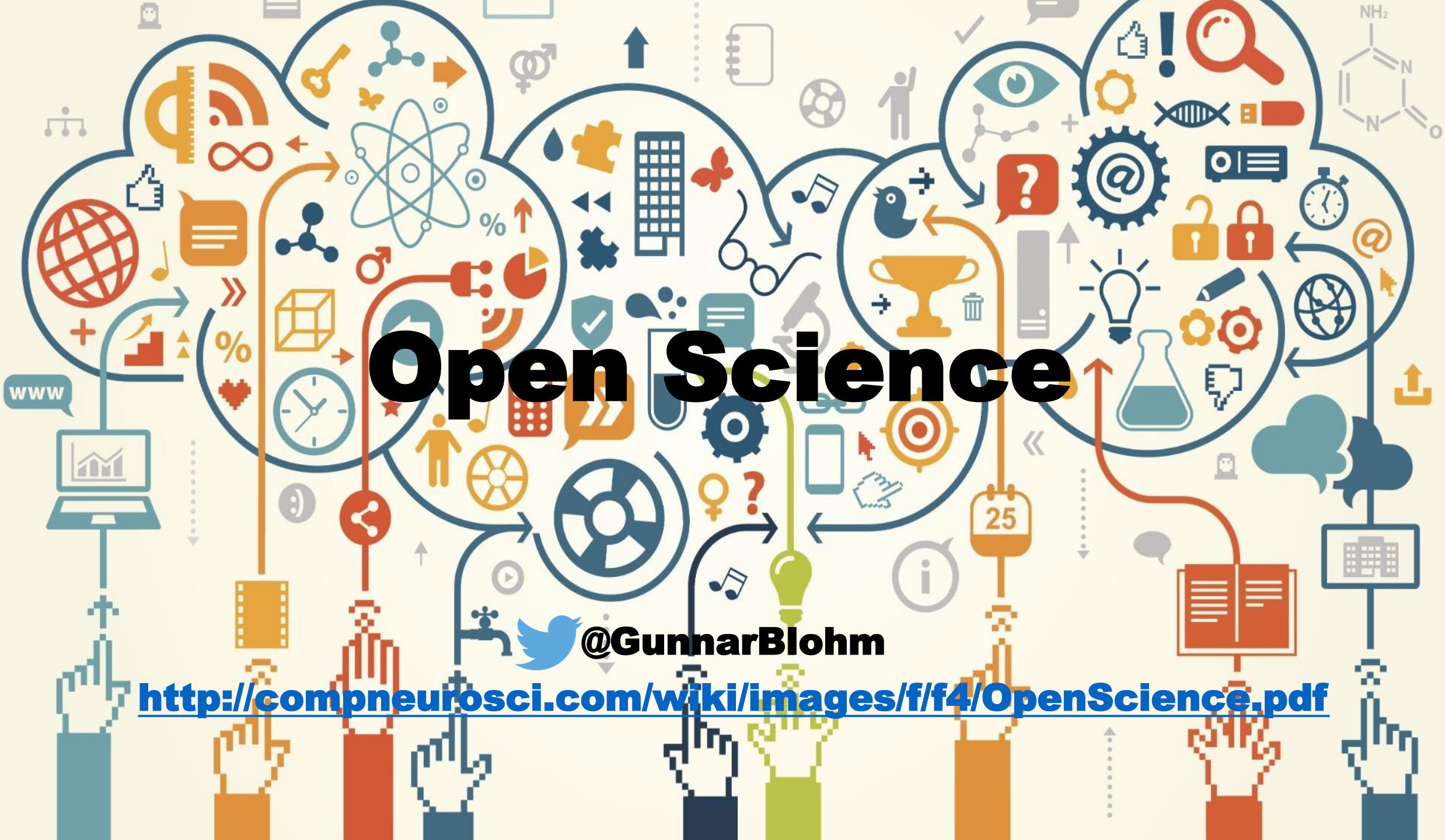


Open Science

@GunnarBlohm

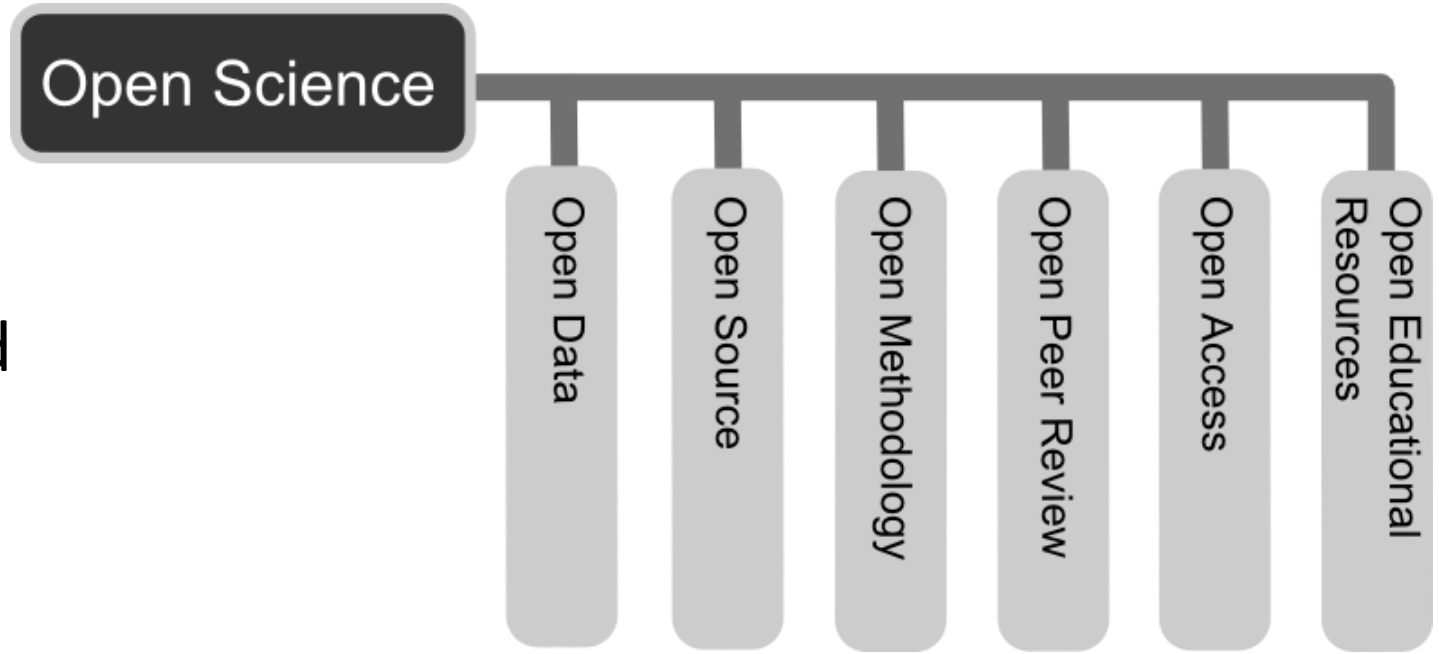
http://compneurosci.com/wiki/images/f/f4/OpenScience.pdf

"On Being a Scientist" (2016)

Solution: Open Science!

More than open access publishing…

- “Open Science, the movement to make scientific products and processes accessible to and reusable by all, is about culture and knowledge as much as it is about technologies and services.”

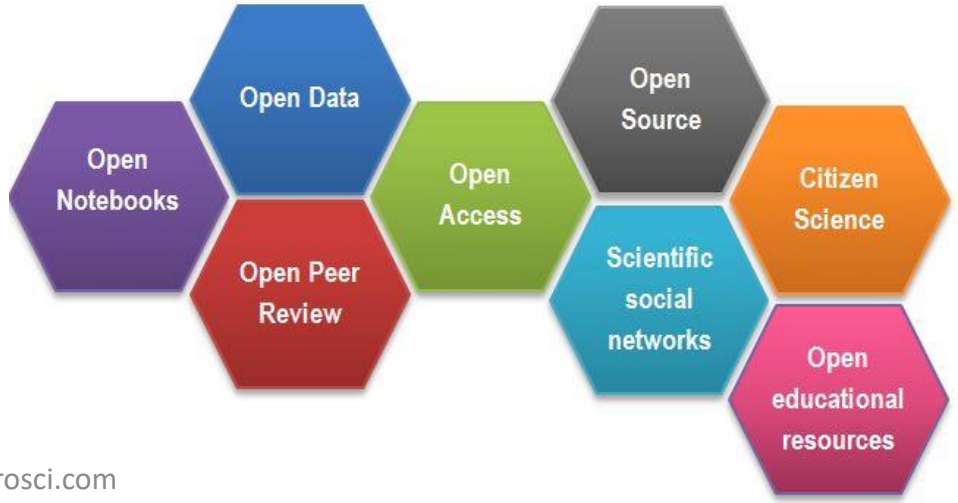


(https://open-science-training-handbook.gitbook.io/book/introduction)

What is Open Science?

- “Open Science is the practice of science in such a way that others can collaborate and contribute, where research data, lab notes and other research processes are freely available, under terms that enable reuse, redistribution and reproduction of the research and its underlying data and methods. In a nutshell, Open Science is transparent and accessible knowledge that is shared and developed through collaborative networks.”

(Vicente-Sáez & Martínez-Fuentes 2018)



Think about it…

- What could you do with open science? What could you study? What could you learn?
- What opportunities would present themselves, if…
  - All data (in your field) were available online
  - All algorithms (in your field) were available online
  - All publications (in your field) were open access
- Most of these opportunities are not little steps forward; instead they promise to be revolutionary!

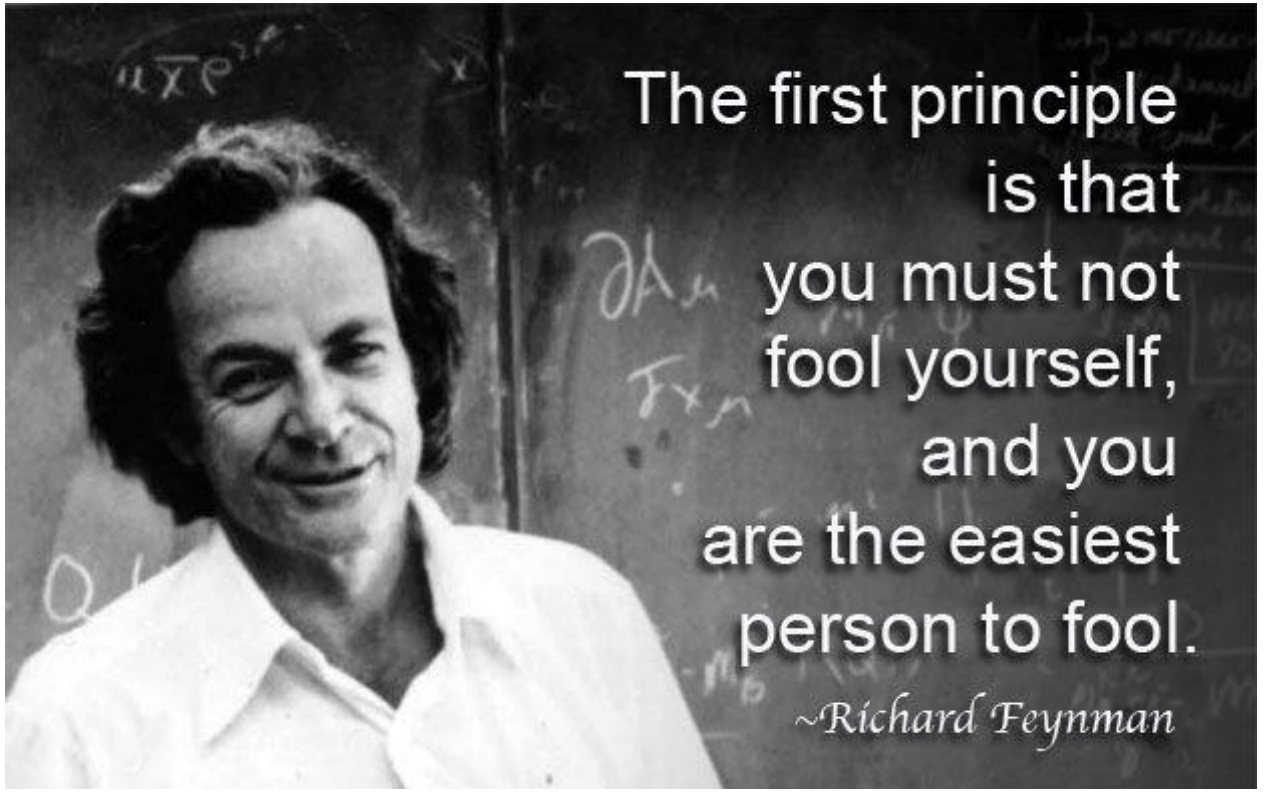
Benefits of Open Science

- Open science makes the work accessible to anyone
- Open science allows people to build much more efficiently on previous work (e.g. expand old models)
- Open science helps maximize the usefulness of each individual research effort (e.g. mine old data, and lots of it!)
- Data tend to have a (much!) longer shelf life than our (limited) interpretations
- Open science fosters creativity, and stimulates revolutionary research
  - Importance of scientific networking…

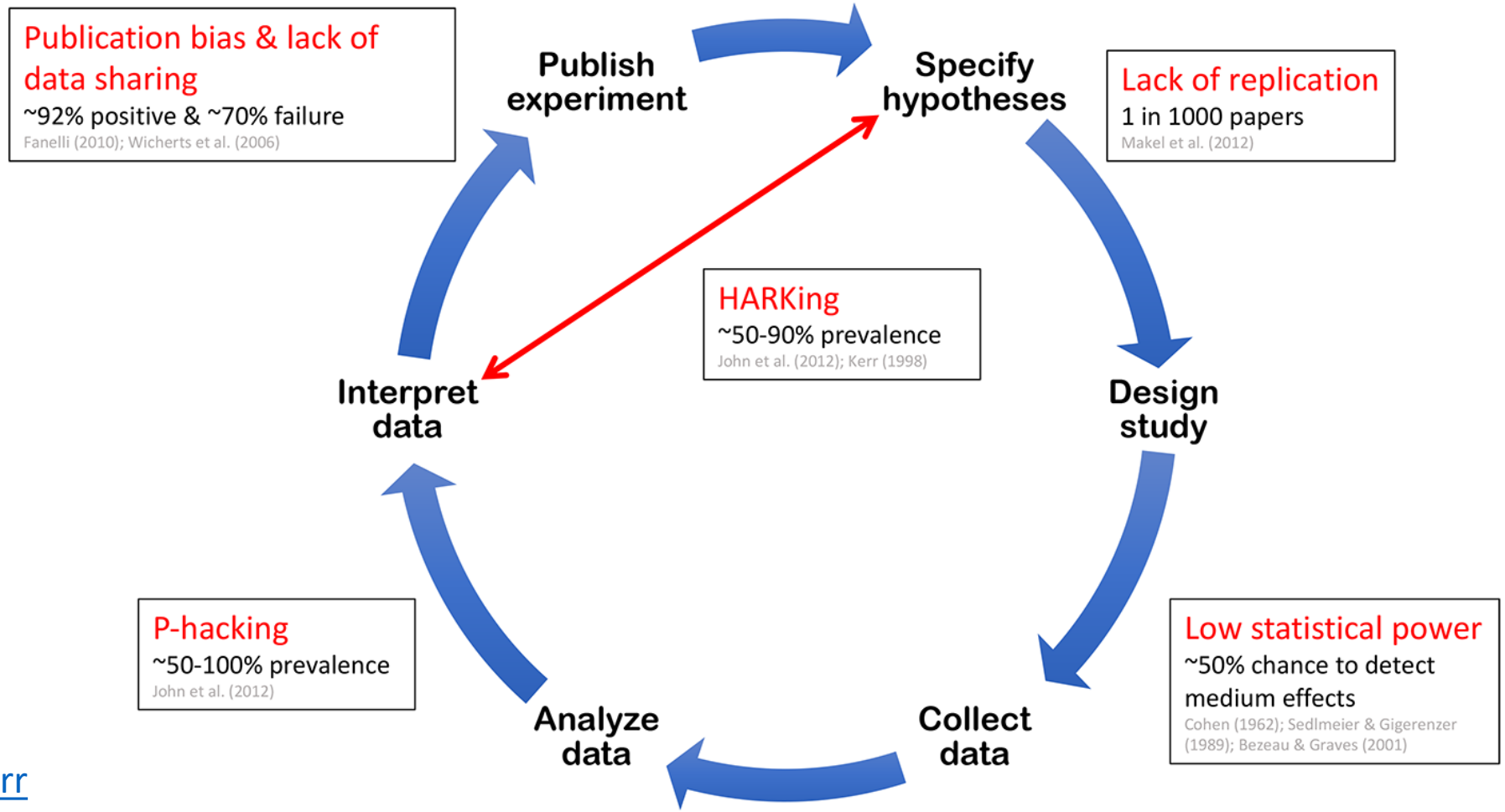
Why should science be open?

- Evaluation requires full understanding of Methods
- Reproducibility
- Replicability
- Impact

- Accelerate discovery
  - Share data
  - Share code
  - Share everything!



Some stats on sketchy science



https://Cos.io/rr

Open Science enables breakthroughs!

www.nature.com/scientificreports

SCIENTIFIC REPORTS

RESEARCH ARTICLE

>100 papers, book chapters, and pre-prints on http://crcns.org/publications (Collaborative Research in Computational Neuroscience)

OPEN

Asymmet… for space … cells

Received: 20 October 2016
Accepted: 17 July 2017
Published online: 17 August 2017

Bryan C. Souza & Adrian…

Hippocampal place cells cor… timing relative to the theta … to independent or related n… spike timing of place cells couples to theta phase before major increases in firing rate, anticipating the animal's entrance into the classical, rate-based place field. In contrast, spikes rapidly decouple from theta as the animal leaves the place field and firing rate decreases. Therefore, temporal coding has strong asymmetry around the place field center. We further show that the dynamics of temporal coding along space evolves in three stages as the animal traverses the place field: phase coupling, sharp precession and phase decoupling. These results suggest that independent mechanisms may govern rate and temporal coding.

The rodent hippocampus plays a role in spatial memory and navigation[1,2]. Some hippocampal neurons, called place cells, increase their firing rate when the animal is at a specific location of the environment, known as the 'place field' of the cell[3]. As the animal crosses place fields, place cells form spike sequences coordinated by the hippocampal theta rhythm (~5–12 Hz) by firing action potentials progressively coupled to earlier phases of the cycle, a phenomenon known as 'phase precession'[4]. Place fields and phase precession are considered canonical examples of rate and temporal coding, respectively, in which the firing rate of the neuron and the exact spike timing relative to the theta cycle provide information about space[5–7]. Whether temporal and rate coding are governed by inde-

…ase-phase coupling …mma oscillations in …

…nde do Norte, Natal, Brazil

Phase-amplitude coupling between theta and multiple gamma sub-bands is a hallmark …npal activity and believed to take part in information routing. More recently, theta and …illations were also reported to exhibit phase-phase coupling, or n:m phase-locking, an important mechanism of neuronal coding that has long received theoretical support. …y analyzing simulated and actual LFPs, here we question the existence of theta-gamma …e coupling in the rat hippocampus. We show that the quasi-linear phase shifts by filtering lead to spurious coupling levels in both white noise and hippocampal LFPs, …depend on epoch length, and that significant coupling may be falsely detected when …mproper surrogate methods. We also show that waveform asymmetry and frequency …may generate artifactual n:m phase-locking. Studies investigating phase-phase coupling

Other Open Science success stories

- Code: Linux & NeuroDebian, R, SPM, LaTeX, etc.
- Raspberry Pi hardware
- Publishers: PLoS, JoV, eLife, eNeuro, etc.
- arXiv: pre-print repositories (bioRxiv, PsyArXiv, etc.)
- Wikipedia, Scholarpedia
- Numerous collaborative datasets / projects

Open Science tools

- Pre-registration keeps you honest!
  - OSF.io & many journals accepting pre-registered studies
  - Rationale, methods, hypotheses, analytic plan, etc
  - Distinguishes hypothesis testing from exploratory analyses
- Data repositories make the most out of data
  - OSF.io
- Model sharing ensure impact of model / hypothesis
  - Github – importance of documentation
- Open peer review
- Open access provides it to everyone!
  - bioRxiv, open-access journals, etc

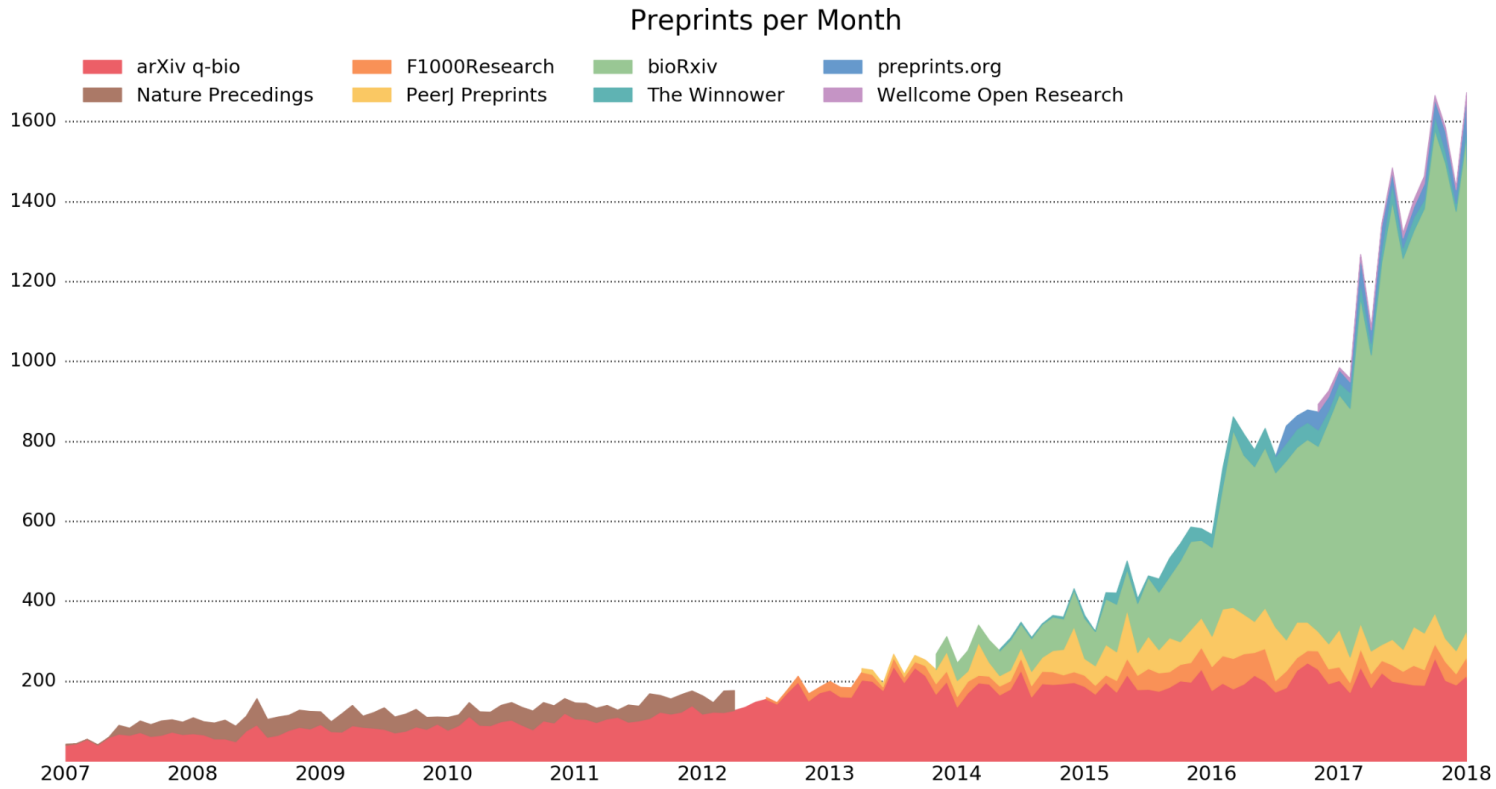
Let’s talk specifics…

Open access to publications

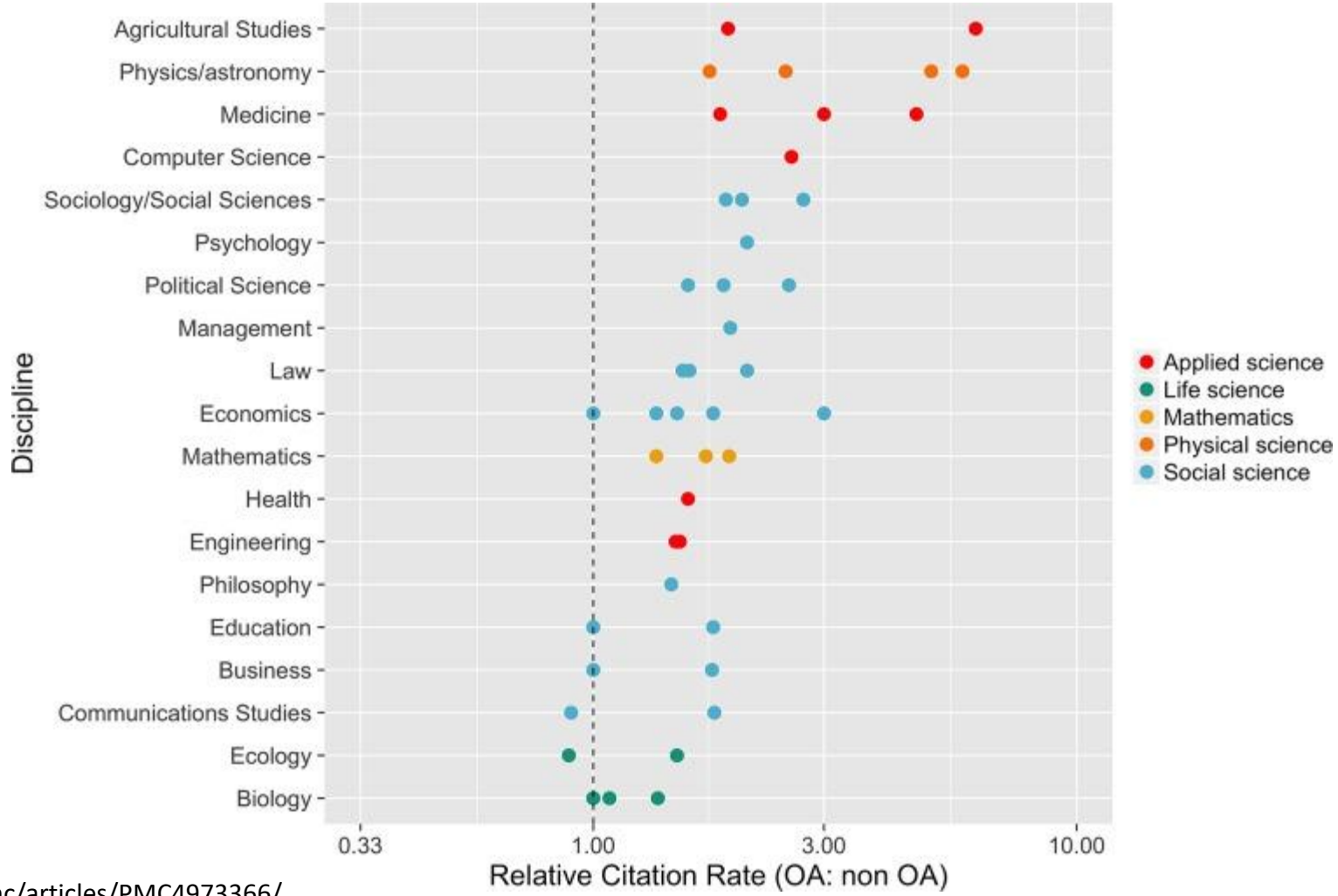
- Open access publications = recent break-through!
- Free, immediate, online access to the results of research
- Free to reuse, e.g. to build tools to mine the content
- Two routes to make sure anyone can access your papers
  - Gold route: paying article processing charges (APCs) to ensure publishers makes copy open
  - Green route: self-archiving Open Access copy in repository
  - Find out what your publisher allows on SHERPA RoMEO – www.sherpa.ac.uk/romeo

Benefit of posting pre-prints

- Time stamp / credit
  - Prevent getting scooped
- Get feedback before submission to journals
  - Makes for better papers!
- Increase visibility
  - Higher research impact and citations
- Faster publication of results!



Open Access articles get more citations



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4973366/

How-to pre-print

- When your manuscript is ready
- Upload on bioRxiv, PsyArXiv, OSF.io, …
  - ArXiv automatically tweets
  - Post on Twitter! Ask for feedback!
  - Consider sending link of pre-print to colleagues
- Collect feedback
  - Give it a few weeks…
  - Improve your manuscript
- Submit to journal as usual…
- Update pre-prints at each round of review / new journal submission

Open peer review

- Open identities
  - Names are explicit
- Open reports
  - review Q&A
- Open participation
  - Anyone can write a review
- Open interaction
  - Direct reciprocal discussion

Why? Broken peer review

- It's supposed to be constructive!
- Battle for high IF publication → high competition, wrong incentives
- High error rate: 3-4 reviewers are not enough to accurately judge!
  - Economist George A. Akerlof's seminal paper, "The Market for Lemons," (how decisions are influenced by one party having more information), was rejected several times before it could be published. Akerlov was later awarded the Nobel Prize for this and other later work.
- Anonymous = problematic
  - Aggressive, subjective, biased reviews
- Review process opaque: review Q&A not published!

Benefits of open peer review

- Greater transparency
- Less bias
- Increased participation to formal and informal peer review processes
  - More feedback is better
  - More solid findings
  - More collaborations
- Faster, more reliable reviews from motivated people
- Opportunities for reviewers
  - Engage with novel research
  - Build academic networks and expertise
  - Refine their own writing skills

How-to peer-review openly

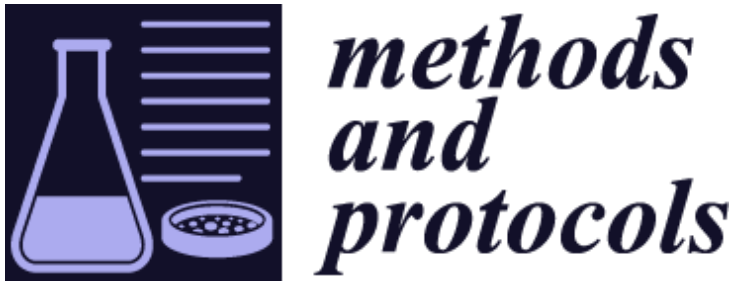
- Send unsolicited review of manuscripts to authors
  - Publish them (e.g. blog, Twitter)
  - Directly interact with authors (e.g. comment in bioRxiv)
- Sign your reviews
- Be constructive!
  - Be reasonable and show integrity
  - Reviewing is about making science better, not to show off
  - Be an ambassador of open science

PUBLONS
EVALUATING ACADEMIC RESEARCH

- Participate in efforts to make review Q&As public
  - Careful about privacy – authors are not allowed to publish reviewer comments without consent
- Pre- vs. post-publication review…

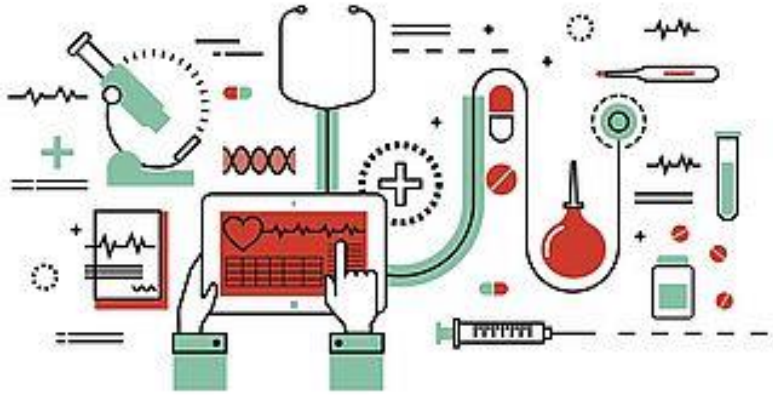
https://www.fosteropenscience.eu/learning/open-peer-review

Open Methods



- Documenting and sharing workflows and methods
- Sharing code and tools to allow others to reproduce work
- Using web based tools to facilitate collaboration and interaction from the outside world
- Open notebook science – “when there is a URL to a laboratory notebook that is freely available and indexed on common search engines.” http://drexel-coas-elearning.blogspot.co.uk/2006/09/open-notebook-science.html

Benefits of open methods



- Facilitates reproducibility
- Increases replicability
- Allows for better understanding and evaluation of Methods used
  - Relates to interpretation of results
  - Limitations of approaches
- Speeds up experimental design
- Makes analysis tools / approaches / rationales available
- Simplifies re-analyses, including unexplored avenues

How-to share methods

- Document everything from the outset
  - Keep detailed lab notes in digital form (if possible)
  - Write clean, well-documented analysis code
  - Decide on a good data organization method
- Publish all experimental procedures (code, notes, etc.)
  - Easy to publish everything (code, manuscript, data, notes) on OSF.io
- Consider sharing code bases in a more comprehensible way
  - e.g. github
- Digital formats, standard formats, open source software preferred

Open data

- Open data make your stuff available on the Web (whatever format) under an open license
  - make it available as structured data (e.g. Excel instead of a scan of a table)
  - use non-proprietary formats (e.g. CSV instead of Excel)
  - use Uniform Resource Identifiers (URIs) to denote things, so that people can point at your stuff (e.g. URLs)
  - link your data to other data to provide context
- Tim Berners-Lee's proposal for five star open data - http://5stardata.info
- "Open data and content can be freely used, modified and shared by anyone for any purpose" http://opendefinition.org

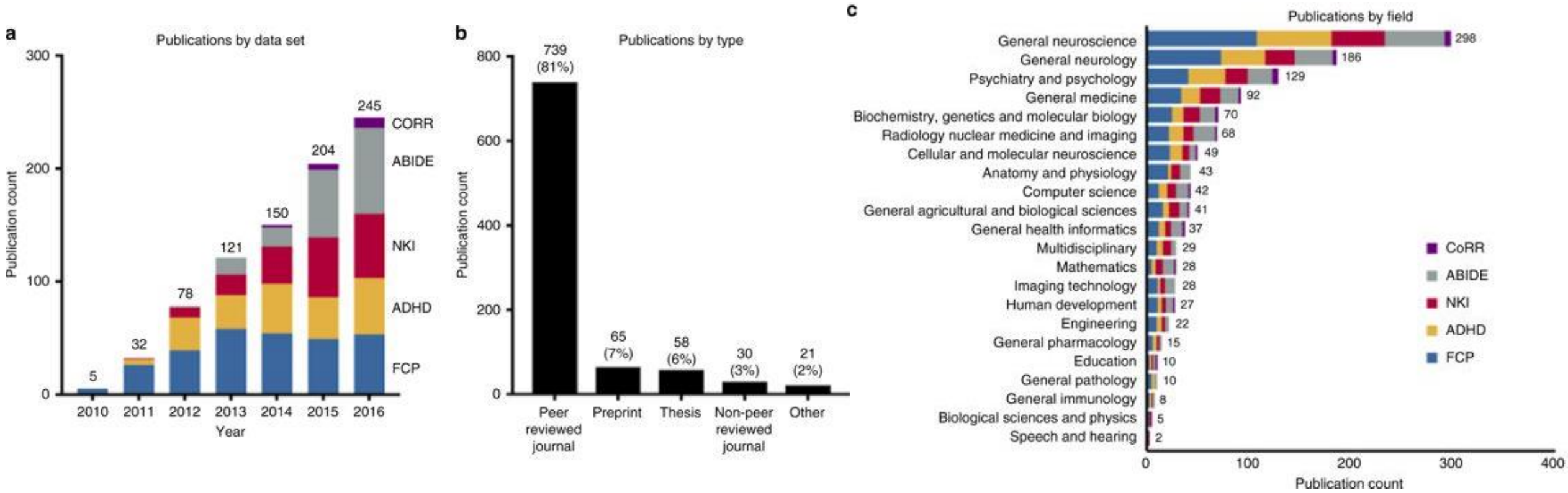
Benefits of open data

- Give data a 2nd, 3rd, … life: the FAIR principle
  - Findable: data is indexed and contains searchable meta-data
  - Accessible: open data and communication protocols
  - Interoperable: data can be combined with other data and tools
  - Re-usable: meaningful metadata and open license
- Re-use of data gives you citations, recognition and visibility
- Satisfaction of making an impact in science and society
- You will get known for your datasets as well as for your science

Open Data is the norm elsewhere…

- Physics
  - Particle physics (e.g. CERN, SnowLab)
  - Astronomy
  - …
- Genetics
- Climate research
- Machine Learning

Success in numbers: an example



Neuroimaging Data-sharing Initiative (INDI)
https://www.nature.com/articles/s41467-018-04976-1

How-to make data available

- Look for good examples in your field
- Organize your data well right from the start
- Use standard formats if possible
  - Neuroimaging
- De-identify data (and follow ethics guidelines)
- Publish data and metadata together, including
  - Protocols
  - Analysis pipeline
- Link to paper

1. Publish in field-specific database
2. Publish on general purpose repository / database (e.g. OSF.io)

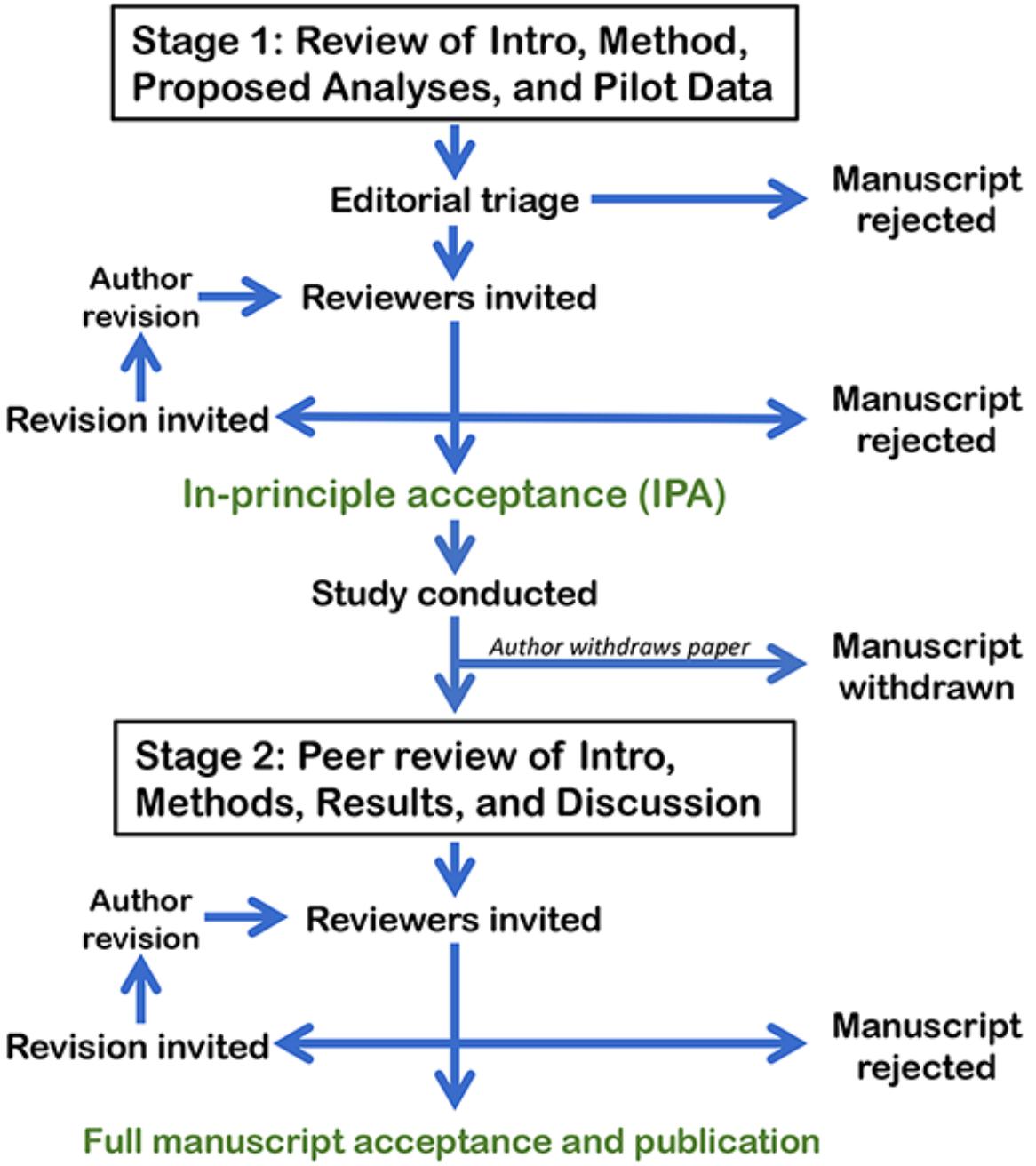
Pre-registration / registered reports

- Ideas, hypotheses, and methods to test them should be the only thing we control in science!
- Write a proposal: Intro, Hypotheses, Methods, Analyses (pilot data)
- Publish the proposal BEFORE collecting data!

https://Cos.io/rr

Pre-registration / **registered reports**

- IPA guarantees publication
  - If original methods are followed
  - Main conclusions need to come from originally proposed analyses
- Does not prevent exploratory analyses
  - Need to be labeled as such



https://Cos.io/rr

Benefits of pre-registrations / registered reports

- Makes your science better by increasing the credibility of your results
  - Avoid p-hacking
  - Avoid HARKing
- Allows you to stake your claim to your ideas earlier
  - Keeps you honest
- Forces you to really think your project through
  - Identify gaps in knowledge and reasoning

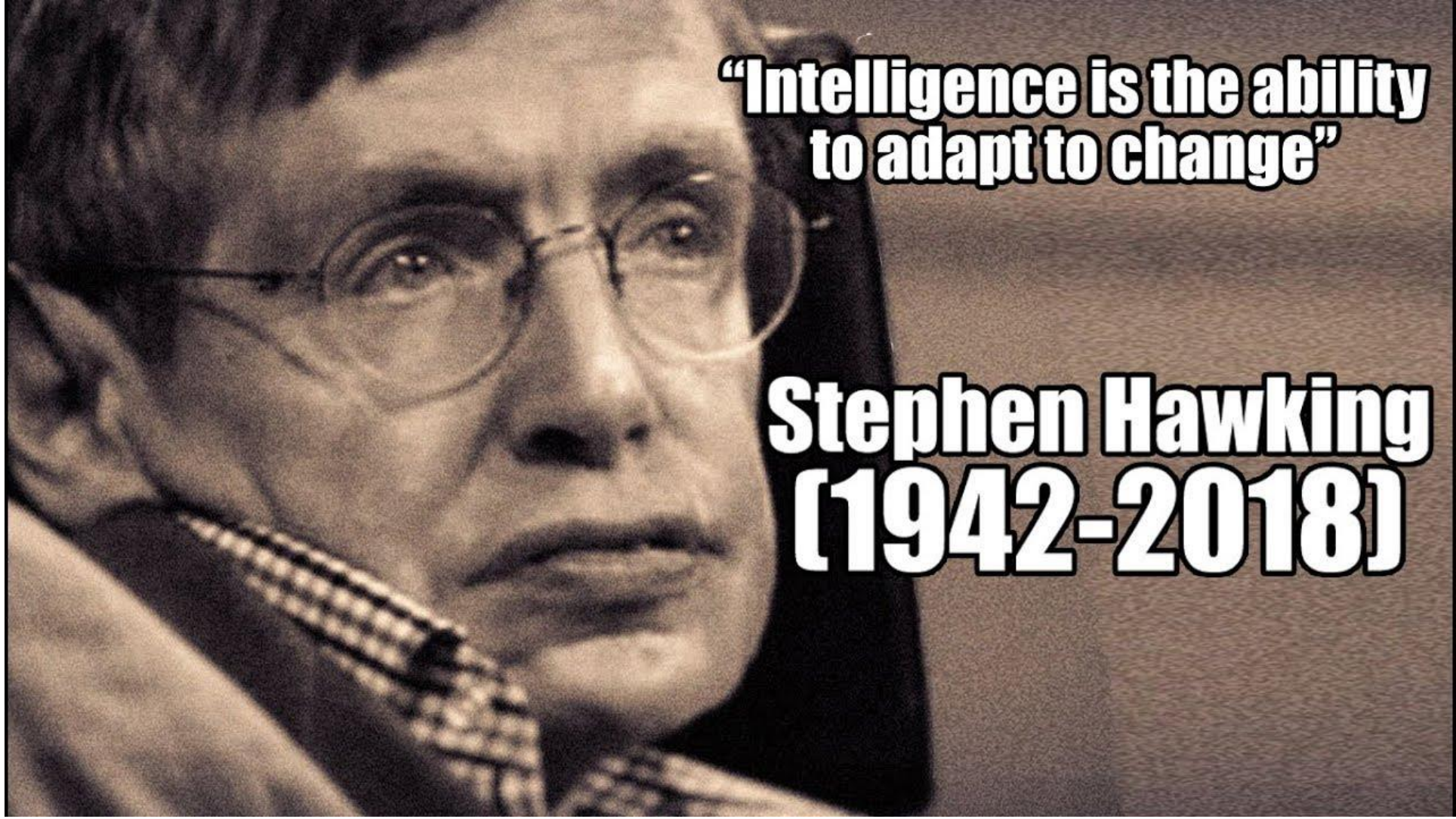
- It's easy and you can win a $1,000 prize for publishing the results of your preregistered research.

https://cos.io/prereg/

How-to pre-register

- As “registered report”
  - See specific journal guidelines:
- As simple “pre-registration”
  - On OSF.io
- When to preregister?
  - Right before your next round of data collection
  - After you are asked to collect more data in peer review
  - Before you begin analysis of an existing data set

Final words


"Intelligence is the ability to adapt to change"
Stephen Hawking
(1942-2018)

Benefits for early career researchers

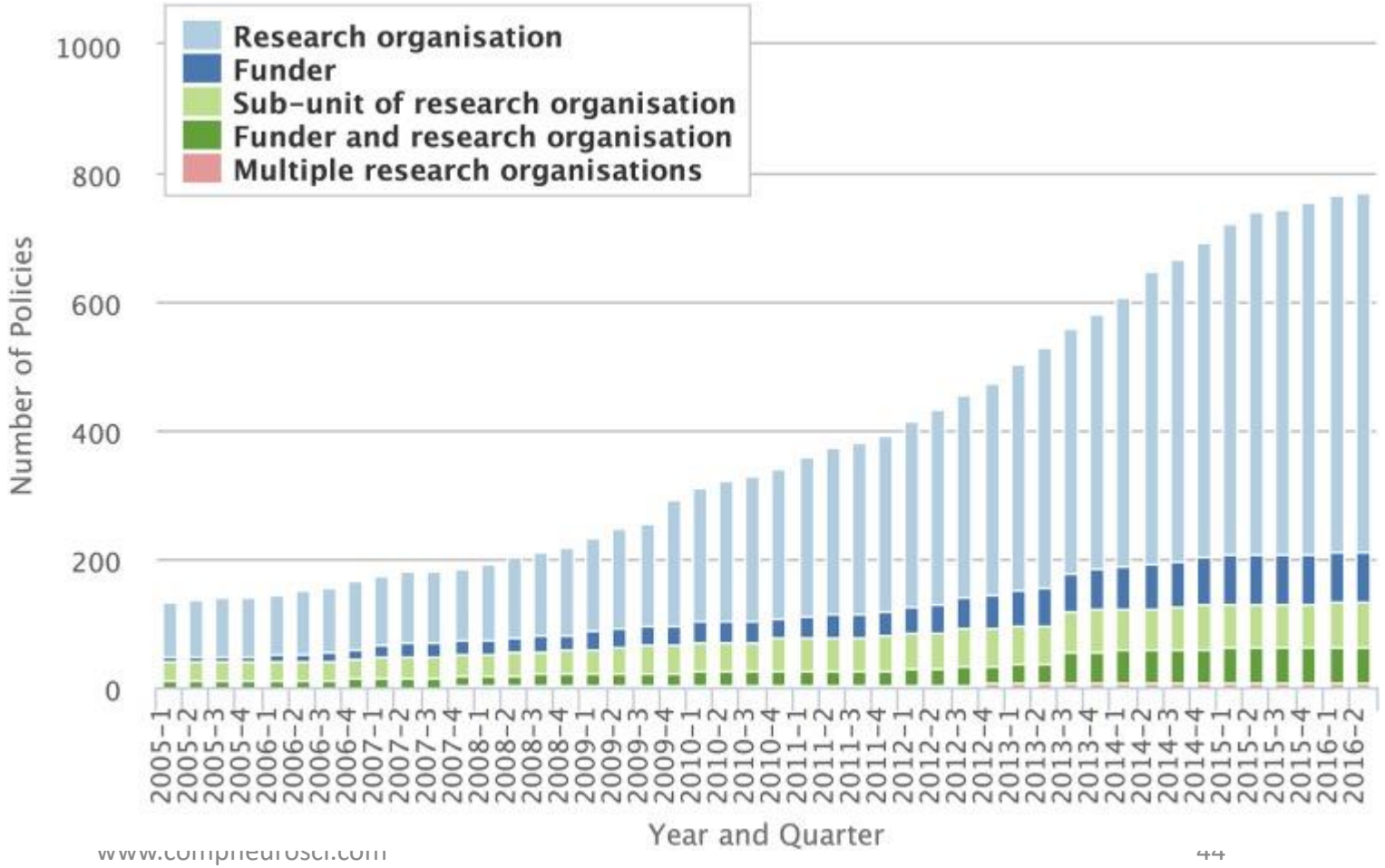
- Become a pioneer
- Gain valuable experience
- Distinguish yourself from the crowd
- Plan successful research proposals
- Receive higher citations
- Get known faster
- Demonstrate research and societal impact
- Enhances your credibility
- Develop a better research network

What can you do as a student?

- Plan on pre-registering your study!
  - Required?
- Provide constructive criticism
  - Be nice!
  - Be helpful
  - Make science better
- Be a good scientist
  - Do what's right: be honest, genuine and true to your beliefs
- Document your project and make outcomes openly available
  - Final report / paper
  - Data & analysis code
  - Lab notes, methods, experiment code and metadata

Open Science = the Future!!!

- Increasingly a requirement!
- Unstoppable!
- Necessary!



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4973366/

What ifs / yes, buts…

It's not The Incentives, it's you (Tal Yarkoni)

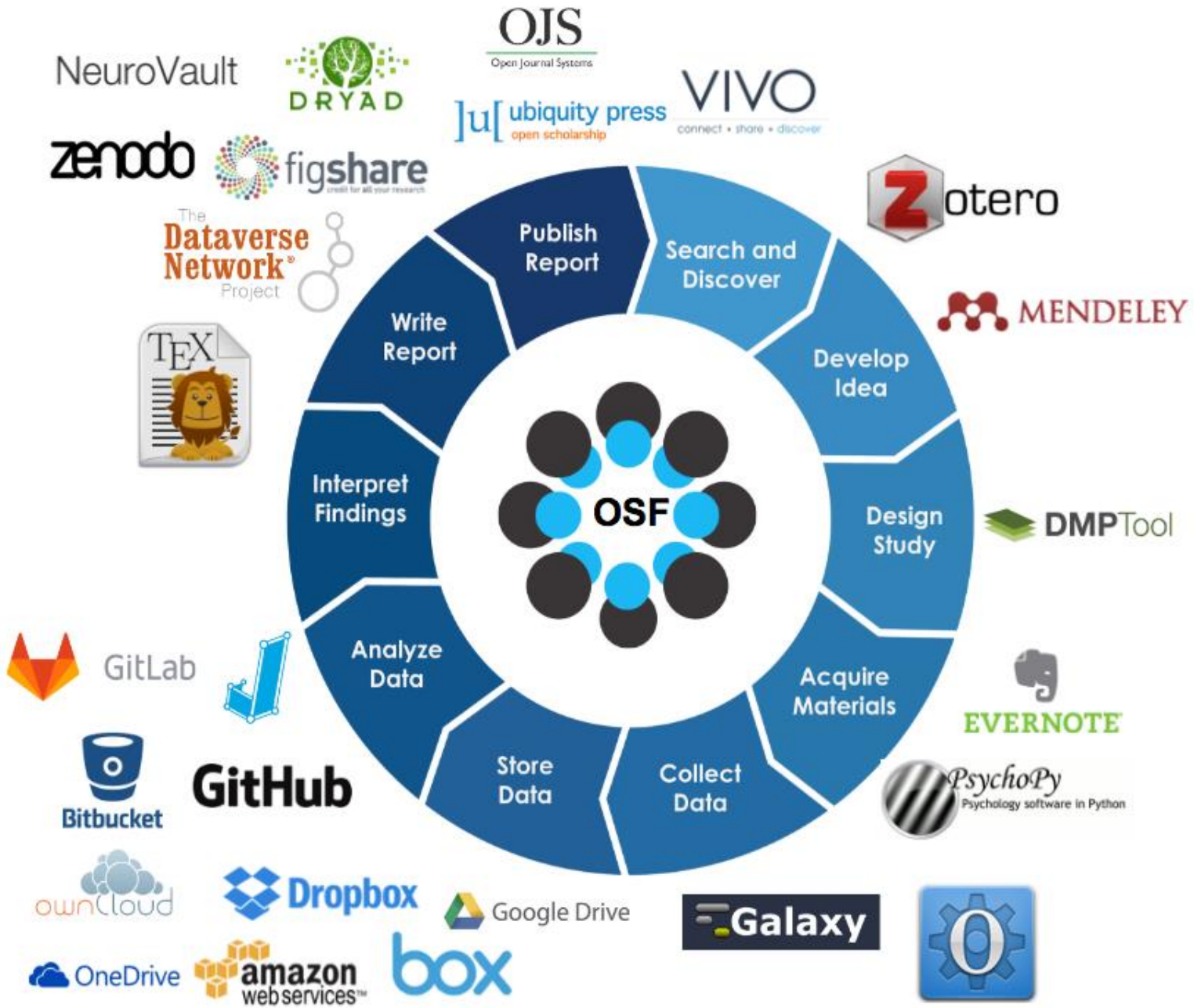
- You can excuse anything by appealing to The Incentives
- Why would it be ok in science if it's not ok, say, in law?
- You are not special
- The Incentives are (probably) not supported by data!
- You (probably) can't boost your career by following The Incentives
- Why would you think that you'd everything better tomorrow?
- You're not thinking long-term!
- It achieves nothing and probably makes things worse
- It's your job!

http://www.talyarkoni.org/blog/2018/10/02/no-its-not-the-incentives-its-you/

Resources

- Open Science handbook: https://zenodo.org/record/1212496#.W1deLbgpDb0
- FOSTER Open Science: www.fosteropenscience.eu
- Open Science Foundation: www.OSF.io
- Center for Open Science: www.cos.io
- www.opensource.com
- www.openscience.com

Resources



https://cos.io/our-products/osf/