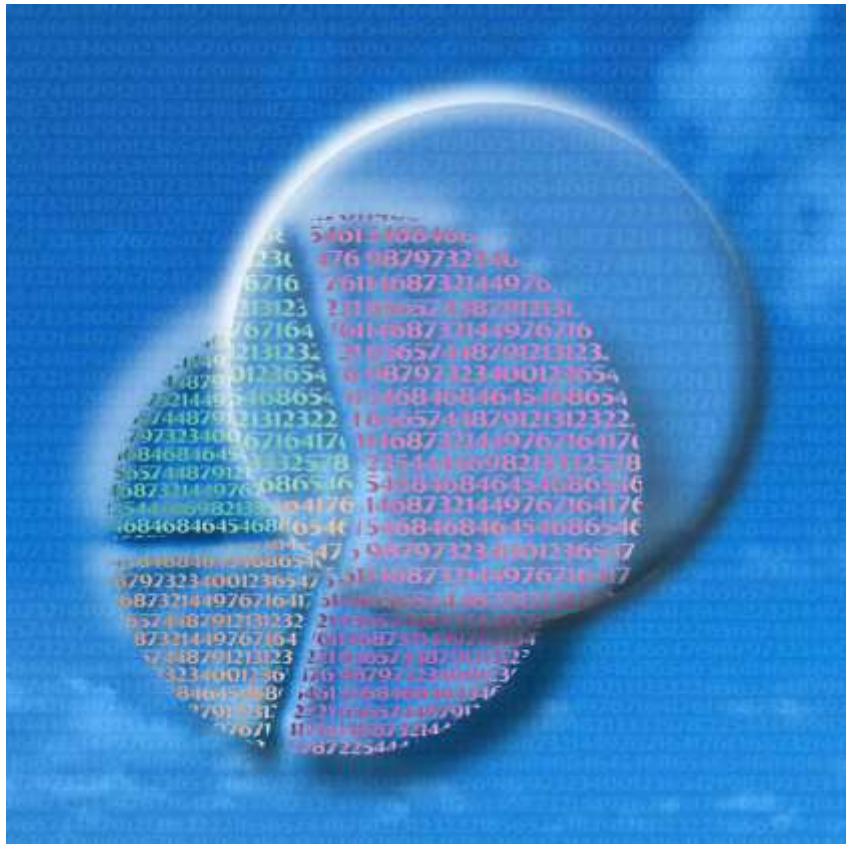


The case of the p-test and science reproducibility problems

Andrea Saltelli
Centre for the Study of the Sciences and the Humanities, University of Bergen, and Open Evidence Research, Open University of Catalonia

Course **Philosophy of Social Sciences**, Vatnahalsen, and Course **Theory of Science and Ethics**, Bergen, February 2019

Where to find this talk: www.andreasaltelli.eu

The topic

From the misuse of a statistical technique to a problem in reproducibility in science; from this to an overall crisis of scientific practice and ethos, the role of technology, the impact on society.

The P-test saga

ROYAL SOCIETY OPEN SCIENCE

rsos.royalsocietypublishing.org

Review

Cite this article: Colquhoun D. 2014 An investigation of the false discovery rate and the misinterpretation of *p*-values. *R. Soc. open sci.* **1**: 140216.
http://dx.doi.org/10.1098/rsos.140216

An investigation of the false discovery rate and the misinterpretation of *p*-values

David Colquhoun

Department of Neuroscience, Physiology and Pharmacology, University College London, Gower Street, London WC1 6BT, UK

P values by way of an example

- Two groups, one with a placebo, one with the treatment
- Random allocation to groups (+more!)
- The difference *d* between the means of the two groups is tested (is it different from zero?)
- *p=0.05* implies that if there were no effect the probability of observing a value equal to *d* or higher would be *5%*

“At first sight, it might be thought that this procedure would guarantee that you would make a fool of yourself only once in every 20 times that you do a test”

Colquhoun D. 2014 An investigation of the false discovery rate and the misinterpretation of p-values. R. Soc. Open sci. 1: 140216. http://dx.doi.org/10.1098/rsos.140216

"The classical p-value does exactly what it says. But it is a statement about what would happen if there were no true effect. That cannot tell you about your long-term probability of making a fool of yourself, simply because sometimes there really is an effect. In order to do the calculation, **we need to know a few more things**"

Colquhoun D. 2014 An investigation of the false discovery rate and the misinterpretation of p-values. R. Soc. Open sci. 1: 140216. http://dx.doi.org/10.1098/rsos.140216

A classic exercise in screening

You test positive for AIDS (one test only). Time for despair?

Only one 1 in 100,000 has AIDS in your population

The test has a 5% false positive rate

Already one can say: in a population of say 100,000 one will have AIDS and 5,000 (5% of 100,000) will test positive

➔ Don't despair (yet)

Another exercise in screening (Colquhoun 2014)

You test positive for mild cognitive impairment (MCI) (one test only). Time to retire?

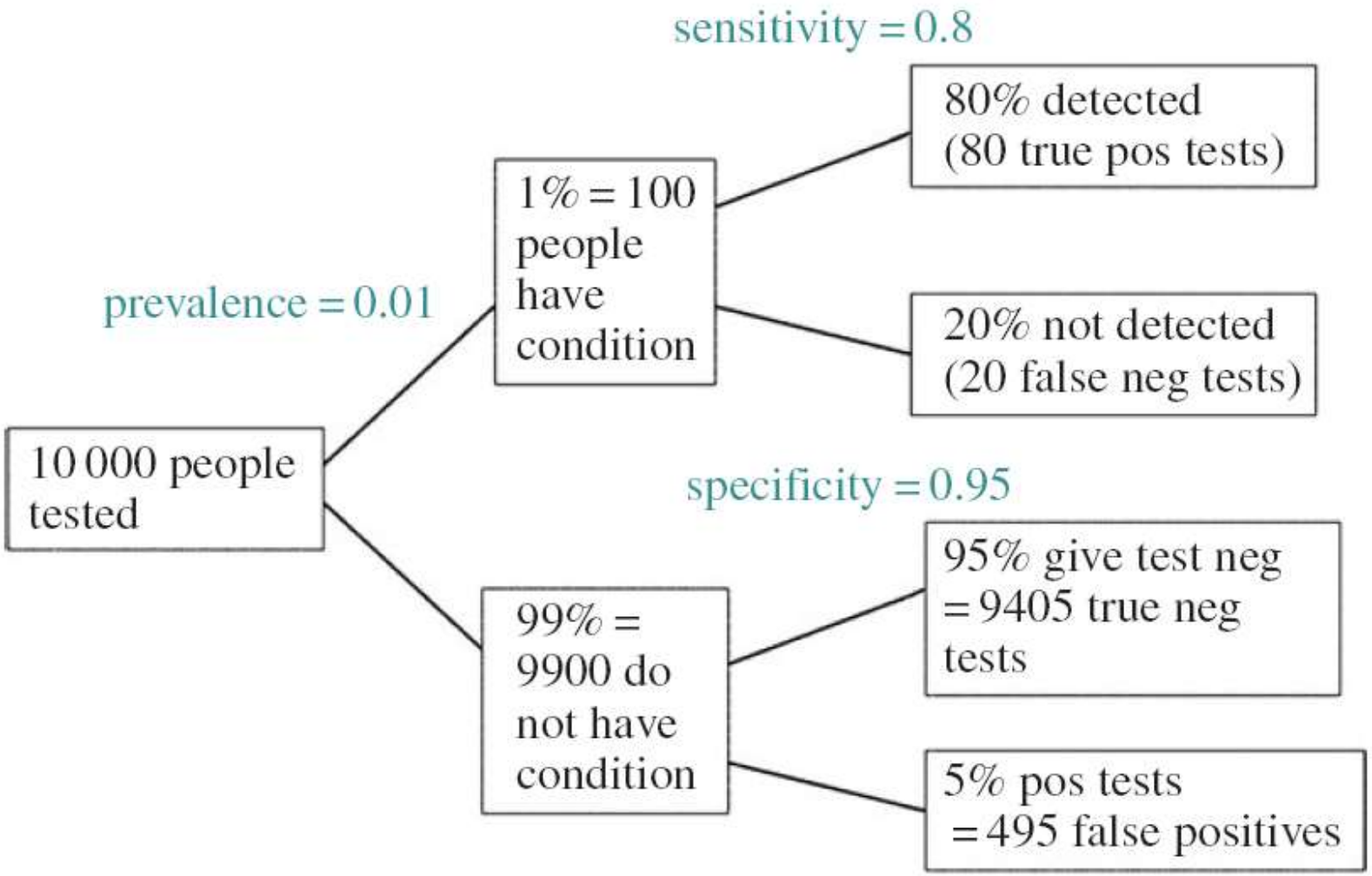
MCI prevalence in the population 1%, i.e. in a sample of 10,000 then 100 have MCI and 9,900 don't

The test has a 5% false positive rate; of the 9,900 who don't have MCI 495 test (false) positive and the remaining 9,405 (true) negative

The test does not pick all the 100 MCI but only 80; there will be 20 false negative. So we see 80+495=575 positive of which only 80 (a 14%) are true and the remaining 86% false

➔ It does not make sense to screen the population for MCI!

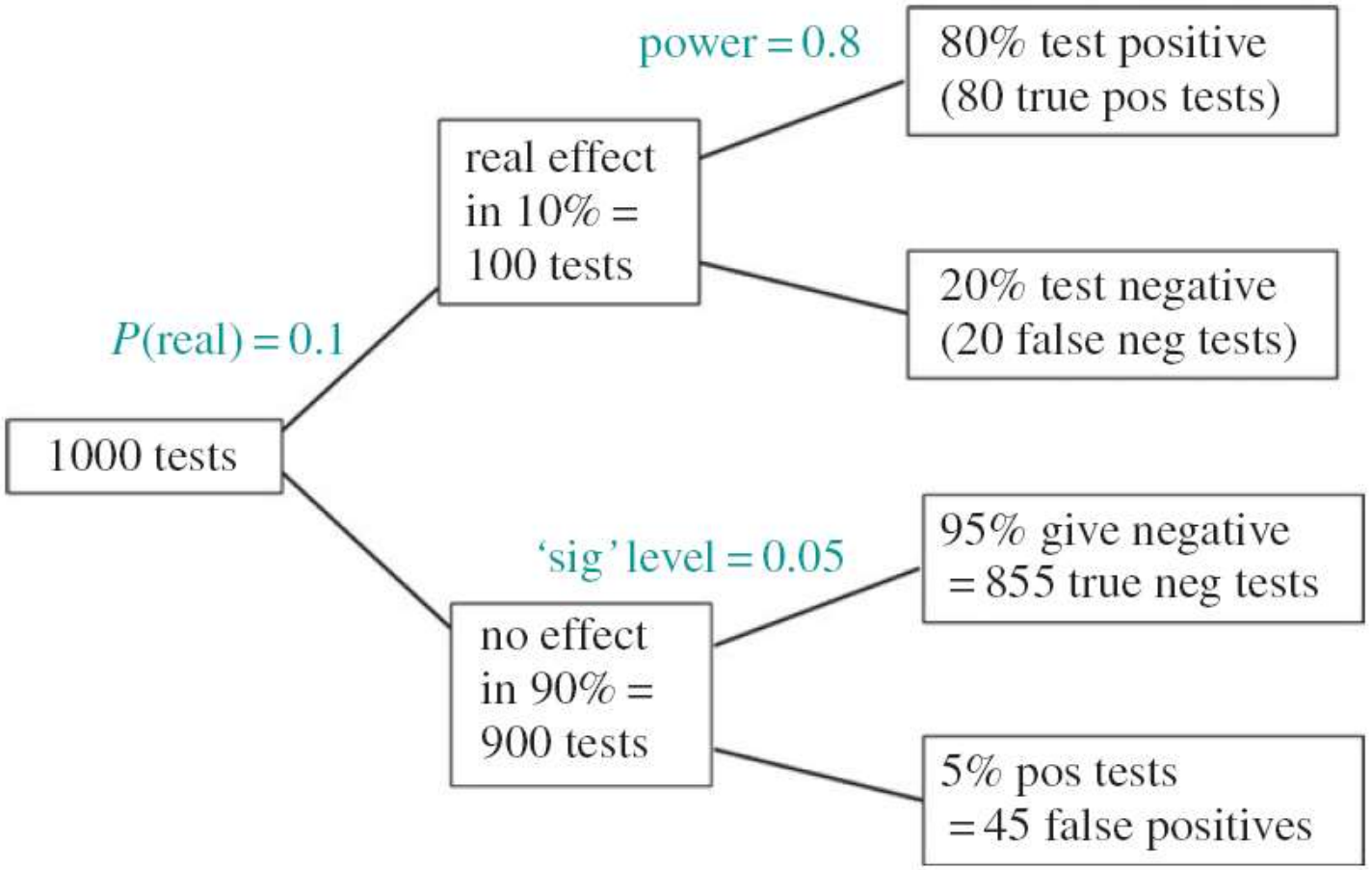
The number 86% = 495/(495+80) is our false discovery rate



Colquhoun D. 2014 An investigation of the false discovery rate and the misinterpretation of p-values. R. Soc. Open sci. 1: 140216. http://dx.doi.org/10.1098/rsos.140216

The same concept of false discovery rate applies to the problem of significance test

We now consider tests instead of individuals



Colquhoun D. 2014 An investigation of the false discovery rate and the misinterpretation of p-values. R. Soc. Open sci. 1: 140216. http://dx.doi.org/10.1098/rsos.140216

➔ We see 125 hypotheses as true 45 of which are not; the false discovery rate is 45/125 = 36%

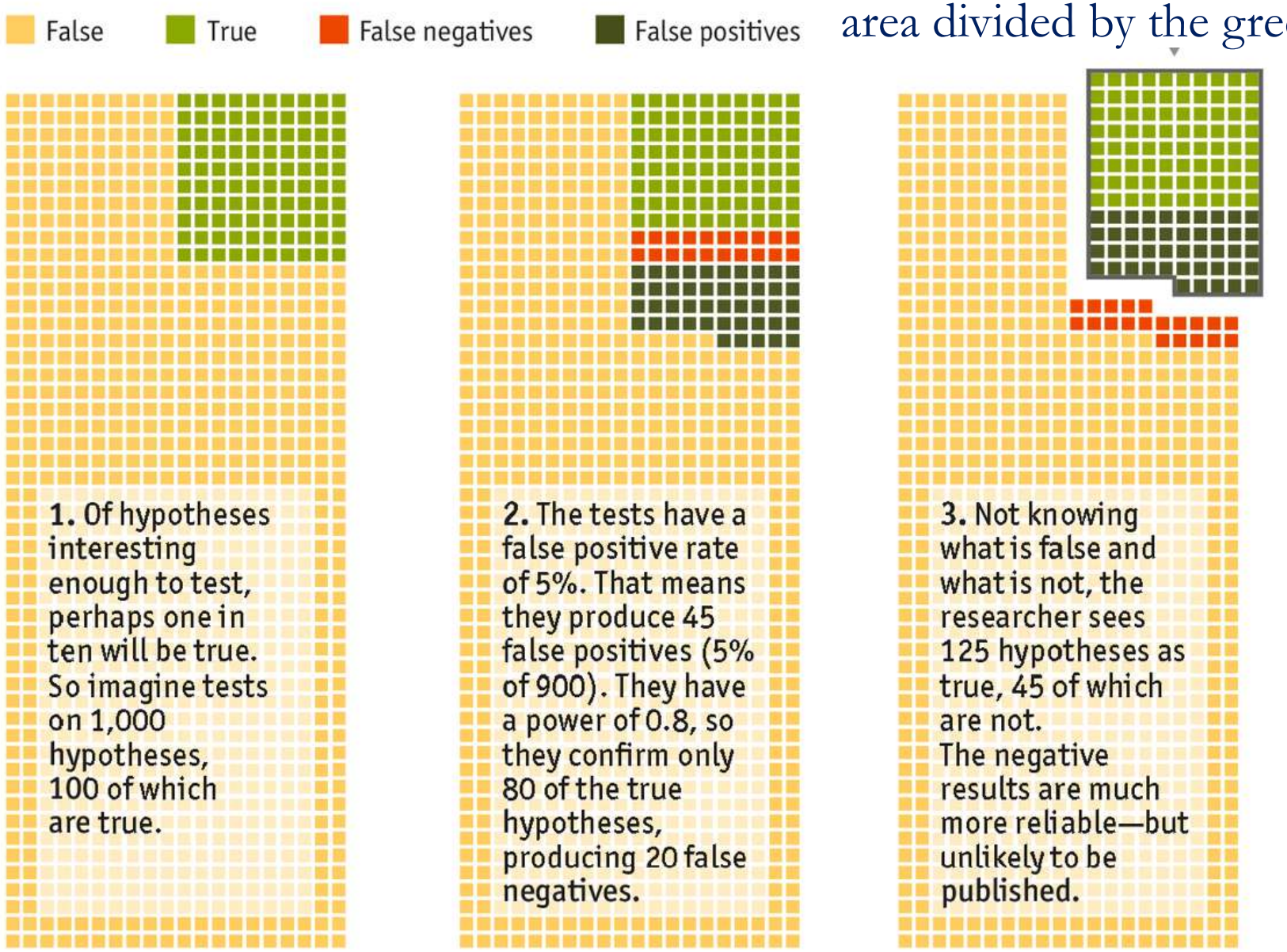
Significance p=0.05 ➔ false discovery rate of 36%

We now know that p=0.05 did not correspond to a chance in twenty of being wrong but in one in three

How many numbers did we need to know to reach this conclusion?

Unlikely results

How a small proportion of false positives can prove very misleading



Source: *The Economist*

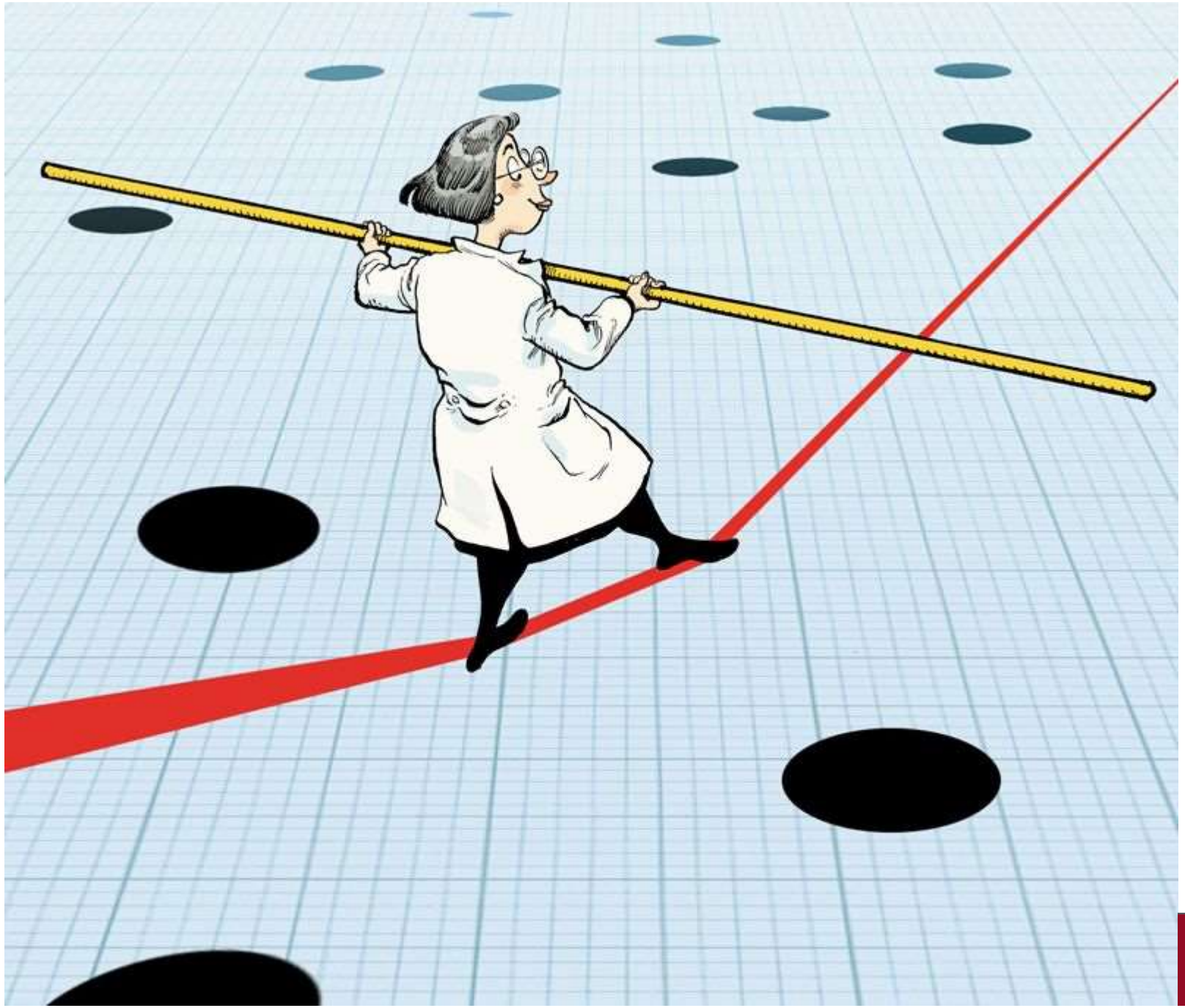
The false discovery rate is ~the dark area divided by the green+dark one

“20% of the faculty teaching statistics in psychology, 39% of the professors and lecturers, and 66% of the students” don’t understand what the P-test is about

Gigerenzer, G., 2018, Statistical Rituals: The Replication Delusion and How We Got There, Advances in Methods and Practices in Psychological Science, 1-21

Crisis in statistics?

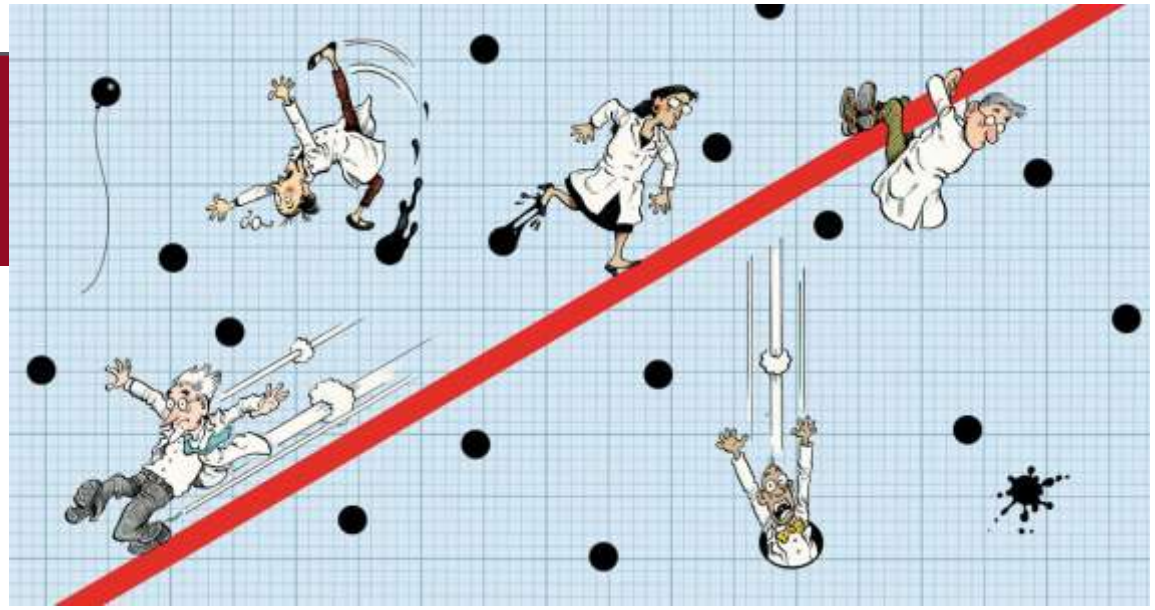
Statistics is experiencing a quality control crisis



Effect or no effect?

nature
International journal of science

nature
International journal of science



COMMENT · 28 NOVEMBER 2017

Five ways to fix statistics

As debate rumbles on about how and how much poor statistics is to blame for poor reproducibility, Nature asked influential statisticians to recommend one change to improve science. The common theme? The problem is not our maths, but ourselves.

Jeff Leek ✉, Blakeley B. McShane, Andrew Gelman ✉, David Colquhoun ✉, Michèle B. Nuijten ✉ & Steven N. Goodman ✉

CORRESPONDENCE · 16 JANUARY 2018

Fixing statistics is more than a technical issue

Andrea Saltelli & Philip Stark

https://www.nature.com/articles/d41586-018-00647-9

CORRESPONDENCE · 16 JANUARY 2018

Integrity must underpin quality of statistics

Jerome Ravetz

https://www.nature.com/articles/d41586-018-00648-8

The great paradox of science is that passionate practitioners must carefully produce dispassionate facts (J. Ravetz *Scientific Knowledge and its Social Problems* Oxford Univ. Press; 1971). Meticulous technical and normative judgement, as well as morals and morale, are necessary to navigate the forking paths of the statistical garden (Saltelli and Stark, 2018)

All users of statistical techniques, as well as those in other mathematical fields such as modelling and algorithms, need an effective societal commitment to the maintenance of quality and integrity in their work. If imposed alone, technical or administrative solutions will only breed manipulation and evasion (Ravetz, 2018)

Statistics reacts

The discipline of statistics has been going through a phase of critique and self-criticism, due to mounting evidence of poor statistical practice of which misuse and abuse of the P-test is the most visible sign

AMERICAN STATISTICAL ASSOCIATION RELEASES STATEMENT ON STATISTICAL SIGNIFICANCE AND *P*-VALUES

Provides Principles to Improve the Conduct and Interpretation of Quantitative Science

March 7, 2016

+ twenty 'dissenting' commentaries

Wasserstein, R.L. and Lazar, N.A., 2016. 'The ASA's statement on p-values: context, process, and purpose', The American Statistician, DOI:10.1080/00031305.2016.1154108.

See also Christie Aschwanden at http://fivethirtyeight.com/features/not-even-scientists-can-easily-explain-p-values/

P-hacking (fishing for favourable p-values) and **HARKing** (formulating the research **H**ypothesis **A**fter the **R**esults are **K**nown);
Desire to achieve a sought for – or simply publishable – result leads to fiddling with the data points, the modelling assumptions, or the research hypotheses themselves

Leamer, E. E. Tantalus on the Road to Asymptopia. J. Econ. Perspect. 24, 31–46 (2010).

Kerr, N. L. HARKing: Hypothesizing After the Results are Known. Personal. Soc. Psychol. Rev. 2, 196–217 (1998).

A. Gelman and E. Loken, "The garden of forking paths: Why multiple comparisons can be a problem, even when there is no 'fishing expedition' or 'p-hacking' and the research hypothesis was posited ahead of time," 2013.

IN PRACTICE

Cargo-cult statistics and scientific crisis

The mechanical, ritualistic application of statistics is contributing to a crisis in science. Education, software and peer review have encouraged poor practice – and it is time for statisticians to fight back. By **Philip B. Stark** and **Andrea Saltelli**

Crisis in science?

There have recently been alarms as to the scientific quality arrangement is several disciplines. The most visible symptom of this possible dysfunction is the so-called reproducibility crisis

On the radar: October 2013

The Economist

HOW SCIENCE GOES WRONG.

Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

2005

John P. A. Ioannides

J. P. A. Ioannidis, Why Most Published Research Findings Are False, PLoS Medicine, August 2005, 2(8), 696-701.

Failed replications, entire subfields going bad, fraudulent peer reviews, predatory publishers, perverse metrics, statistics on trial …

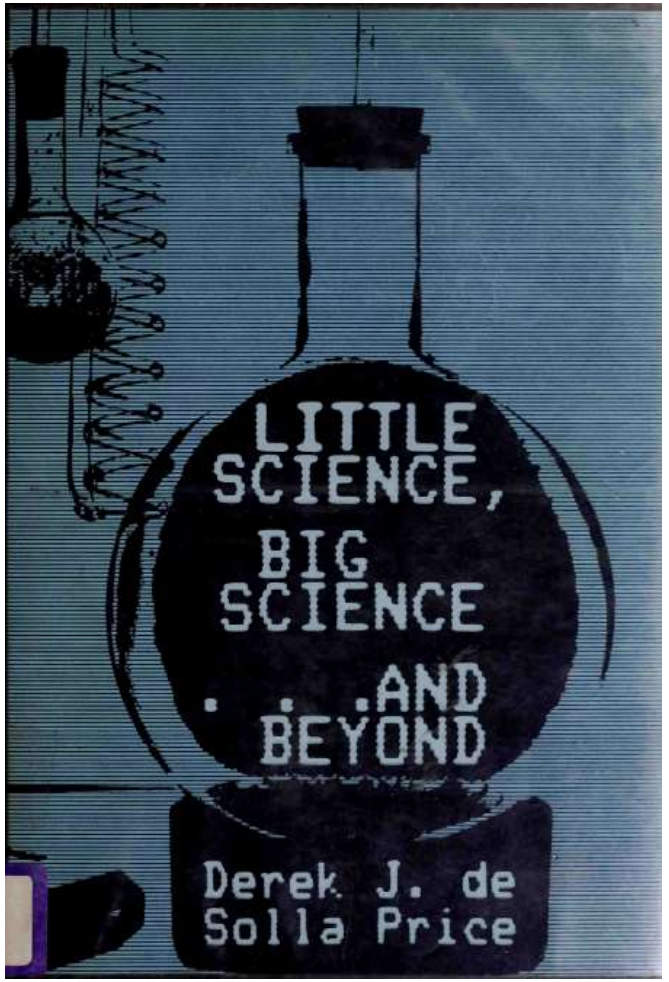
… misleading science advice, institutions on denial, a new breed of science wars

The crisis is methodological, epistemological, ethical and metaphysical

Scholars who saw it coming …

and how they were vindicated

In 1963 Derek J. de Solla Price prophesized that Science would reach saturation (and in the worst case senility) under its own weight, victim of its own success and exponential growth (pp 1-32)



Derek J. de Solla Price

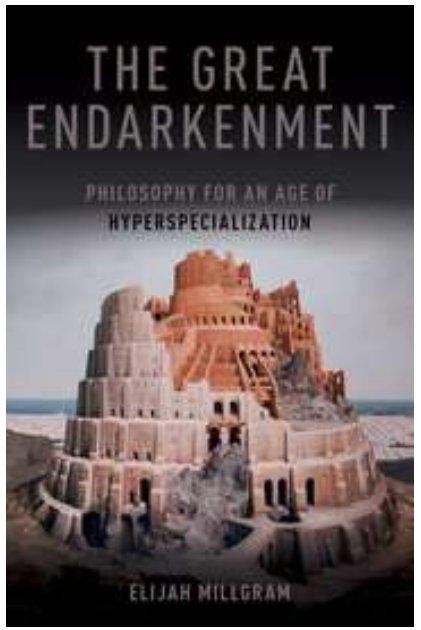
de Solla Price, D.J., 1963, Little science big science, Columbia University Press.

~2.2 million articles a year (2016) over ~30,000 journals

https://www.aje.com/en/arc/scholarly-publishing-trends-2016/

http://blogs.nature.com/news/2014/05/global-scientific-output-doubles-every-nine-years.html

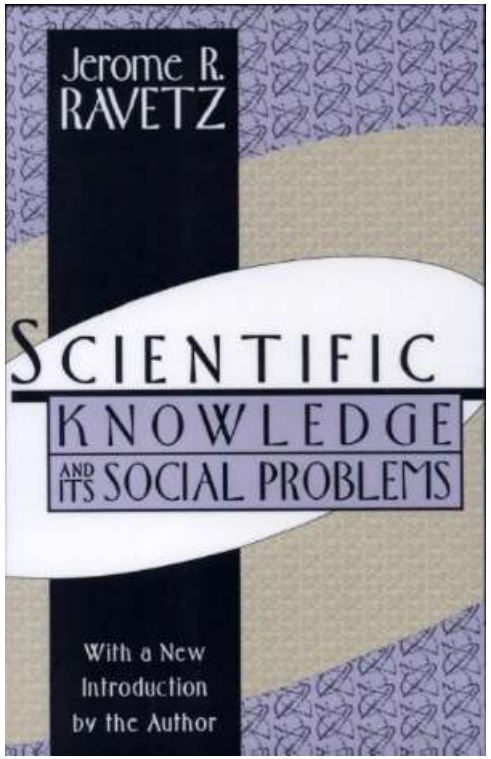
Derek de Solla Price ←→ Elijah Millgram



The Great Endarkenment.
Philosophy for an Age of Hyperspecialization
By Elijah Millgram

Describes a world in which all knowledge and products are the result of some form of extremely specialized expertise, and in which expertise is itself highly circumscribed, since experts depend in turn on other experts whose knowledge claims and styles of argumentation cannot be exported from one discipline to the next. ➔ “serial hyperspecializers” (p. 26)
Experts thus become “logical aliens” (p. 32)

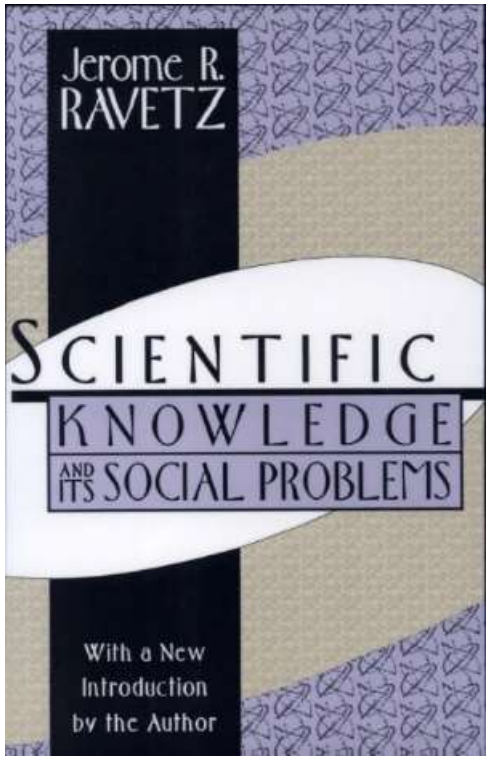
p.22: [...] The problem of quality control in science is at the centre of the social problems of the industrialized science of the present period."



Jerome R. Ravetz

Ravetz, J., **1971**, Scientific Knowledge and its Social Problems, Oxford University Press.

“If [science] fails to resolve this problem [⋯] then the immediate consequences for morale and recruitment will be serious; and those for the survival of science itself, grave”



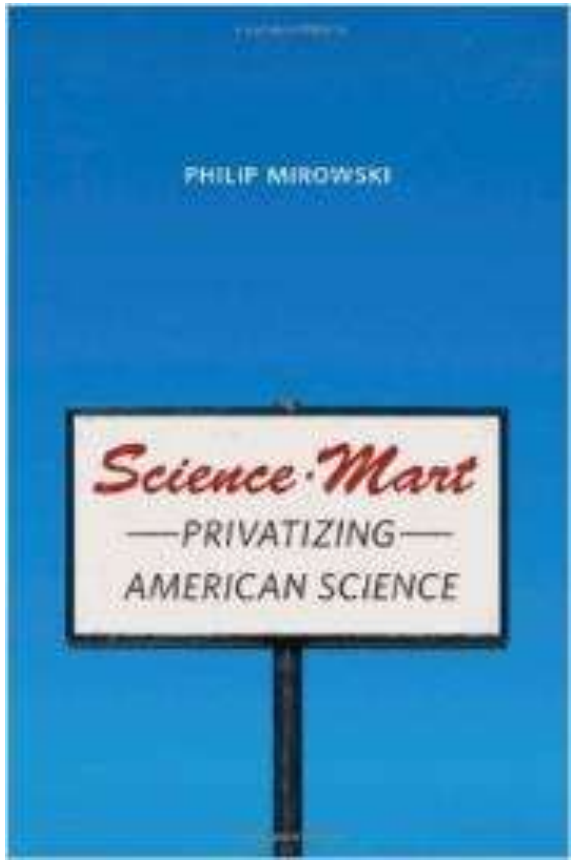
Jerome R. Ravetz

Ravetz, J., **1971**, Scientific Knowledge and its Social Problems, Oxford University Press.

… neoliberal ideologies lead to decreasing state funding of science, which becomes privatized … knowledge as a monetized commodity replaces knowledge as a public good ➔ collapse of quality

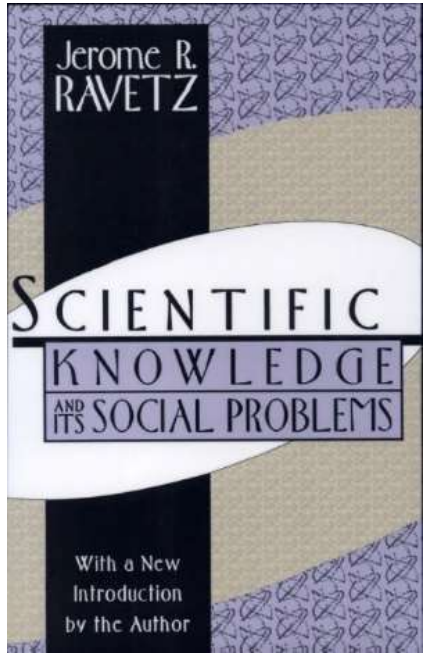
Philip Mirowski

Mirowski, P. 2011. Science-Mart: Privatizing American Science, Harvard University Press.



p. 179. For it is possible for a field to be diseased [...] reforming a diseased field is a task of great delicacy [...] not even an apparatus of institutional structures can do anything to maintain or restore the health of a field **in the absence of an essential ethical element operating through the interpersonal channel of communication.**

Ravetz, J., 1971, Scientific Knowledge and its Social Problems, Oxford University Press.



Jerome R. Ravetz

PLOS | MEDICINE

Brow

THE ECONOMIC JOURNAL

The Economic Journal, **127** (*October*), F236–F265. Doi: 10.1111/ecoj.12461 © 2017 Royal Economic Society. Published by John Wiley & Sons, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

OPEN ACCESS

ESSAY

June 21, 2017

Why Most Clinical Research Is Not Useful

John P. A. Ioannidis

Published: June 21, 2016 • https://doi.org/10.1371/journal.pmed.1002049

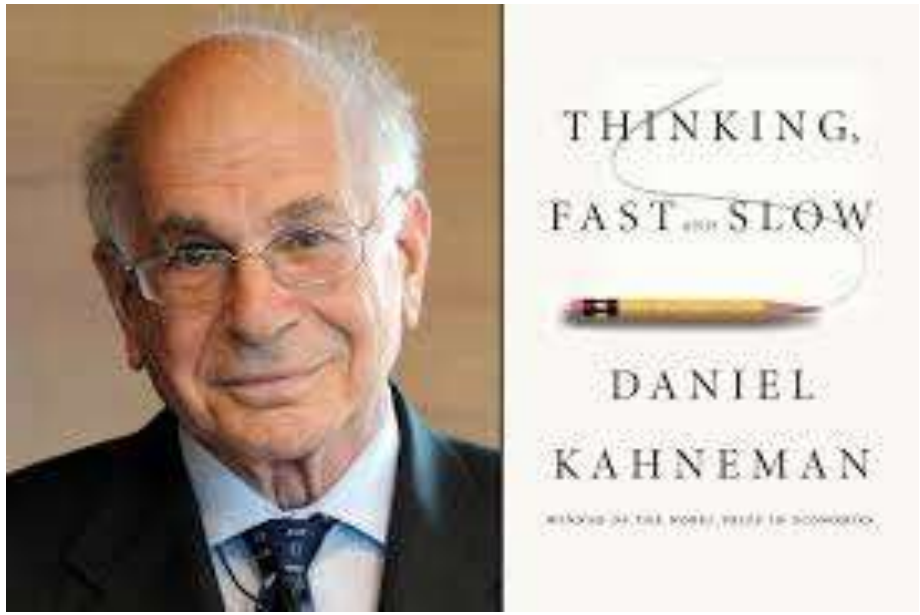
THE POWER OF BIAS IN ECONOMICS RESEARCH*

John P. A. Ioannidis, T. D. Stanley and Hristos Doucouliagos

October 27, 2017

Rather than isolated instances of corruption now entire fields of research are found diseased

Reconstruction of a Train Wreck: How Priming Research Went off the Rails



"[…]questions have been raised about the robustness of priming results … your field is now the poster child for doubts about the integrity of psychological research…"

https://replicationindex.wordpress.com/2017/02/02/reconstruction-of-a-train-wreck-how-priming-research-went-of-the-rails/comment-page-1/

An existential crisis?

Most observers have noted that the crisis has technical as well as ethical and behavioural elements which interact with one another – e.g. the 'publish or perish' obsession has an impact on selection bias – the tendency to favour positive over negative results

Bad science reproduces better than the good sort

ROYAL SOCIETY OPEN SCIENCE

rsos.royalsocietypublishing.org

Research

Cite this article: Smaldino PE, McElreath R. 2016 The natural selection of bad science. *R. Soc. open sci.* **3**: 160384.
http://dx.doi.org/10.1098/rsos.160384

Received: 1 June 2016
Accepted: 17 August 2016

The natural selection of bad science

Paul E. Smaldino[1] and Richard McElreath[2]

[1]Cognitive and Information Sciences, University of California, Merced, CA 95343, USA
[2]Department of Human Behavior, Ecology, and Culture, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

PES, 0000-0002-7133-5620; RME, 0000-0002-0387-5377

Poor research design and data analysis encourage false-positive findings. Such poor methods persist despite perennial calls for improvement, suggesting that they result from something more than just misunderstanding. The persistence of poor methods results partly from incentives that favour them, leading to the natural selection of bad science. This dynamic requires no conscious strategizing—no deliberate cheating nor loafing—by scientists, only that publication is a principal factor for

As in the real world, successful labs produce more 'progeny,' such that their methods are more often copied and their students are more likely to start labs of their own. Selection for high output leads to poorer methods and increasingly high false discovery rates. Improving the quality of research requires change at the institutional level.

Smaldino PE, McElreath R., 2016 The natural selection of bad science. R. Soc. open sci. 3: 160384. http://dx.doi.org/10.1098/rsos.160384

Bad science is ‘sticky’

ECOSPHERE
AN ESA OPEN ACCESS JOURNAL

Article | Open Access

Do rebuttals affect future science?

Jeannette A. Banobi, Trevor A. Branch, Ray Hilborn

First published: 30 March 2011 | https://doi.org/10.1890/ES10-00142.1 | Cited by: 13

"We examined seven high-profile original articles and their rebuttals, finding that original articles were cited 17 times more than rebuttals, and that annual citation numbers were unaffected by rebuttals"

For Gigerenzer & Marewski statistics has changed the nature all disciplines …

… Creating a persistent surrogate science based on worshipping P-values

Better to have no beliefs than to embrace falsehoods… (➔ F. Bacon's idols)

G. Gigerenzer and J. N. Marewski, "Surrogate Science," J. Manage., vol. 41, no. 2, pp. 421–440, Feb. 2015.

MBI: Magnitude-based inference: persistent bad stats in sports research

MBI false positive rate two to six time higher than in NHST (Null hypothesis significance testing)

Christie Aschwanden and Mai Nguyen, How Shoddy Statistics Found A Home In Sports Research, Fivethirtyeight, May 16, 2018, https://fivethirtyeight.com/features/how-shoddy-statistics-found-a-home-in-sports-research/

K. L. Sainani, The Problem with 'Magnitude-Based Inference,' Medicine & Science in Sports & Exercise (MSSE), p. 1, Apr. 2018.

Bad science in bad journals?

The 1st most cited journal in Psychology

frontiers in Human Neuroscience

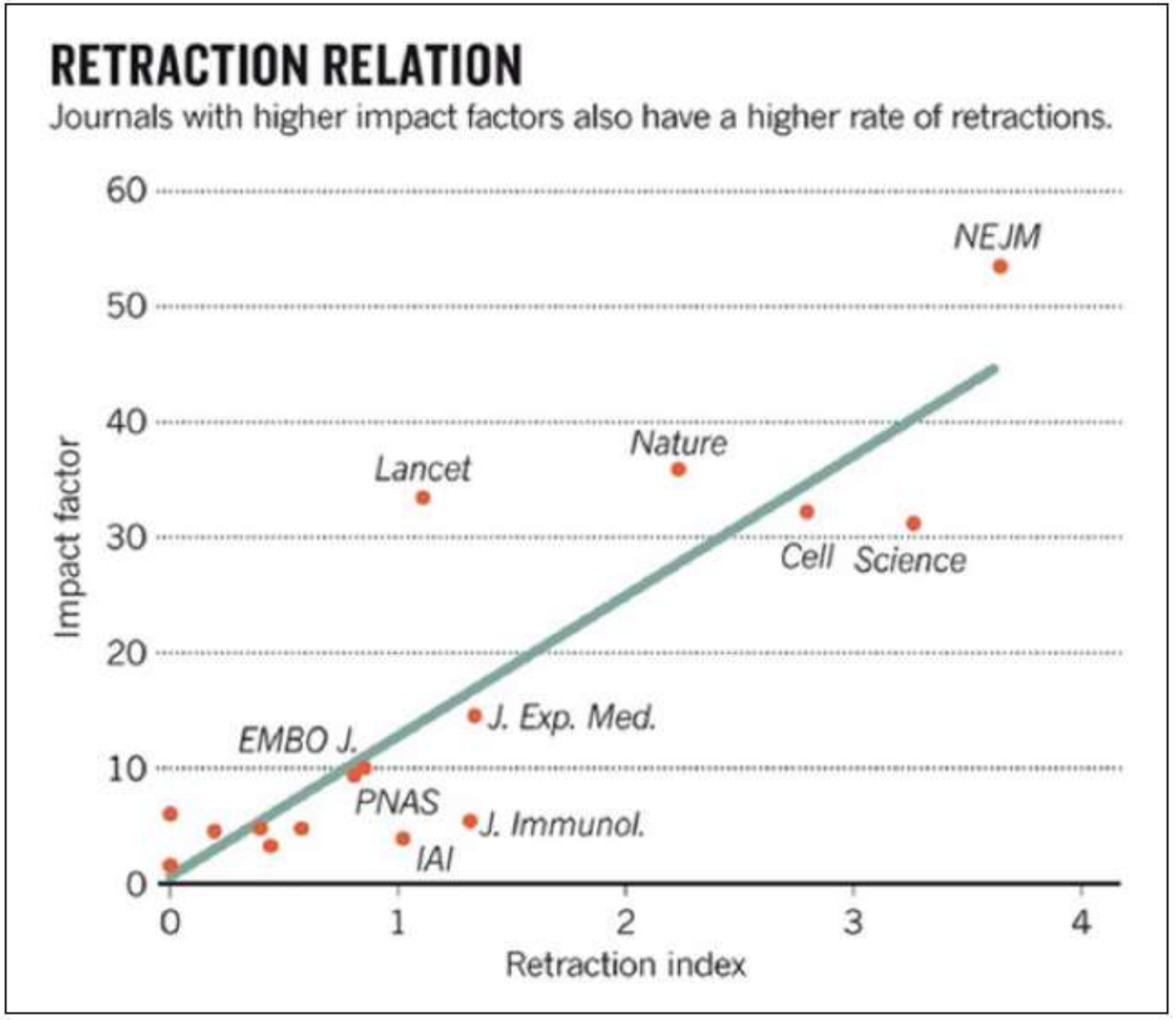
Prestigious Science Journals Struggle to Reach Even Average Reliability

"…an accumulating body of evidence suggests that methodological quality & reliability of published research works in several fields may be decreasing with increasing journal rank" (20 February, 2018)

Cutting corners effect?

Björn Brembs*

Institute of Zoology—Neurogenetics, Universität Regensburg, Regensburg, Germany



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

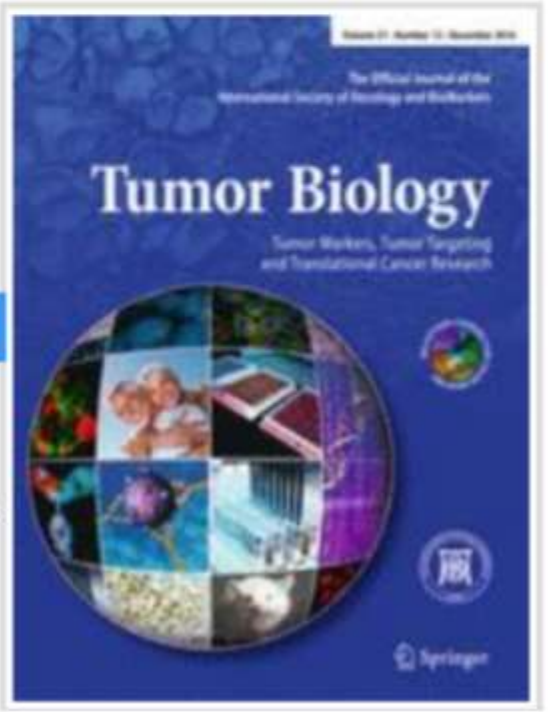
Retraction Watch April 20, 2017 Tracking retractions as a

A new record: Major publisher retracting more than 100 studies from cancer journal over fake peer reviews

with 11 comments

Springer is retracting 107 papers from one journal after discovering they had been accepted with fake peer reviews. Yes, 107.

To submit a fake review, someone (often the author of a paper) either makes up an outside expert to review the paper, or suggests a real researcher — and in both cases, provides a fake email address that comes back to someone who will invariably give the paper a glowing review. In this case, Springer, the publisher of *Tumor Biology* through 2016, told us that an investigation produced "clear evidence" the reviews were submitted under the names of real researchers with faked emails. Some of the authors may have used a third-party editing service, which may have supplied the reviews. The journal is now published by SAGE.



Unintended effects of reforms

Good intentions going bad

TABLE 1. GROWING PERVERSE INCENTIVES IN ACADEMIA

Incentive	*Intended effect*	*Actual effect*
"Researchers rewarded for increased number of publications."	"Improve research productivity," provide a means of evaluating performance.	"Avalanche of" substandard, "incremental papers"; poor methods and increase in false discovery rates leading to a "natural selection of bad science" (Smaldino and Mcelreath, 2016); reduced quality of peer review
"Researchers rewarded for increased number of citations."	Reward quality work that influences others.	Extended reference lists to inflate citations; reviewers request citation of their work through peer review
"Researchers rewarded for increased grant funding."	"Ensure that research programs are funded, promote growth, generate overhead."	Increased time writing proposals and less time gathering and thinking about data. Overselling positive results and downplay of negative results.
Increase PhD student productivity	Higher school ranking and more prestige of program.	Lower standards and create oversupply of PhDs. Postdocs often required for entry-level academic positions, and PhDs hired for work MS students used to do.
Reduced teaching load for research-active faculty	Necessary to pursue additional competitive grants.	Increased demand for untenured, adjunct faculty to teach classes.
"Teachers rewarded for increased student evaluation scores."	"Improved accountability; ensure customer satisfaction."	Reduced course work, grade inflation.
"Teachers rewarded for increased student test scores."	"Improve teacher effectiveness."	"Teaching to the tests; emphasis on short-term learning."
"Departments rewarded for increasing U.S. News ranking."	"Stronger departments."	Extensive efforts to reverse engineer, game, and cheat rankings.
"Departments rewarded for increasing numbers of BS, MS, and PhD degrees granted."	"Promote efficiency; stop students from being trapped in degree programs; impress the state legislature."	"Class sizes increase; entrance requirements" decrease; reduce graduation requirements.
"Departments rewarded for increasing student credit/contact hours (SCH)."	"The university's teaching mission is fulfilled."	"SCH-maximization games are played": duplication of classes, competition for service courses.

Modified from Regehr (pers. comm., 2015) with permission.

Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hyper-competition, Marc A. Edwards and Siddhartha Roy, ENVIRONMENTAL ENGINEERING SCIENCE, 34(1), 2017

Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hyper-competition, Marc A. Edwards and Siddhartha Roy, ENVIRONMENTAL ENGINEERING SCIENCE, 34(1), 2017

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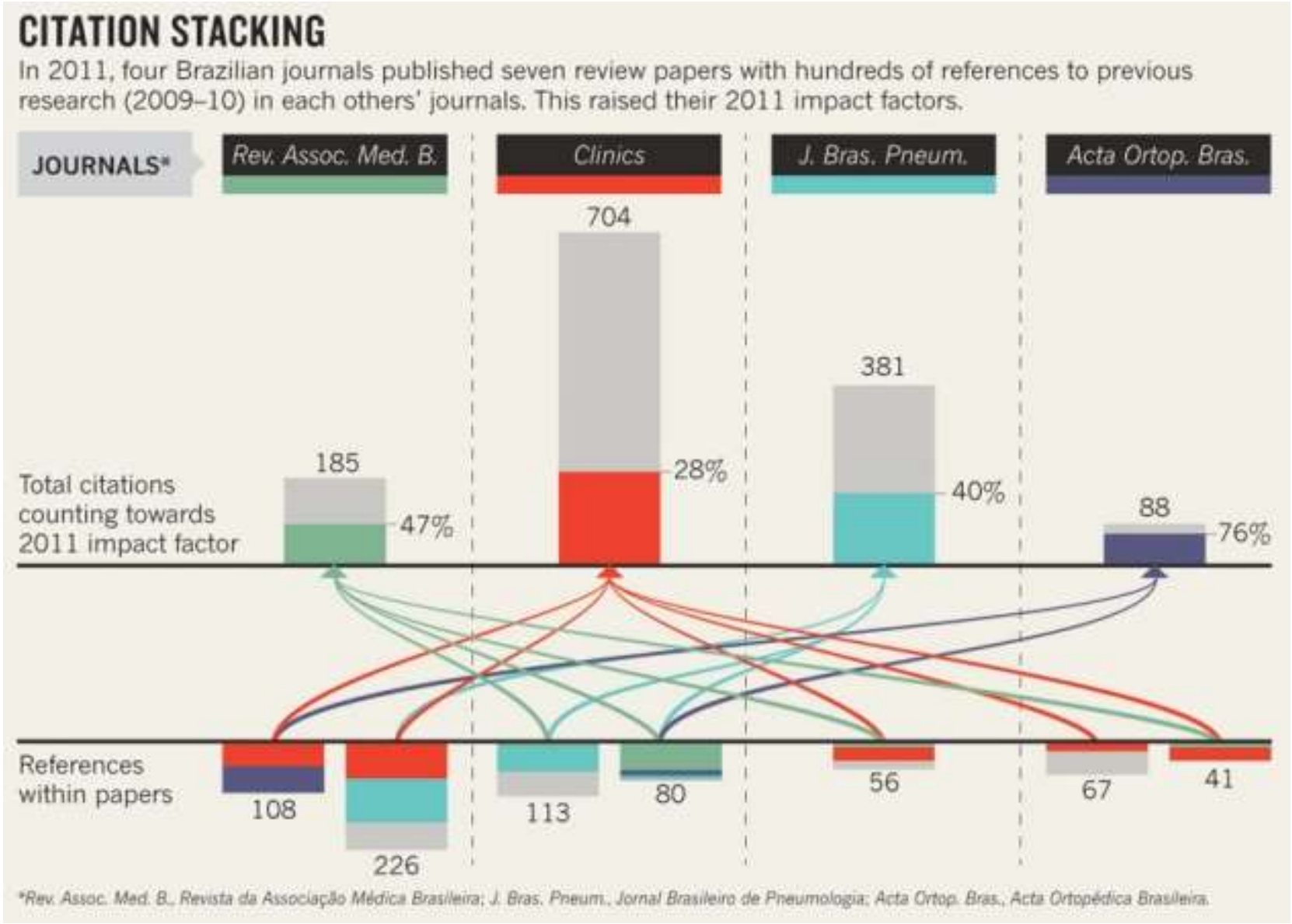
"Researchers rewarded for increased number of publications."	"Improve research productivity," provide a means of evaluating performance.	"Avalanche of" substandard, "incremental papers"; poor methods and increase in false discovery rates leading to a "natural selection of bad science" (Smaldino and Mcelreath, 2016); reduced quality of peer review

See also P. Mirowski, "The future(s) of open science," Soc. Stud. Sci., vol. 48, no. 2, pp. 171–203, Apr. 2018.

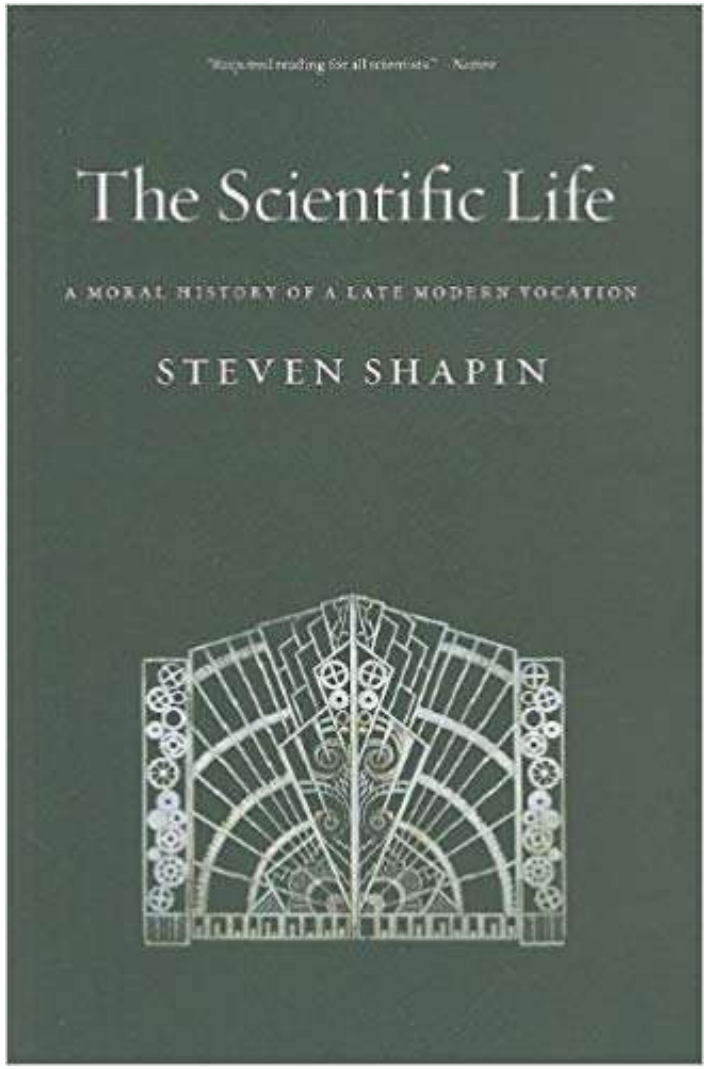
Gaming the system

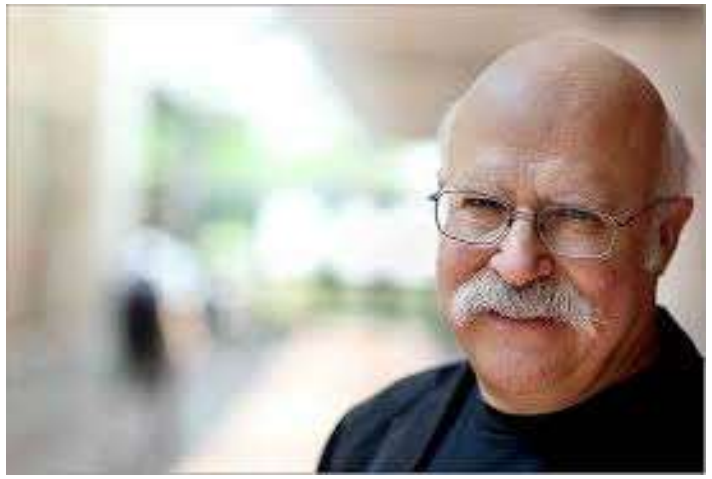
Use and abuse of metrics: from self-citation to citation cartels to citation stacking



Richard Van Noorden, 2017, Brazilian citation scheme outed. Thomson Reuters suspends journals from its rankings for 'citation stacking'. Nature, 27 August 2013

Lost ethos?





Steven Shapin

Is scientists' civility to each other what holds the venture together?

But someone disagrees: J.R. Ravetz, Morals and manners in modern science, Nature, 457(5), 662-663.

Renewable sources 100% of energy in US by 2050, says Jacobson…

…and sues for $10-million a dissenter

Los Angeles Times

A Stanford professor drops his ridiculous defamation lawsuit against his scientific critics

http://www.latimes.com/business/hiltzik/la-fi-hiltzik-jacobson-lawsuit-20180223-story.html

Climate change scepticism

World court should rule on climate science to quash sceptics, says Philippe Sands

International Court of Justice ruling would settle the scientific dispute and pave the way for future legal cases on climate change, says high-profile lawyer

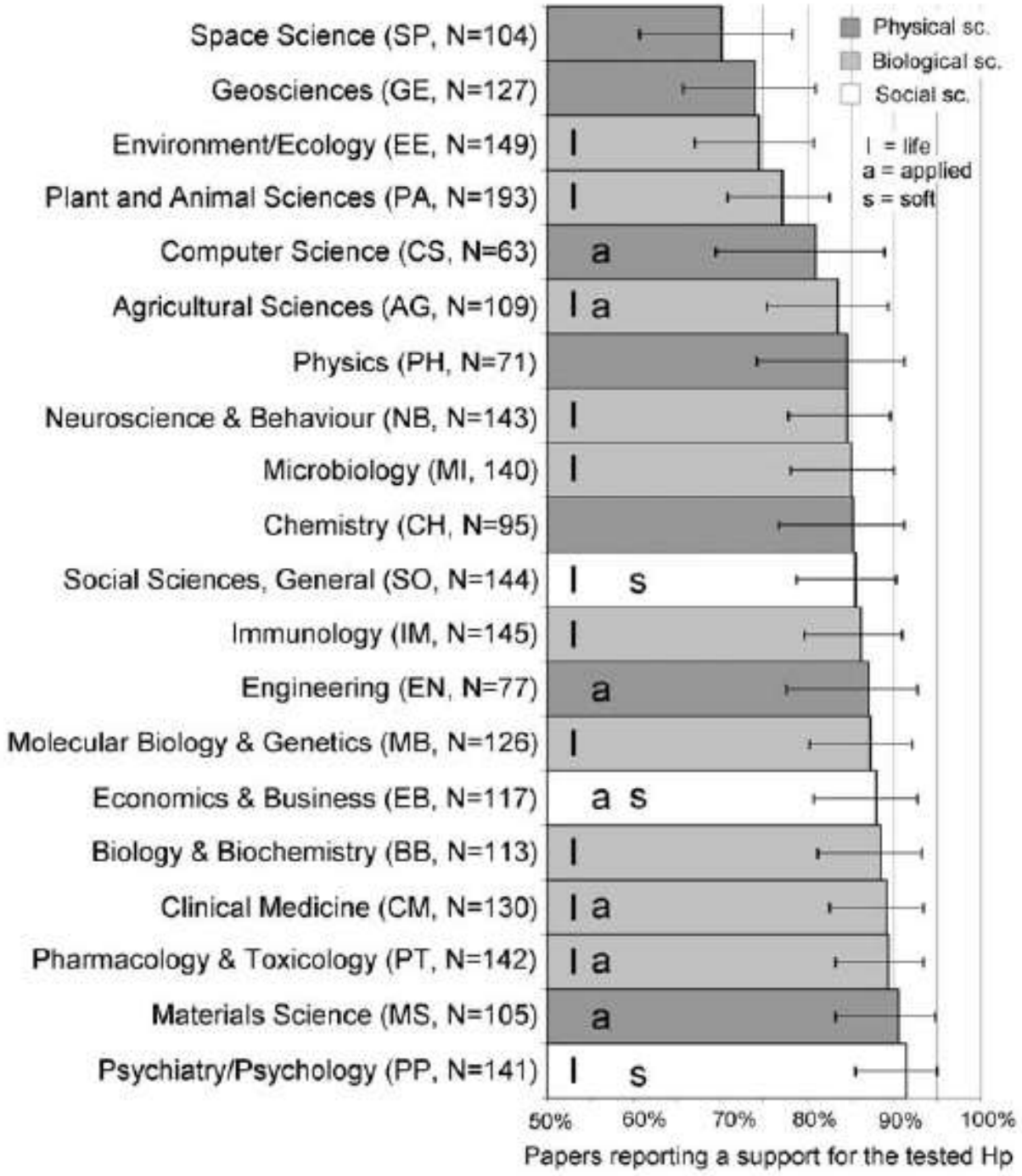
Adam Vaughan

@adamvaughan_uk

Friday 18 September 2015 10.34 BST

Philippe Sands QC says a court ruling would carry more weight with public opinion than science alone. Photograph: Antonio Zazueta Olmos/Antonio Olmos

Not all disciplines the same



OPEN ACCESS Freely available online

PLoS one

"Positive" Results Increase Down the Hierarchy of the Sciences

Daniele Fanelli*

INNOGEN and ISSTI-Institute for the Study of Science, Technology & Innovation, The University of Edinburgh, Edinburgh, United Kingdom

"odds of reporting a positive result ~5 times higher among papers in the disciplines of Psychology and Psychiatry and Economics and Business than Space Science"

April 7, 2010

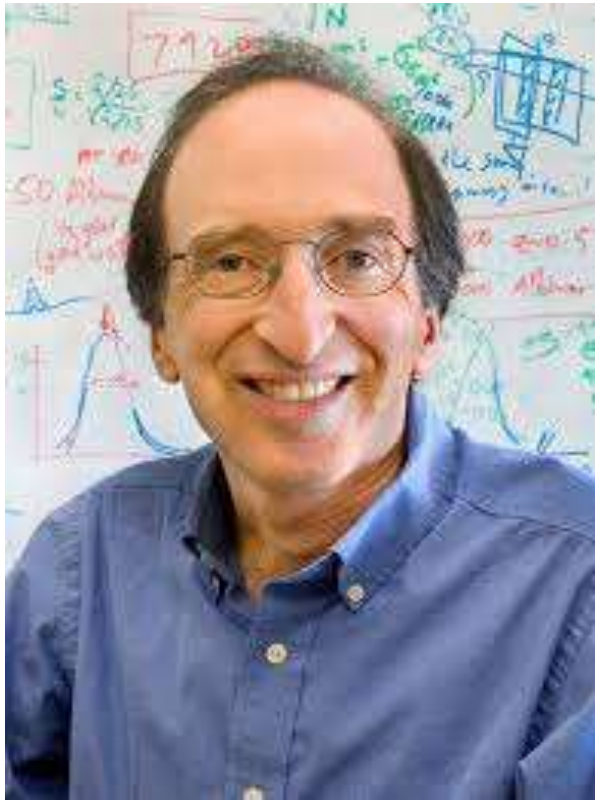
Physics as a model:

Following several high-profile errors, the particle physics community now invests great effort into intensive checking and re-checking of data prior to publication. By filtering results through independent working groups, physicists are encouraged to criticise.

R. Horton, “Offline: What is medicine’s 5 sigma?,” **Lancet**, vol. 385, p. 1380, 2015.

Saul Perlmutter, an astrophysicist at the University of California, Berkeley.

"Science is an ongoing race between our inventing ways to fool ourselves, and our inventing ways to avoid fooling ourselves.



Saul Perlmutter

R. Nuzzo, "How scientists fool themselves – and how they can stop," Nature, vol. 526, no. 7572, pp. 182–185, Oct. 2015.

From science crisis to science wars?

A new breed of science wars, predicted in 2016

January 27, 2017

To tackle the post-truth world, science must reform itself

Andrea Saltelli, *University of Bergen* and Silvio Oscar Funtowicz, *University of Bergen*

Scientists must bear some responsibility for the post-truth era and the current crisis in democracy.

November 16, 2016

Science wars in the age of Donald Trump

Andrea Saltelli, *University of Bergen* and Silvio Oscar Funtowicz, *University of Bergen*

Is the election of Donald Trump going to reignite a futile war between science and anti-science?

What the present science war looks like:

Opinion: Is science really facing a reproducibility crisis, and do we need it to?

Daniele Fanelli

PNAS March 12, 2018. 201708272; published ahead of print March 12, 2018. https://doi.org/10.1073/pnas.1708272114

"The new "science is in crisis" narrative is not only empirically unsupported, but also quite obviously counterproductive. Instead of inspiring younger generations to do more and better science, it might foster in them cynicism and indifference. Instead of inviting greater respect for and investment in research, it risks discrediting the value of evidence and feeding antiscientific agendas."

What the present science war looks like:

Crisis or self-correction: Rethinking media narratives about the well-being of science

Kathleen Hall Jamieson

PNAS March 13, 2018. 115 (11) 2620-2627; published ahead of print March 12, 2018. https://doi.org/10.1073/pnas.1708276114

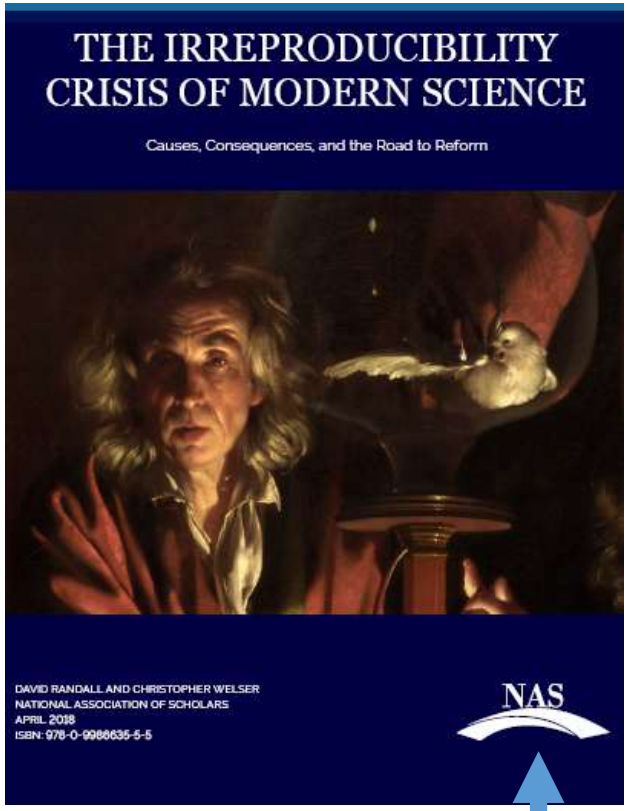
"Because those whose work is prominently cited to certify that science is broken [Ioannidis, Oransky, Begley, and Nosek among them] are spearheading efforts to solve identified problems, their work is evidence of the resilience of science"

“Even well-intentioned academics, perceiving an attack on science, may be tempted to take an unproductive, hand-waving defensive position: ‘We have no problem with reproducibility’, ‘everything is fine’, ‘science is making progress’.”

John P. A. Ioannides

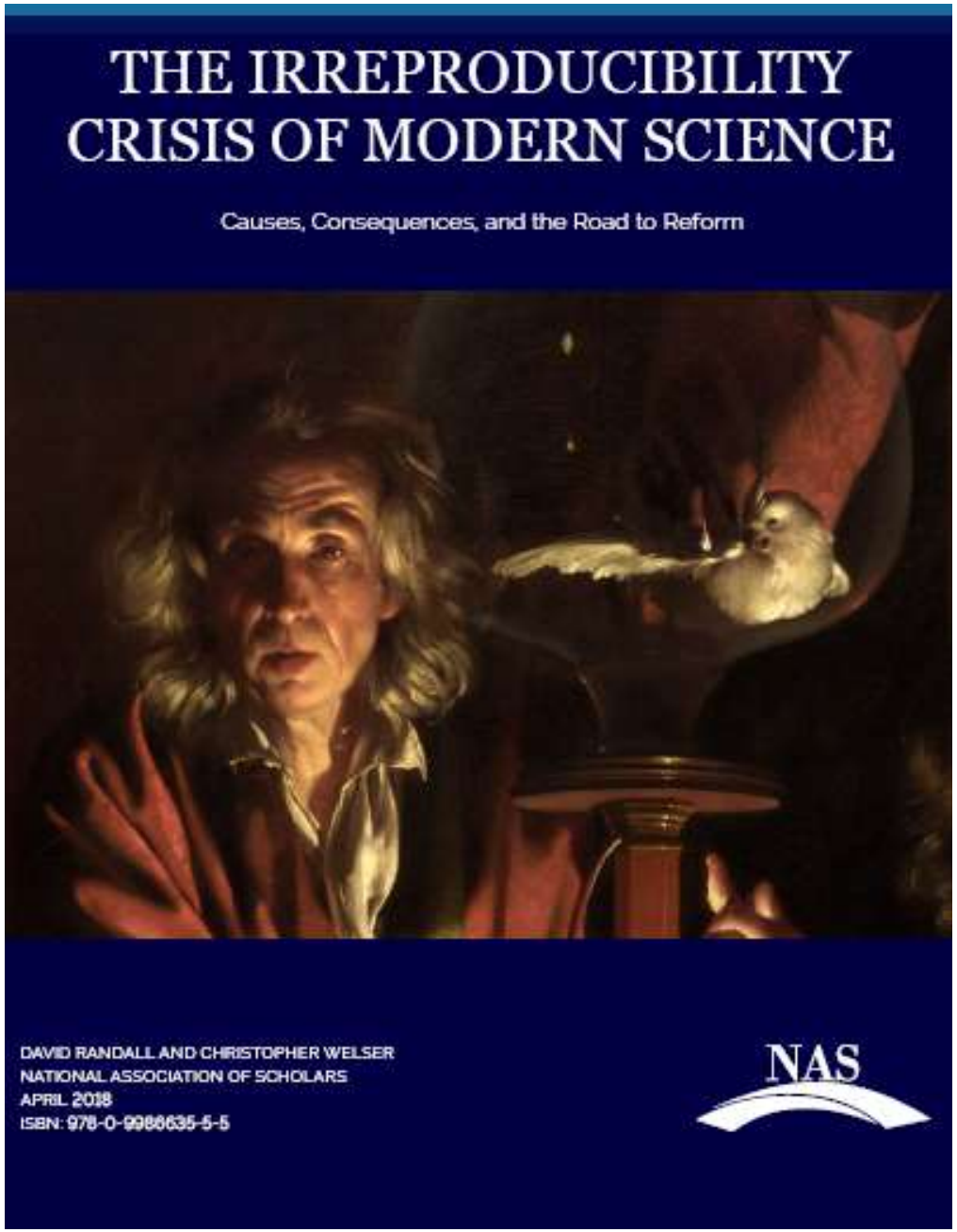
J. P. A. Ioannidis, “All science should inform policy and regulation,” PLOS Med., vol. 15, no. 5, p. e1002576, May 2018.

On the other side: (conservatives, corporations)



Crisis? Yes, due to progressives' assault on higher education with ideologies such as "neo-Marxism, radical feminism, historicism, post-colonialism, deconstructionism, post-modernism, liberation theology"

National Association of Scholars



"Congress should pass an expanded Secret Science Reform Act to prevent government agencies from making regulations based on irreproducible research …"

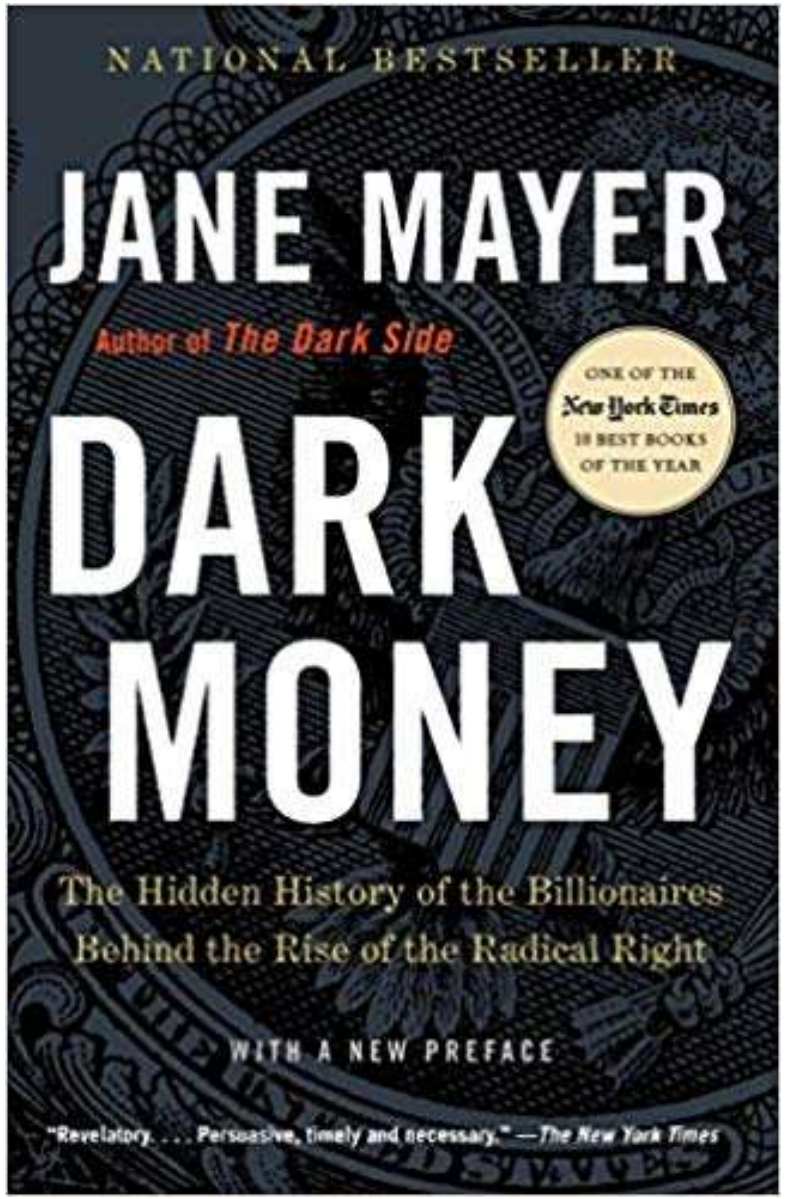
Date: 27/10/16 | Global Warming Policy Foundation

PEER REVIEW

Why skepticism is essential

Donna Laframboise

"If half of published, peer-reviewed papers 'may simply be untrue', half of the papers cited by the IPCC may also be untrue…"



Chapter 8, The fossils, on Koch brothers against climate

Gaming the crisis, also in Europe

OECDpublishing

Please cite this paper as:

OECD (2015), "Scientific Advice for Policy Making: The Role and Responsibility of Expert Bodies and Individual Scientists", *OECD Science, Technology and Industry Policy Papers*, No. 21, OECD Publishing, Paris.
http://dx.doi.org/10.1787/5js33l1jcpwb-en

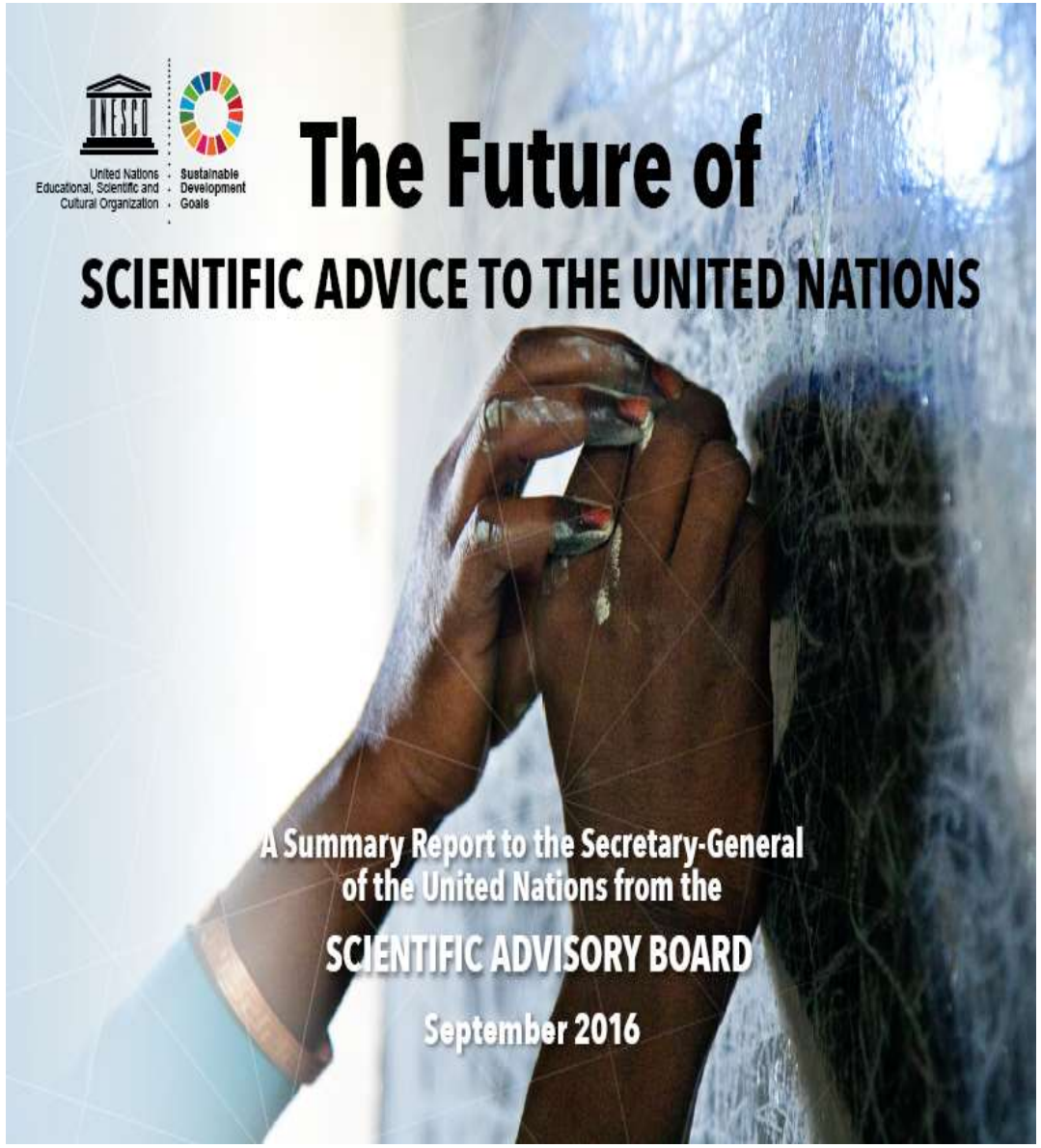
OECD Science, Technology and Industry Policy Papers No. 21

Scientific Advice for Policy Making

THE ROLE AND RESPONSIBILITY OF EXPERT BODIES AND INDIVIDUAL SCIENTISTS

OECD

2015

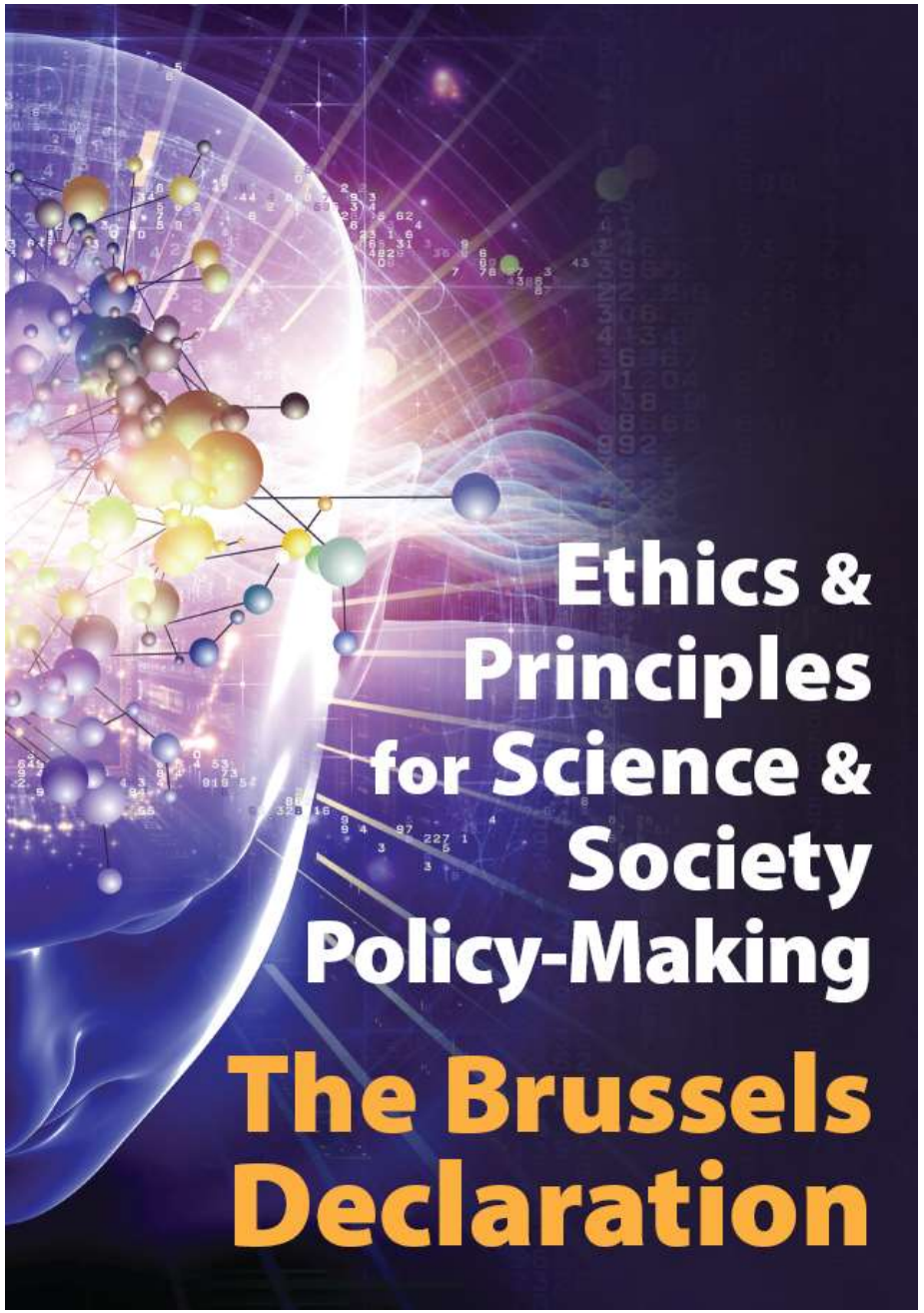


2016

Adopted Feb. 2017 at AAAS symposium, 5y gestation

Hundreds of experts involved

- No crisis
- No effect of crisis on evidence based policy



… extensive involvement of tobacco and alcohol industry actors… the Declaration offers potential to serve as a vehicle for advancing the vested interests of corporate sectors in public policymaking and appears to have been regarded in this way by a range of organisations related to the alcohol industry

J. McCambridge, M. Daube, and M. McKee, "**Brussels Declaration: a vehicle for the advancement of tobacco and alcohol industry interests at the science/policy interface**?," Tob. Control, p. tobaccocontrol-2018-054264, Jun. 2018.

L. Bero, "**Ten tips for spotting industry involvement in science policy.**" Tob. Control, p. tobaccocontrol-2018-054386, Jun. 2018.

A left-right divide in the reading of the present predicaments is unhelpful and dangerous

The same for a too complacent attitude of science institutions toward corporate interests

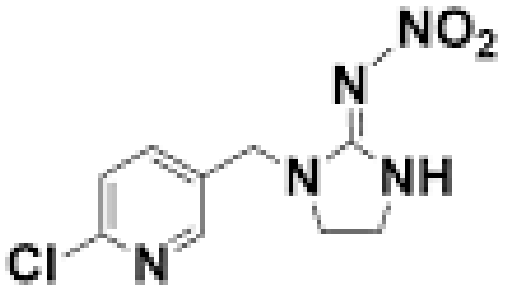
Ewen Callaway, 2018, CRISPR plants now subject to tough GM laws in European Union, Top court's ruling threatens research on gene-edited crops in the bloc, Nature, doi: 10.1038/d41586-018-05814-6, https://www.nature.com/articles/d41586-018-05814-6

Alternative reading of the crisis: structural contradictions have emerged in modern science

Addressing them should be the focus of our attention

J.R. Ravetz, Postnormal Science and the maturing of the structural contradictions of modern European science, Futures, 43(2), (2011), pp. 142-148.

Shoddy science, entrepreneurial science, reckless science, and dirty science (Ravetz, 1971)



Ravetz, J., **1971**, Scientific Knowledge and its Social Problems, Oxford University Press.

Contradictions between:

- the public image of science and its roles;
- real and acknowledged uncertainty in science's pronouncements;
- technological progress and technological risk

...

J.R. Ravetz, Postnormal Science and the maturing of the structural contradictions of modern European science, Futures, 43(2), (2011), pp. 142-148.

What is science, or who is a scientist?

Mark Edwards,
Aleksandr Kogan

Paolo Macchiarini,
Rick Mishkin

Does history repeats itself?

(Love canal, Flint…)

Lois Gibbs

Marc Edwards

http://www.andreasaltelli.eu/file/repository/LOVE_CANAL.pdf
https://en.wikipedia.org/wiki/Flint_water_crisis; http://flintwaterstudy.org/;
http://www.nytimes.com/2016/08/21/magazine/flints-water-crisis-and-the-troublemaker-scientist.html

Different cultures, different reactions

Yoshiki Sasai 1962 – 2014

http://www.nature.com/news/stem-cell-pioneer-blamed-media-bashing-in-suicide-note-1.15715

Different cultures, different reactions

Aaron Swartz, 1986 - 2013

https://www.rollingstone.com/culture/news/the-brilliant-life-and-tragic-death-of-aaron-swartz-20130215

Futures xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Futures

journal homepage: www.elsevier.com/locate/futures

Why science's crisis should not become a political battling ground

Andrea Saltelli

Centre for the Study of the Sciences and the Humanities – University of Bergen, Norway; Open Evidence Research, Universitat Oberta de Catalunya (UOC), Barcelona, Spain

A triple crisis of science, policy and technology

There was once upon a time
an interface between science,
policy and technology

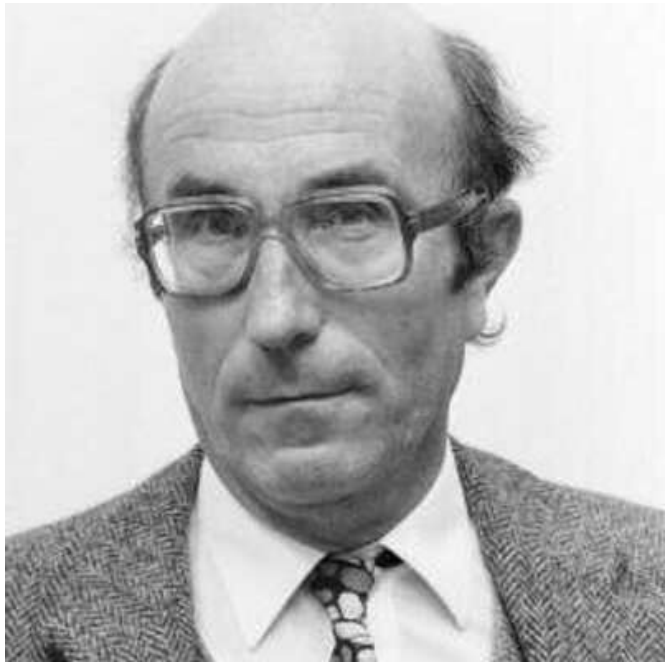
This is no longer an interface.
It has filled all the available
space…

…permeating all discussions
on human condition

Majone, G. Evidence, argument, and persuasion in the policy process. Yale University Press, 1989.

A social system theory reading

Social evolution leads us toward functionally differentiated societal systems enhancing communication (e.g. Love as a generalized symbolic medium of communication) … and much more

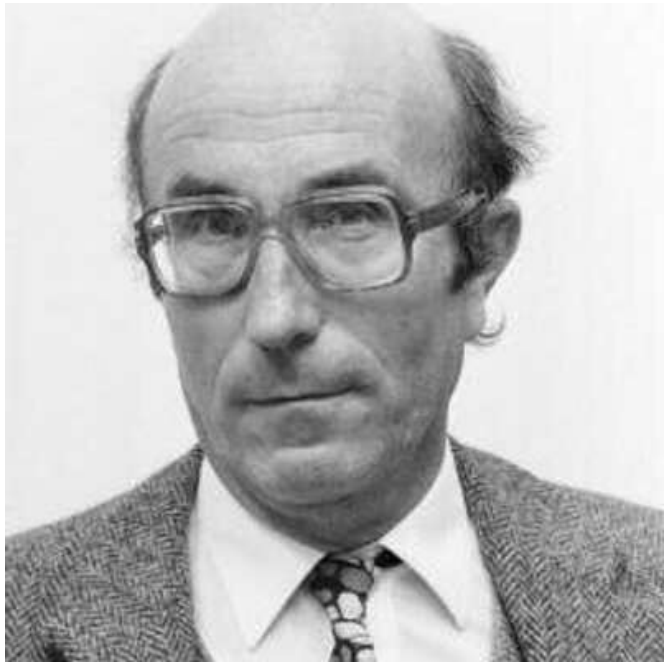


Niklas Luhmann

Moeller, H. G. Luhmann explained. Open Court Publishing Company, 2006.
Niklas Luhmann, Love as Passion, 1987, Harvard University Press

Science/innovation/technology = a system with a life of its own; humans as compulsive communicators

Lewis Mumford's Technological compulsiveness'



Niklas Luhmann

Lewis Mumford

The Brave New World we are entitled to?

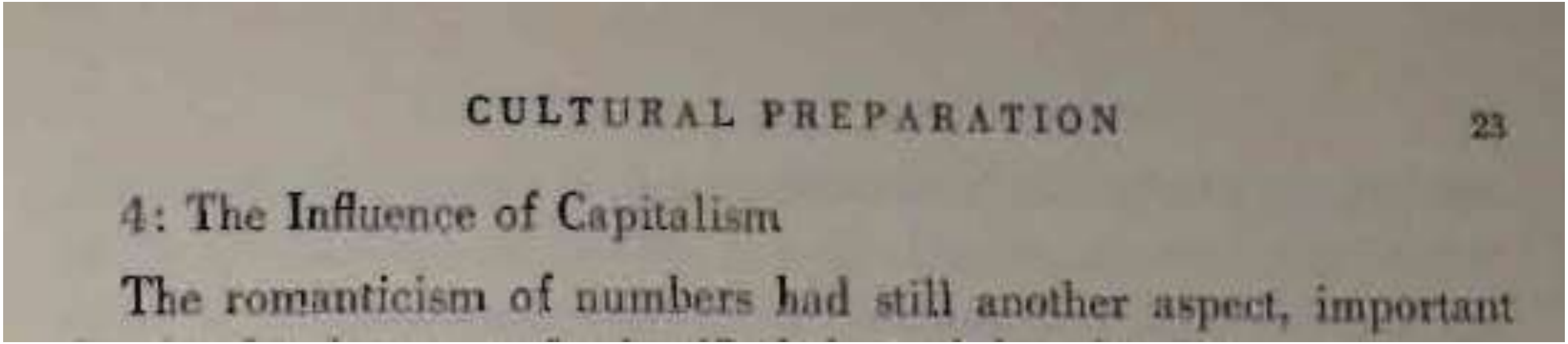
Who controls whom?

"Have you seen those zombies who roam the streets with their faces glued to their smartphones? Do you think they control the technology, or does the technology control them?"

Yuval Noah Harari

Yuval Harari, 21 Lessons for the 21st Century, 2018, Jonathan Cape publisher; for autopoietic technology see also W. Brian Arthur, 2010, The Nature of Technology, Free Press.

Lewis Mumford explained in 1934 how well the ‘machine’ integrates with capitalism



CULTURAL PREPARATION 23

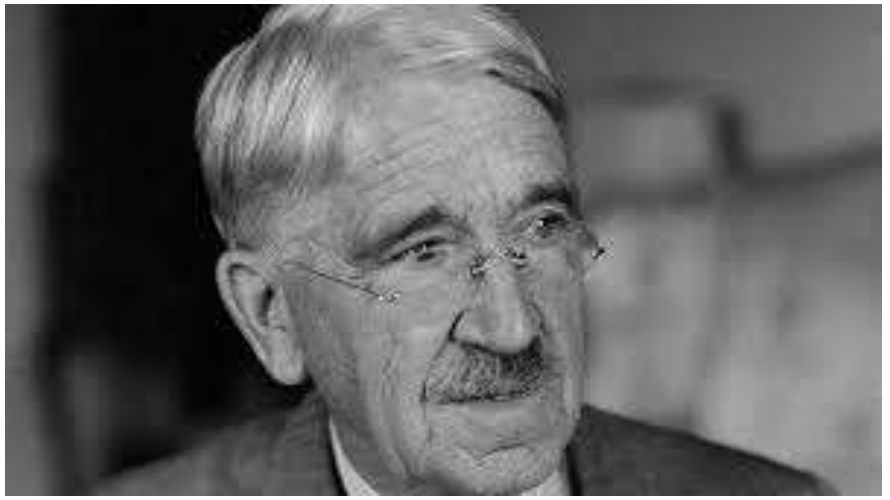
4: The Influence of Capitalism

The romanticism of numbers had still another aspect, important

Lewis Mumford, **1934**, Techniques and Civilization, ROUTLEDGE & KEGAN PAUL LTD, p. 23-31 of the 1955 edition.

From pragmatists to anarchists (Peter Kropotkin, Mikhail Bakunin), from the fathers of the ecological movement to post-modern thinkers: a common concern about mastering science and technology

“Here lies the contradiction of our civilization. The potentiality of science as the most powerful instrument of control which has ever existed puts to mankind its one outstanding present challenge”



John Dewey

J. Dewey, Science and society, in ‘John Dewey: The Later work , 1931-1932 Vol. 6

"Science, which should have been the wind of truth to clear the air, has polluted the air, helped to brainwash, and provided weapons for war."

Paul Goodman

Now resurgent concern for military/authoritarian apps

Paul Goodman, 1970, New Reformation, Notes of a Neolithic Conservative, PM press (2010 Edition).

Techies' fury at being drafted for Trump army

Working for the Pentagon is prompting staff revolts in Silicon Valley

Danny Fortson, San Francisco

November 4 2018, 12:01am, The Sunday Times

"From Amazon to Google, rank-and-file employees are revolting against their employers for taking the powerful tools they helped to build and selling them for unexpected purposes, from apprehending illegal immigrants to supercharging America's war machine"

Doubts about the scientific quantification of the impact of new technologies

Fritz Schumacher

Langdon Winner

E. F. Schumacher, 1973, Small Is Beautiful. Economics as if People Mattered, Penguin Perennial.

Winner, L., 1986. The Whale and the Reactor: a Search for Limits in an Age of High Technology. The University of Chicago Press, 1989 edition.

Funtowicz, S.O. and Ravetz, J.R. (1994). The worth of a songbird: Ecological economics as a post-normal science. Ecological Economics 10(3), 197-207.

For Lyotard the grand narrative of the relation between knowledge/science and power has come to an end

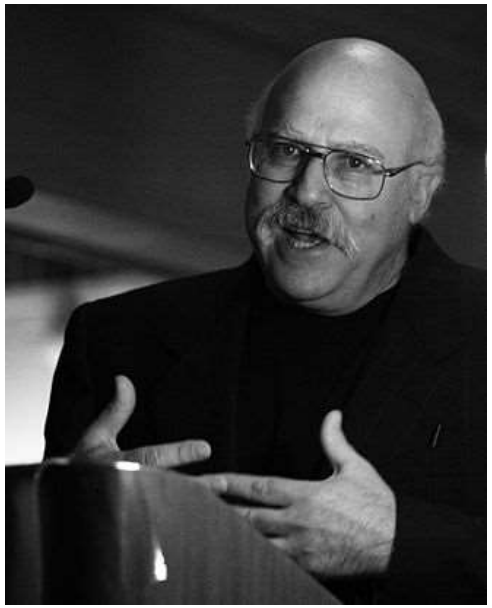
Jean-François Lyotard

Lyotard, J.-F. 1979. La Condition postmoderne. Rapport sur le savoir, Paris : Minuit.

“Solutions to the problem of knowledge are solutions to the problem of social order…

Trust in Science and trust in the prevailing social order are linked.”

Simon Schaffer



Steven Shapin

Shapin, S., Schaffer, S., 1985, Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life, Princeton, 2011 Edition

So far:

The crisis is triple: science, technology and policy; it has to be triple; an announced crisis

Communication our destiny, made ineluctable by a self-organizing ‘machine’ efficiently coupled to capital

This is not a larger or faster version of the old crisis

Salem witch trials

#jewsdid911

13. Cover of a popular French edition of the *Protocols*, c. 1934

14. Cover of another popular French edition, c. 1934

Zion protocols

deepfake

Instead of cultural evolution of the mind ➔ mind hacking

Jaron Lanier

Instead of science fostering social discovery ➔ poisonous algorithms (purposeful or otherwise)

Yuval Noah Harari, Homo Deus 2015 & 21 Lessons for the 21st Century, 2018.

Jaron Lanier, 2018 Ten Arguments for Deleting Your Social Media Accounts Right Now

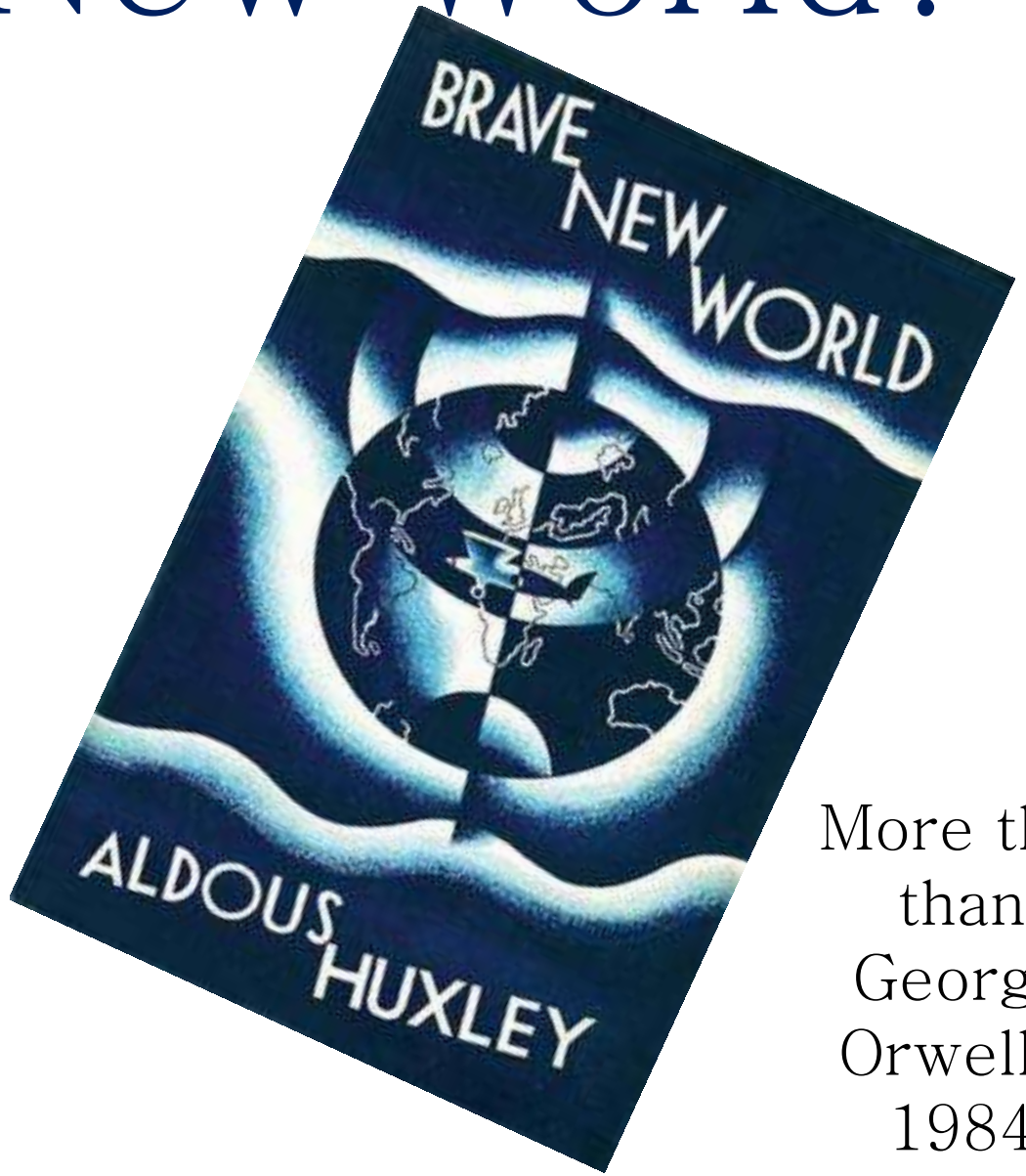
https://www.theguardian.com/society/2018/aug/23/russian-trolls-spread-vaccine-misinformation-on-twitter

Instead of a strategy of confusion ➔ confusion without strategy

A new Brave New World?

Aldous Huxley

SCI-FI; a totally regimented world 1932 where drug takes care of consent



More this than George Orwell's 1984

Recap:

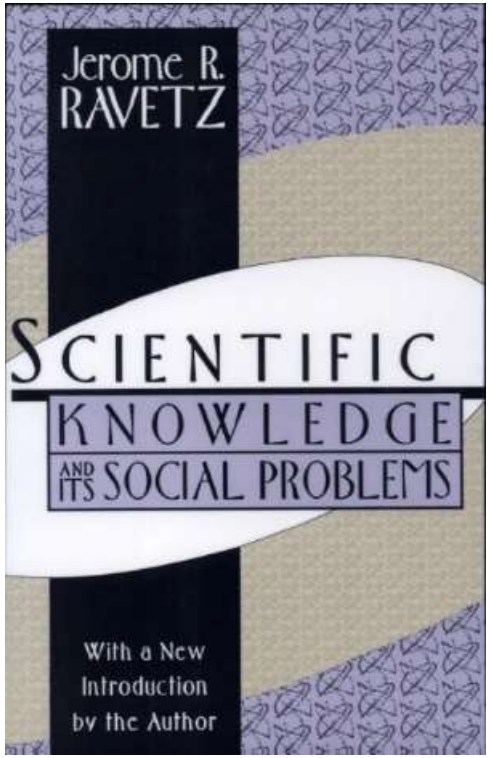
A divisive crisis

A different crisis

The maturing of structural contradictions

Ravetz, J., **1971**, Scientific Knowledge and its Social Problems, Oxford University Press, available here; https://bit.ly/2K7qGvD

Ravetz, J. R. Postnormal Science and the maturing of the structural contradictions of modern European science. Futures 43, 142–148 (2011).



Jerome R. Ravetz

Contradictions between:

The public image of science and its roles (example: illuminístic versus colonial/imperialistic science)

Real and acknowledged uncertainty in science's pronouncements (technological hubris, techno-optimism, ecomodernism; the scourge of implausible quantifications)

Ravetz, J. R. Postnormal Science and the maturing of the structural contradictions of modern European science. Futures 43, 142–148 (2011).

Contradictions between:

Technological progress and technological risk

The quality arrangements of little science and big or mega science

Ravetz, J. R. Postnormal Science and the maturing of the structural contradictions of modern European science. Futures 43, 142–148 (2011).

Majone, G. Evidence, argument, and persuasion in the policy process. Yale University Press, 1989.

Contradictions between:

Democratic aspirations and elitist practices, aggravated by present proletarianization of research (Jerry's opening; "One can even imagine a bifurcation within science, between the socially elite grantholders, … and the non-elite researchers, hoping in vain for social mobility or even for job security")

Ravetz, J. R. Postnormal Science and the maturing of the structural contradictions of modern European science. Futures 43, 142–148 (2011).

Contradictions between ideals and incentives in research practices

Ravetz, J. R. Postnormal Science and the maturing of the structural contradictions of modern European science. Futures 43, 142–148 (2011).

… but this is a minority report

Nobel and Holberg Prize to advocates/practitioners of cost benefit analyses; new enlightenment frenzy…

William Nordhaus

Cass Sunstein

Steven Pinker

https://www.sciencemag.org/news/2018/10/roles-ideas-and-climate-growth-earn-duo-economics-nobel-prize
https://www.vox.com/future-perfect/2018/10/22/18001014/cass-sunstein-cost-benefit-analysis-technocracy-liberalism
Steven Pinker, 2018, Enlightenment Now, Penguin.

Where will this lead?

Where will this lead?

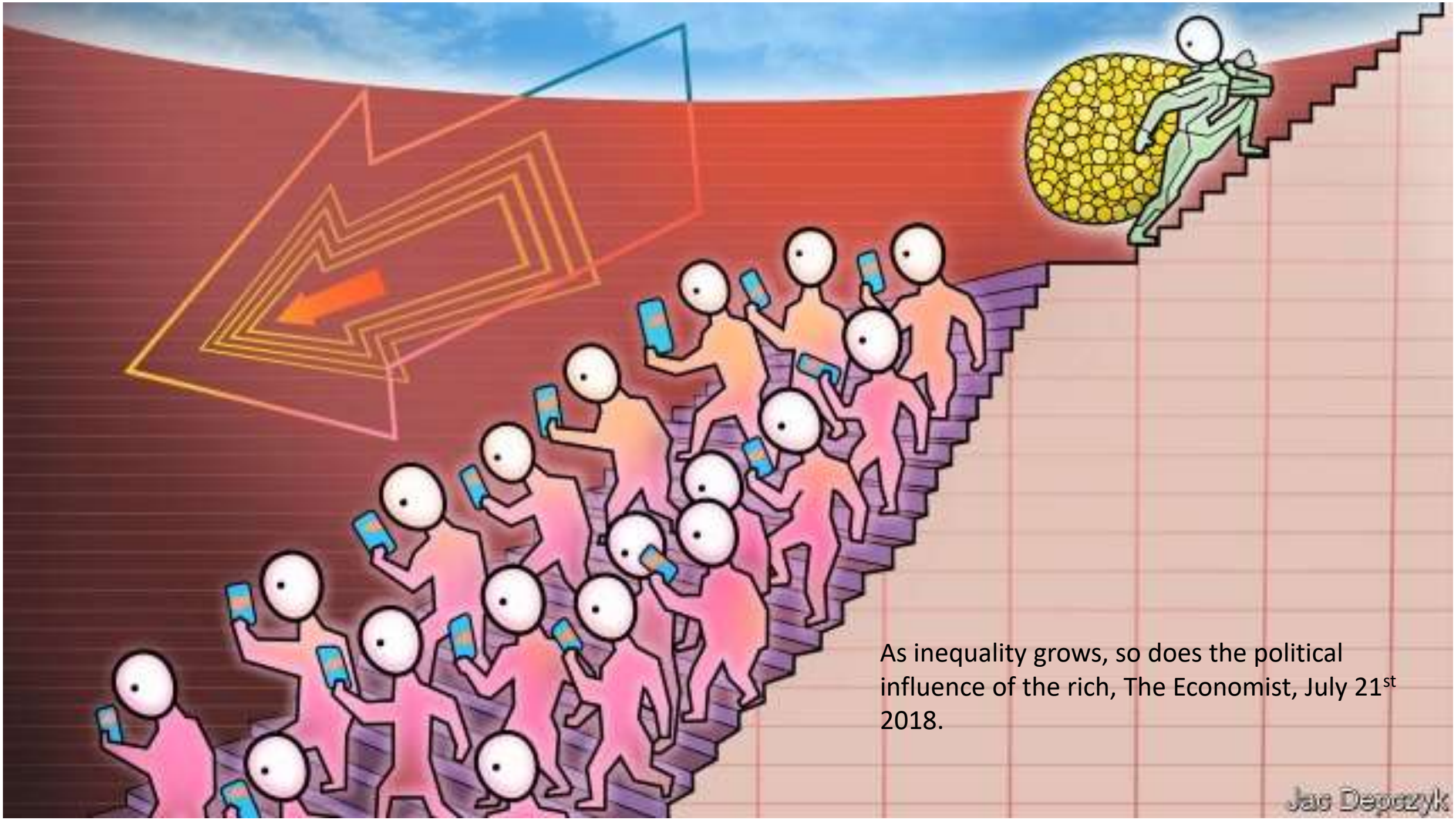
Techno-split (Lent, Harari, Lanier)

Rich- versus poor-man science

Transhumanism for the well off

Jeremy Lent, 2017, The patterning instinct, Prometheus Books

Techno-split
(*sensu* Jeremy Lent)



As inequality grows, so does the political influence of the rich, The Economist, July 21st 2018.

Techno-split?

John and Laura Arnold

Brian Nosek, the Reproducibility Project.

John Ioannidis, Meta-research innovation centre at Stanford

Ben Goldacre, alltrials.net

Gary Taubes, The case against sugar

https://www.wired.com/2017/01/john-arnold-waging-war-on-bad-science/

Where will this lead?

Collapse

In politics: nativism, nationalism, authoritarianism, politics terrible simplifiers …)

In science: war of all against all (see example of grievance study hoax)

The grievances study hoax https://areomagazine.com/2018/10/02/academic-grievance-studies-and-the-corruption-of-scholarship/

Where will this lead?

The system holds:

Open Science, 'cOAlition S', but read Philip Mirowski critique on Open Science as a panacea for all of science's problems, as a favour to corporate interests, the dangers of a Uberization of Science (platform capitalism), gamification, etc.

https://ec.europa.eu/research/openscience/index.cfm
https://www.theguardian.com/science/political-science/2018/jun/29/elsevier-are-corrupting-open-science-in-europe
https://www.nature.com/articles/d41586-018-07386-x?
Mirowski's paper here: https://www.insis.ox.ac.uk/event/crisis-what-crisis-science

Better hopes? Avenues for resistance and Reform

Silvio Funtowicz: a Reformation for science

Funtowicz, S. & Ravetz, J. R. Peer review and quality control. Int. Encycl. Soc. Behav. Sci. 11179–11183 (2015)

https://theconversation.com/to-tackle-the-post-truthworld-science-must-reform-itself-70455

http://www.andreasaltelli.eu/file/repository/Saltelli_London_0.pdf

“By "Reformation" I mean simply an upheaval of belief that is of religious depth, but that does not involve destroying the common faith, but to purge and reform it…”

Paul Goodman

Paul Goodman, 1970, New Reformation, Notes of a Neolithic Conservative, PM press (2010 Edition).

“we are not going to give up the mass faith in scientific technology that is the religion of modern times; and yet we cannot continue with it, as it has been perverted.”

Paul Goodman

Paul Goodman, 1970, New Reformation, Notes of a Neolithic Conservative, PM press (2010 Edition).

A PNS-inspired agenda for resistance

(1) Recast our public conversation about science – e.g. science isn't a victim

(2) Seek inspiration in the radical 1970s-era movements that sought to change the world by changing first science itself – turn the deficit model on itself; privilege work with the NGO's and the scientific proletariat rather than with powerful institutions and lobbyists

A post-normal agenda for resistance:

(3) Fight knowledge asymmetries; offer expertise to the weaker stakeholders; help them to shape the questions asked of science

(4) Fight methodological corruption, e.g. deconstructing shoddy quantifications, with NUSAP, sensitivity auditing …

Saltelli, A., Guimarães Pereira, Â., Van der Sluijs, J.P. and Funtowicz, S., 2013, 'What do I make of your latinorum? Sensitivity auditing of mathematical modelling', Int. J. Foresight and Innovation Policy, (9), 2/3/4, 213-234.

The End

@andreasaltelli