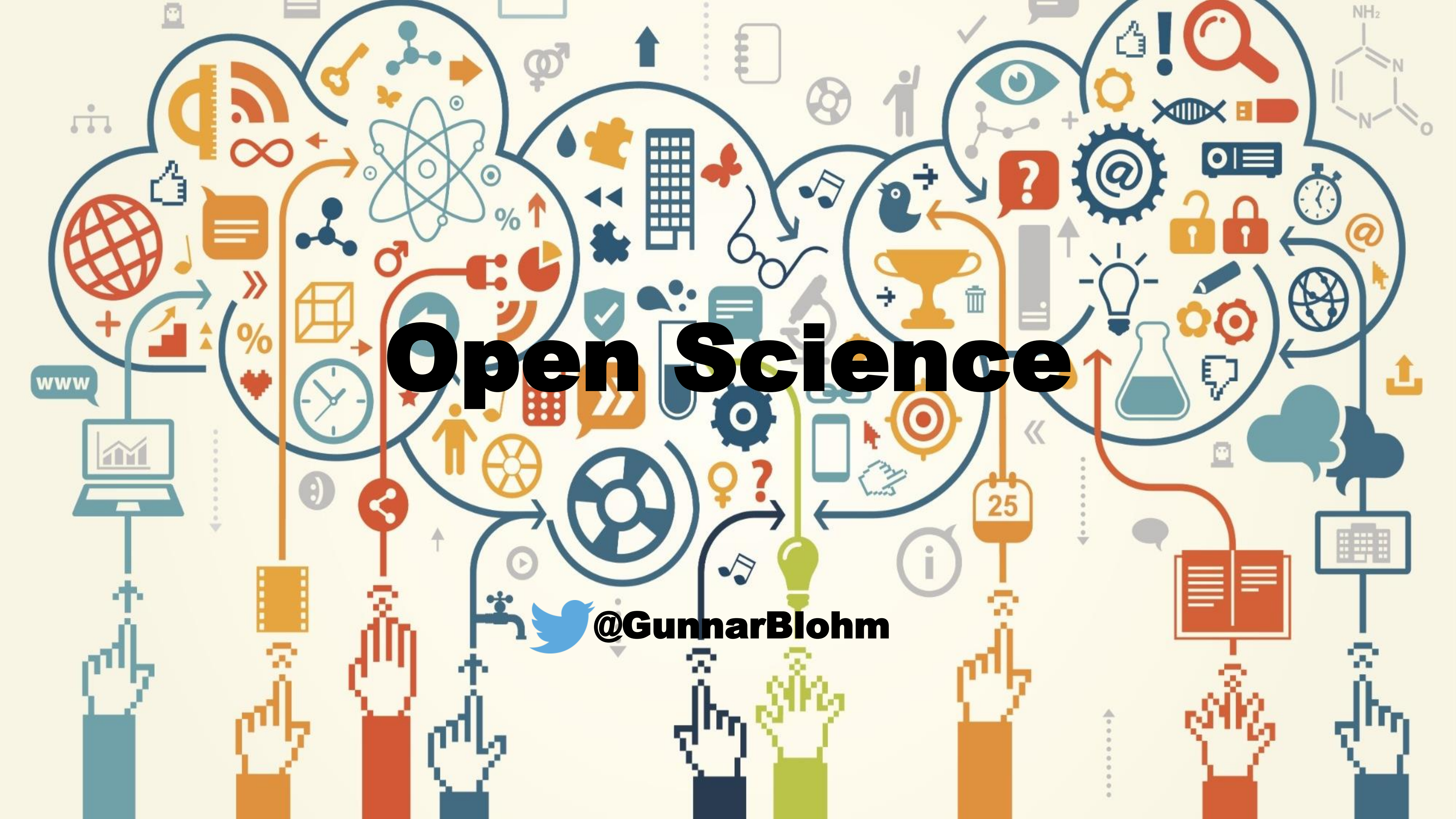
Open Science

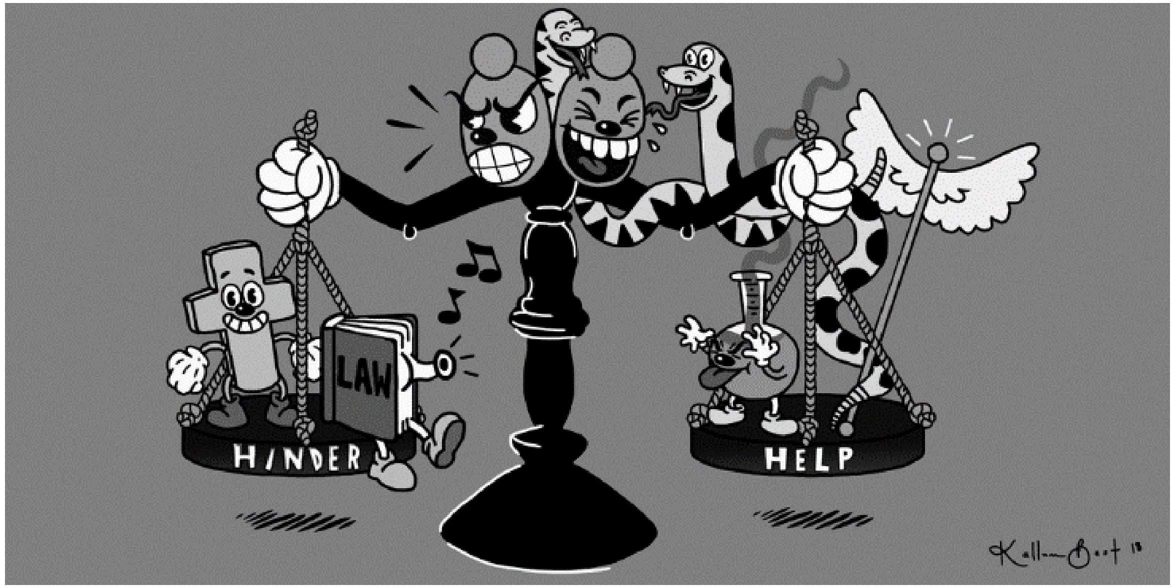


@GunnarBlohm

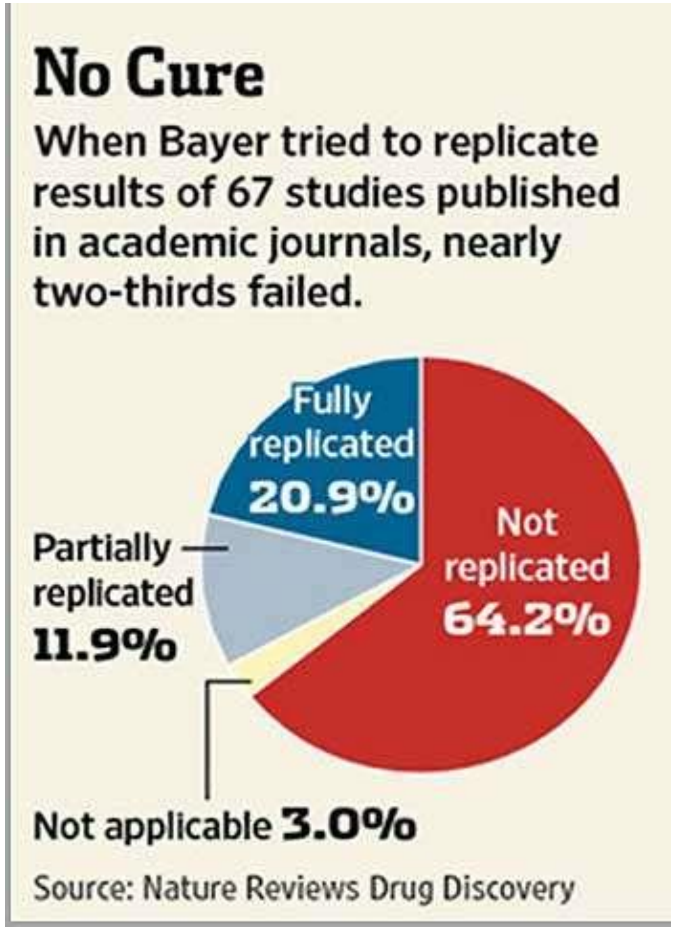
"On Being a Scientist" (2016)

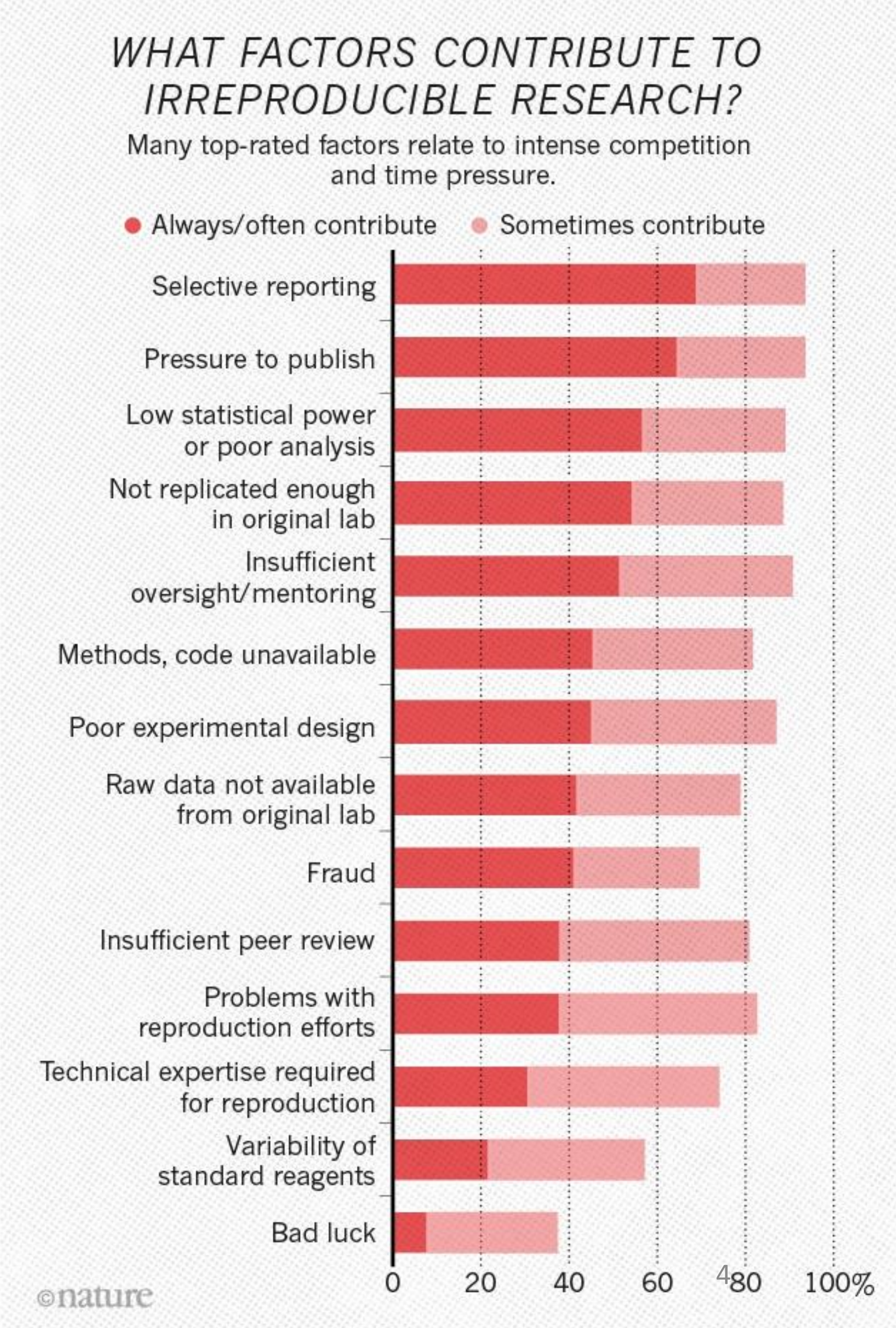
Outline

- Current issues in science
- Better scientific practices
    - Project organization
    - Tools & good practices
- Intro to Open Science



Replication crisis





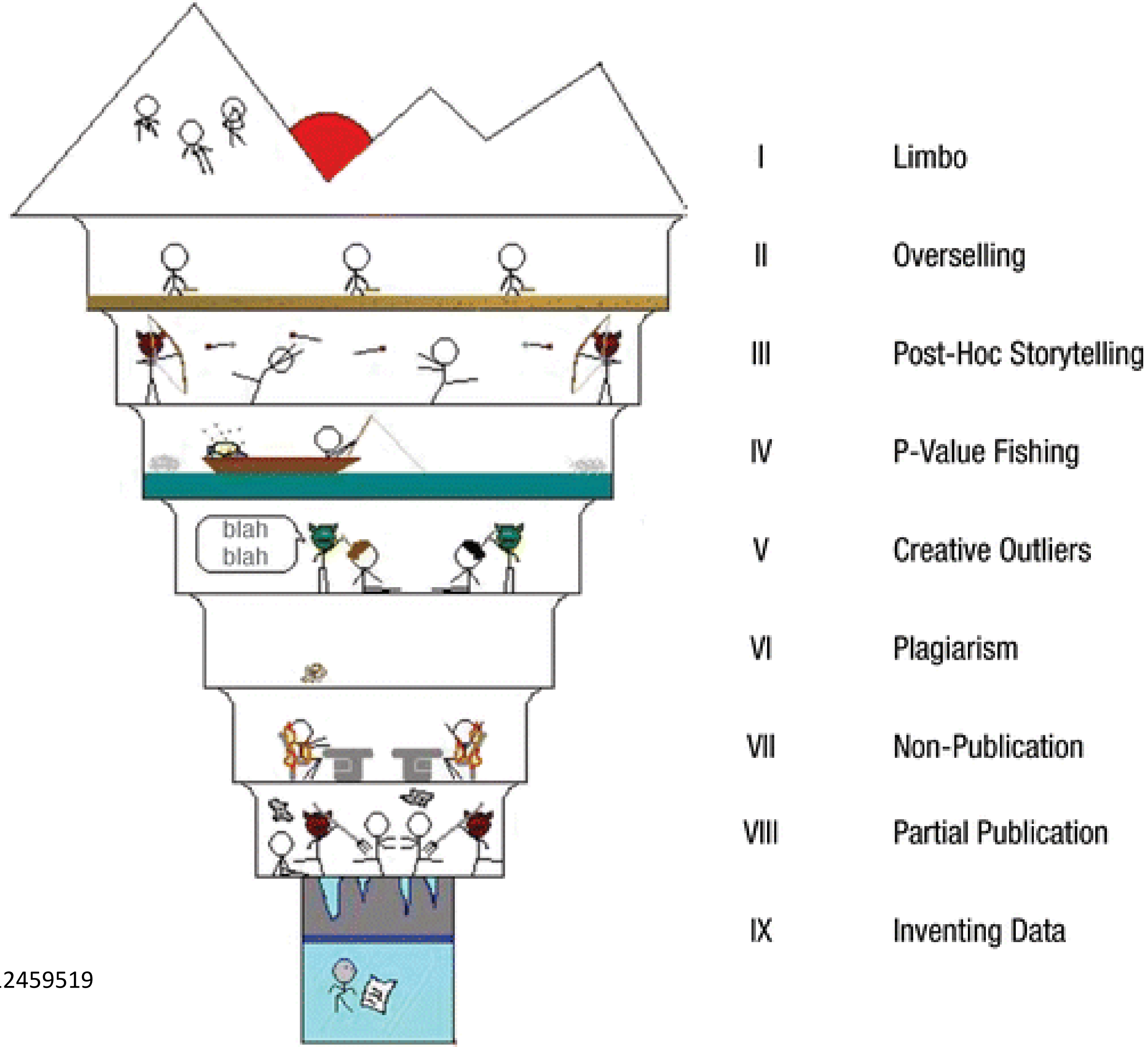
Issues

- Unconscious bias
  - Wishful thinking (e.g. data seems to suggest something…)
  - Embed observations into favorite theory
- Research / procedural bias
  - Design studies in favour of your theory
- Selection/sampling bias
  - Pick and chose data
- Measurement / interviewer / response / reporting bias…

More issues with traditional science…

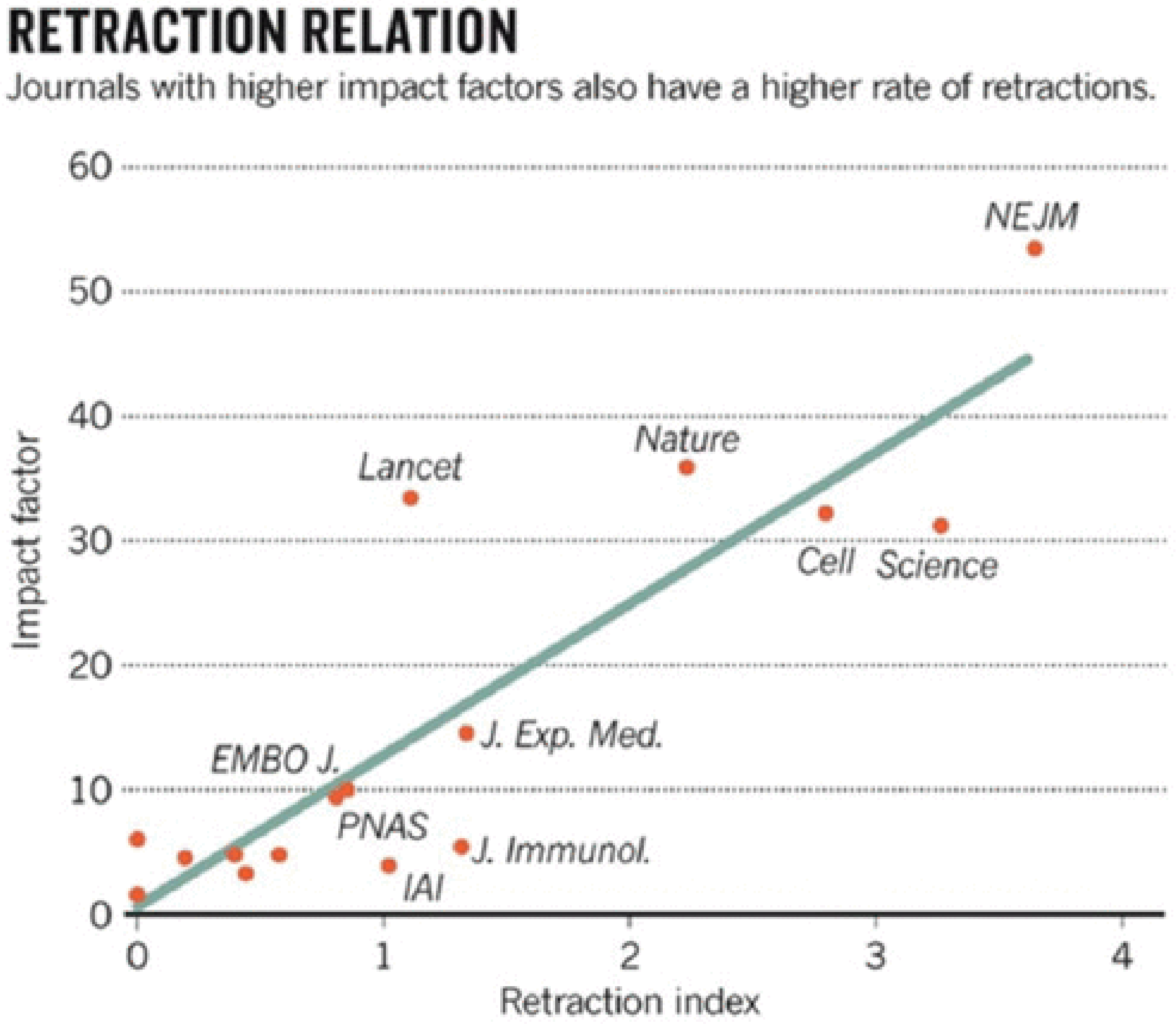
- Access to research results (paywall)
  - Public health, translation, industry…
- High cost of publishing (e.g. Nature Communication: US $5,700!)
- HARking
- Underused data = waste of resources
- No access to code = waste of time
- False sense of ownership
- Fear of being scooped
- Selfishness
- Broken peer review process
- Life is stressful (especially for young academics)

9 circles of scientific hell



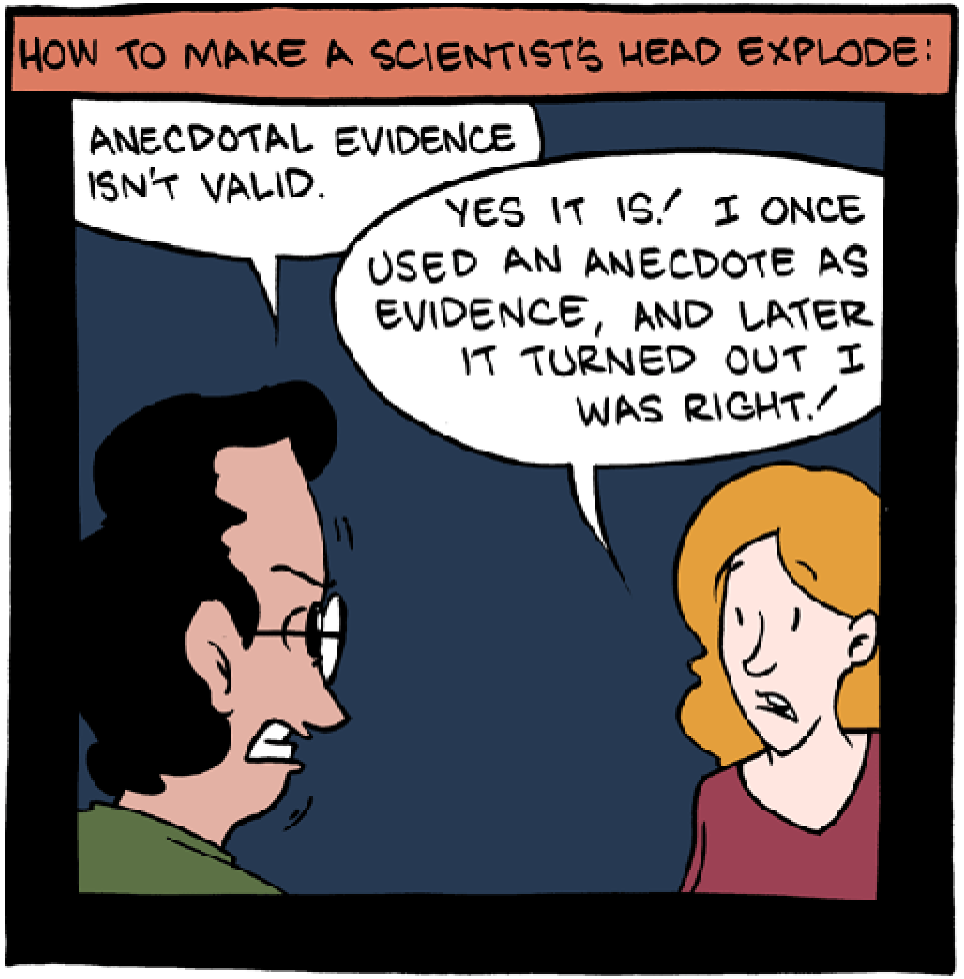
https://journals.sagepub.com/doi/10.1177/1745691612459519

IF perversity



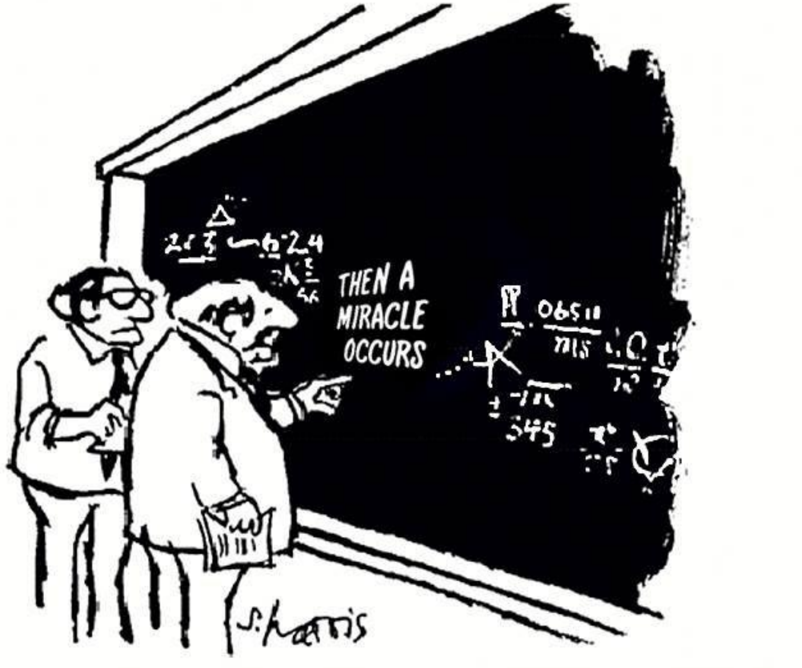
Fang FC, Casadevall A, Morrison R (2011) Retracted science and the retraction index. Infection and Immunity 79(10): 3855–3859.

Better scientific practices



Communication is key

- Be honest at all times
- Write project abstracts first
  - Bulletproof logic
  - Make sure everyone agrees on goals
  - Is this important enough?
- Talk about authorship (who is doing what)
- Be professional!
- Be respectful!
- Always keep your collaborators (and supervisors) updated



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

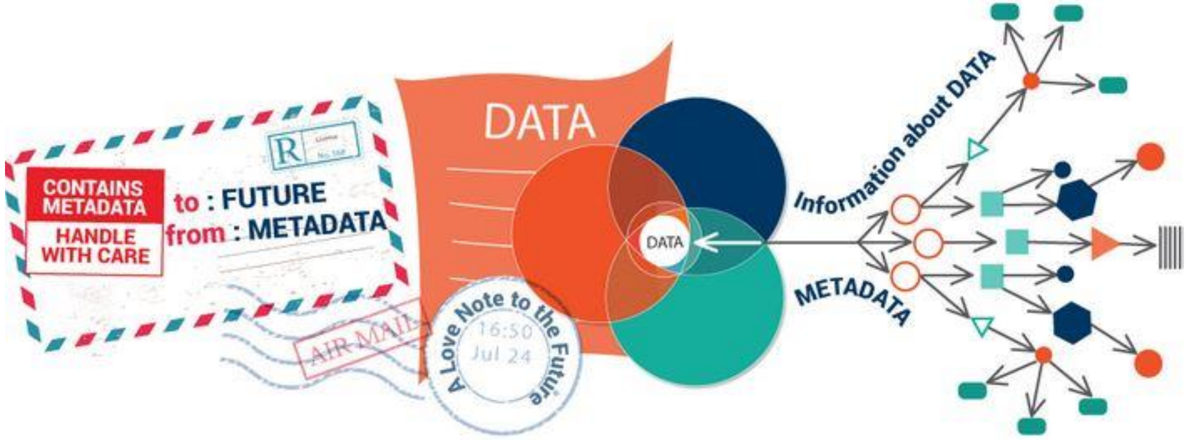
Learning attitudes

- Curiosity is key!
- There is no dumb question, only dumb answers!
- Teaching = learning!
- Dig deep to find answers…
- Question things – don't take anything for granted
- Read… LOTS!
- Leverage the power of people around you
- Allow yourself to get lost but know when to get back into focus…

Project organization

- Always back up all data!
- Inspect newly recorded data immediately
  - Quality control
  - Software / hardware problems…
- Keep detailed lab notes!!! (part of metadata)
- Create one folder for each project!
  - Sub-folders: raw data & metadata, analyzed data, software / code, experimental software, manuscripts
  - Organize your data → database? Metadata = data documentation
- Write clean analysis code & organize data well!
  - Publication ready…

Metadata



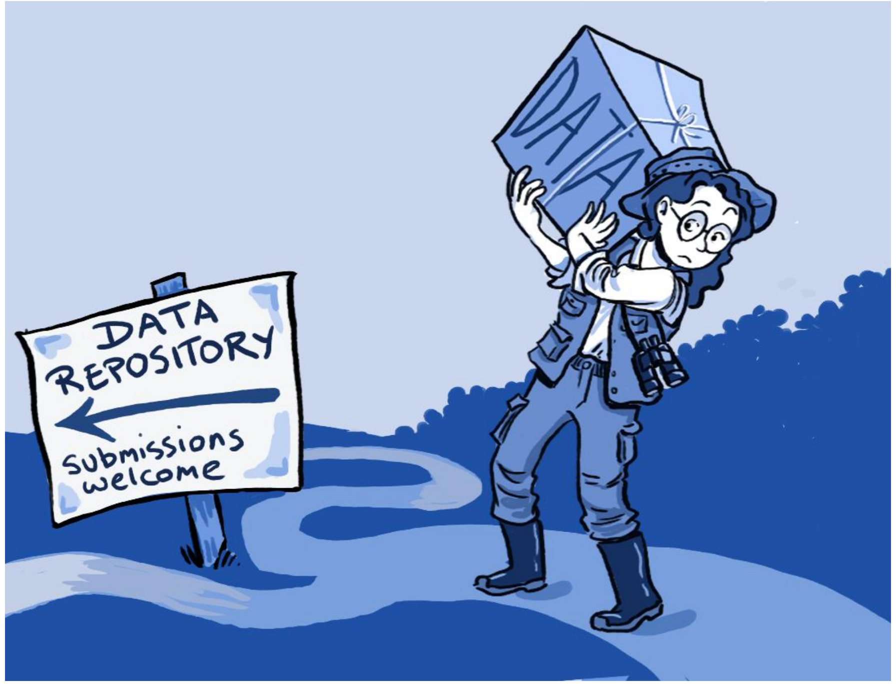
- General overview
  - Project title, creator address (email), identifier (e.g. DOI), date, method (equipment, software), processing (e.g. normalization), source (if not your data), funding
- Content description
  - Subject keywords, location (physical/virtual), languages used, variable list, code list & conventions (e.g. 9999 = missing data)
- Technical description
  - File inventory, file formats, file structure, version numbers, checksum, necessary software (e.g. visualization, analysis, etc)
- Access
  - Rights
  - Access information (e.g. repository IP)

Data security & storage

- Make sure you have appropriate data access rights!
- Keep confidential data off the internet!
- Make sure physical access to data is restricted
- Use secure computer systems and files
  - Up to date virus protection
  - Don’t send unencrypted data!
  - Set passwords on files and computers
  - Don’t get fooled by fishing emails (e.g. claiming to be from your IT dept.)
- Encrypt sensitive data!
- Back up your data daily!!!

Sharing and archiving

- Why share data?
  - Required by publisher
  - Required by funding agency
  - Allows answering new questions, transparency, increased usefulness
- Considerations
  - Use open file formats! (long-term viability of data)
  - Don’t forget documentation (metadata)
  - Ensure ownership and privacy rights
- Ways to share
  - Repository (preferred)
  - Journal web site
  - Personal web site…



Resources

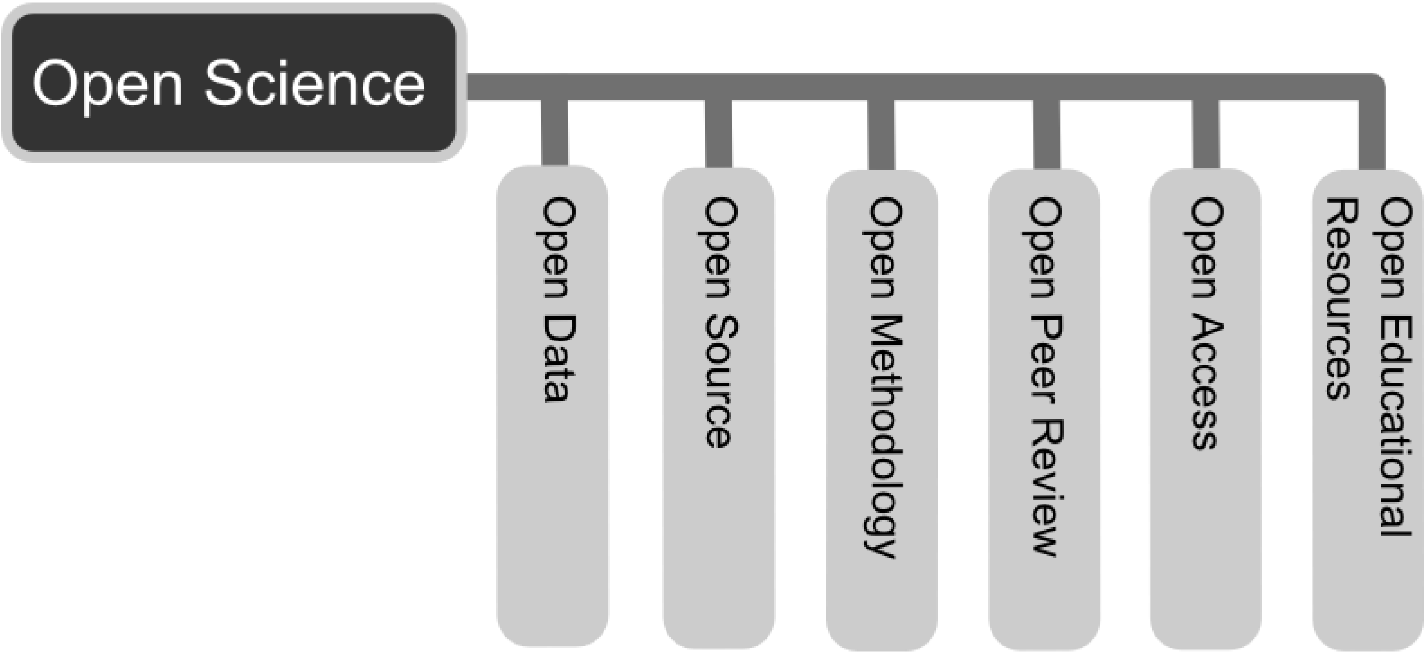
- Statistical tools
  - R project
  - JASP
  - Statcheck
- Text editors
  - TeXnicCenter
  - LyX
  - Atom
  - Spacemacs

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

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.”

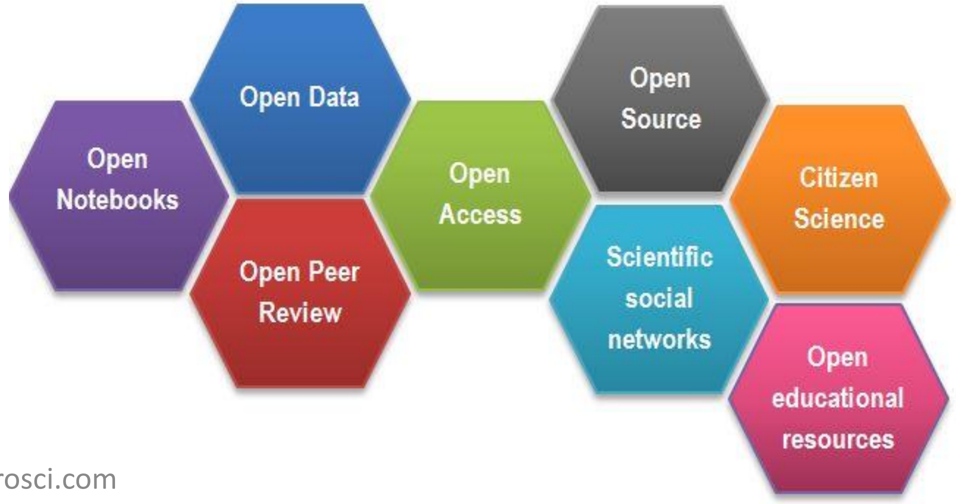


(https://open-science-training-handbook.gitbook.io/book/introduction)

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!

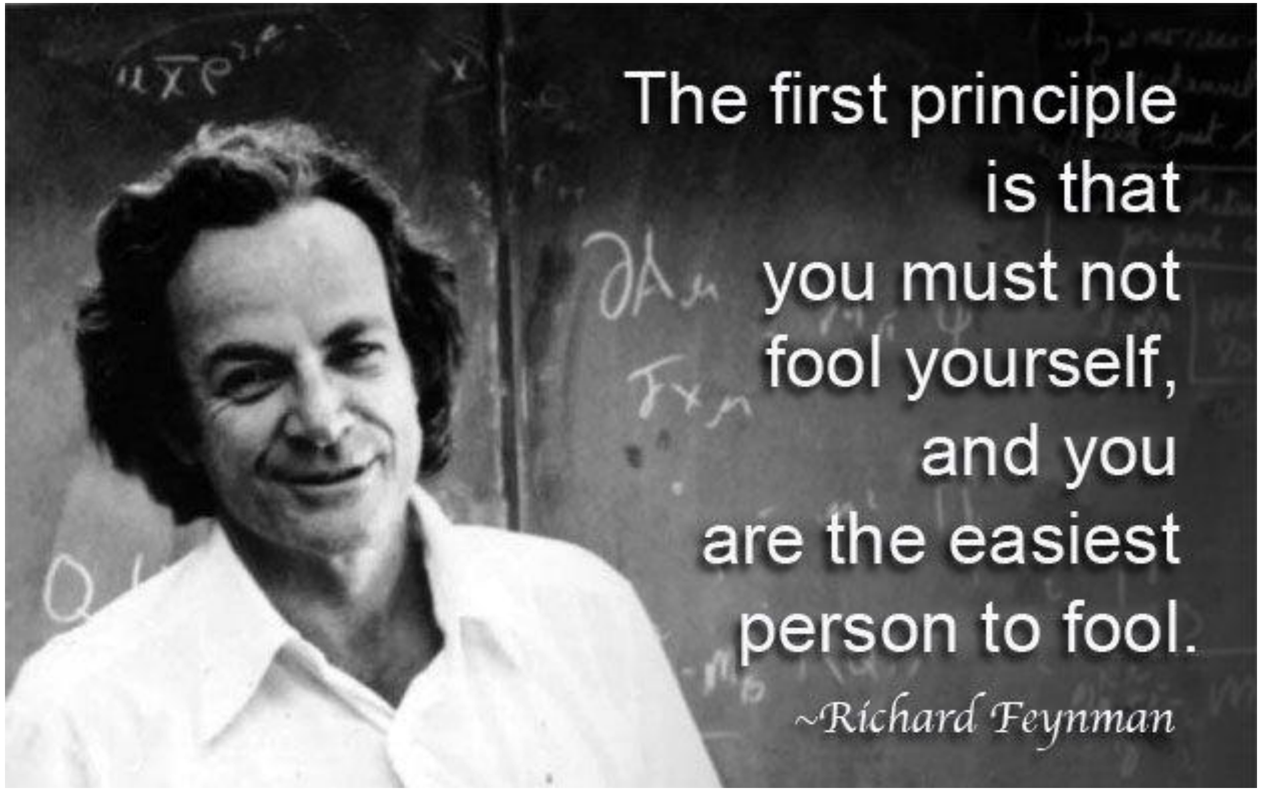
Benefits of Open Science

- 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!



Open Science enables breakthroughs!

www.nature.com/scientificreports

SCIENTIFIC REPORTS

RESEARCH ARTICLE

OPEN

Asymmet
for space
cells

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Bryan C. Souza & Adrian

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

hase-phase coupling
mma oscillations in

*
nde do Norte, Natal, Brazil

Hippocampal place cells co
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-

: 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
nay generate artifactual n:m phase-locking. Studies investigating phase-phase coupling

Other Open Science success stories

- Code: Python, 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

Benefits of Open Access for you and society

Source: Australian Open Access Support Group

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