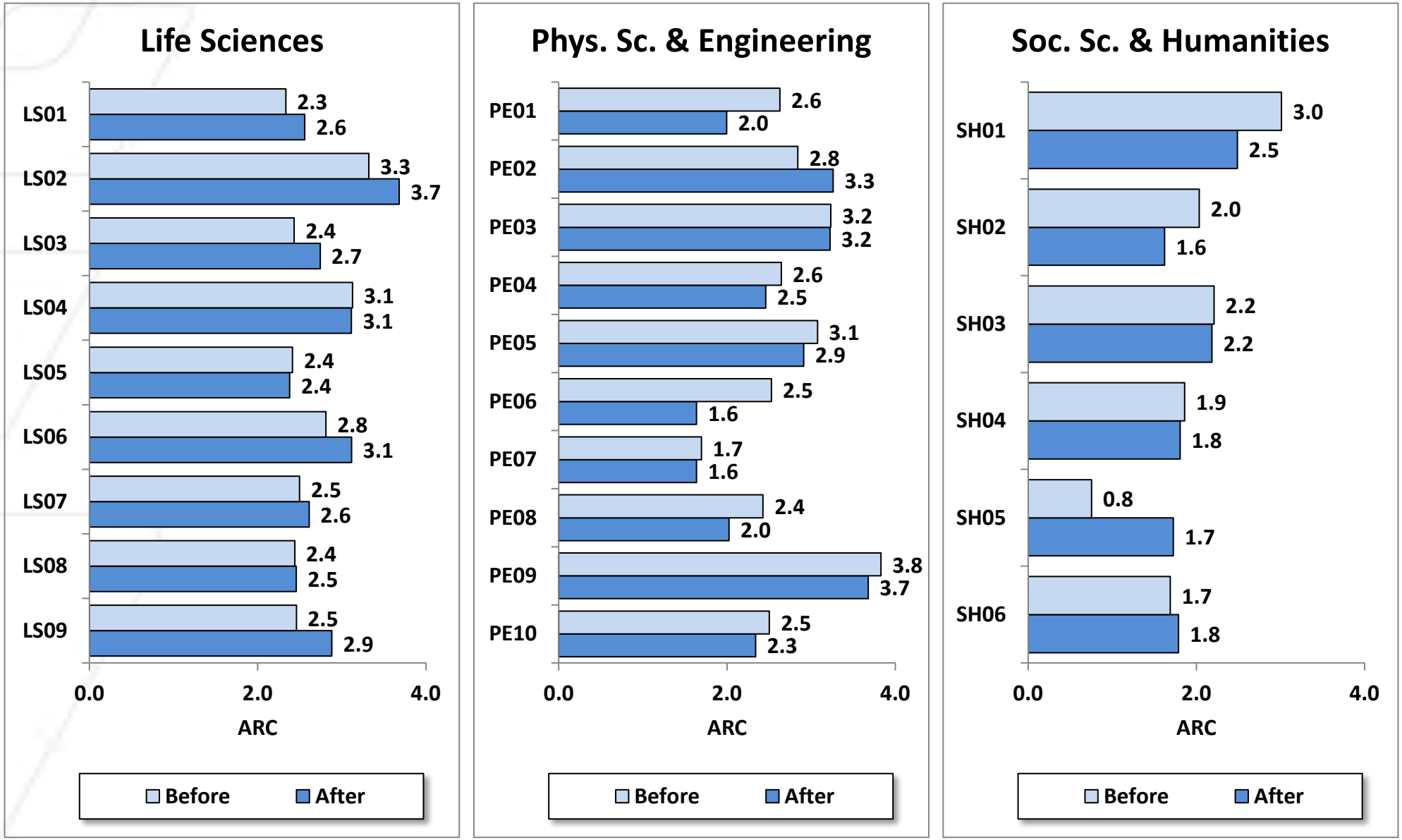


Funding the already established: is growth a good indicator? How much growth?

https://www.rand.org/pubs/external_publications/EP67210.html

Georgia Tech

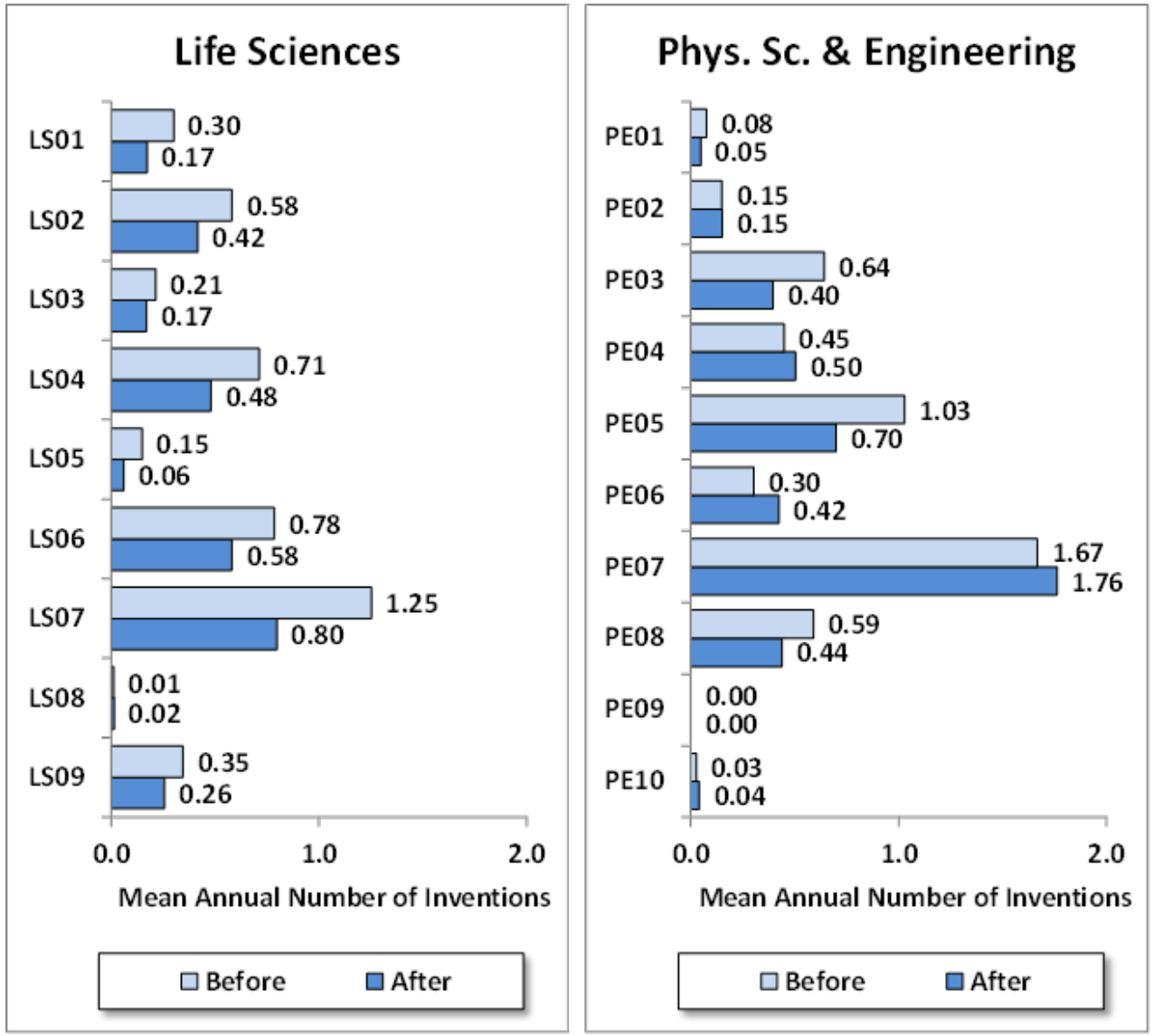
Average relative citations of ERC researchers before/after competition



https://www.rand.org/pubs/external_publications/EP67210.html

Georgia Tech

Improvement of grantees on mean # of patents



Value check: is innovation incentivized?

Georgia Tech

Metascience can help funding institutions with outcome evaluation by:

…measuring outcomes according to values;

…providing largescale comparisons of impact of funding.

Georgia Tech

Concluding thoughts

Science funding is a critical actor in the scientific system. Funders must acknowledge their roles and understand the context. **Metascience is a useful tool for contextualization**.

Science funding should be done scientifically. **Funders collect data that they rarely employ for evidenced-based decision making**. They should either develop skills internally or consult to utilize these data effectively to improve funding.

Funding should reinforce values and serve society. Whether public or privately funded, organizations should examine their values and whether their investments are maximized for the greatest good. **Metascience creates analytic instruments to match values to evidence**.

Metasciences are inclusive of all fields that study science, including from historical and sociological perspectives. The **best studies are those that triangulate evidence from a variety of approaches and include key stakeholders in processes of co-creation**.

Georgia Tech

Thank you! Questions?

…and thanks to Dr.Vincent Larivière

Georgia Tech