

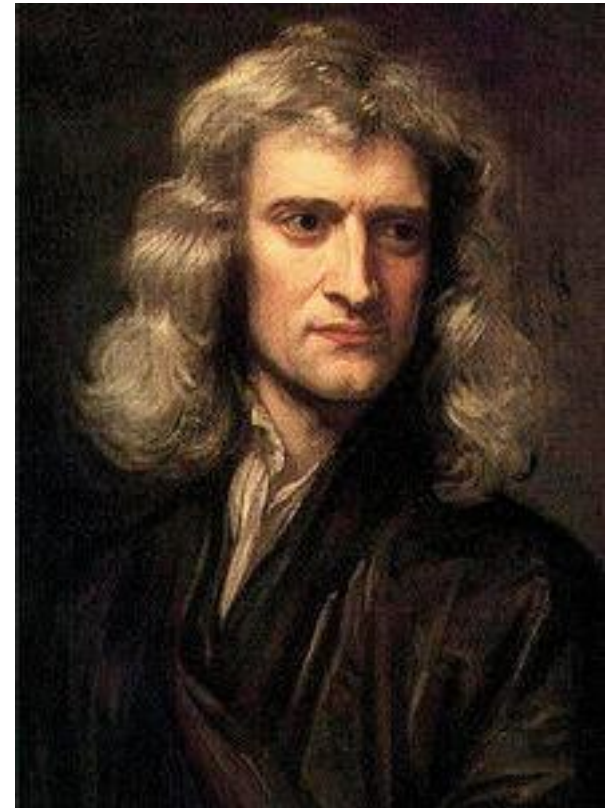
What Science Tells Us About Scientific Fraud

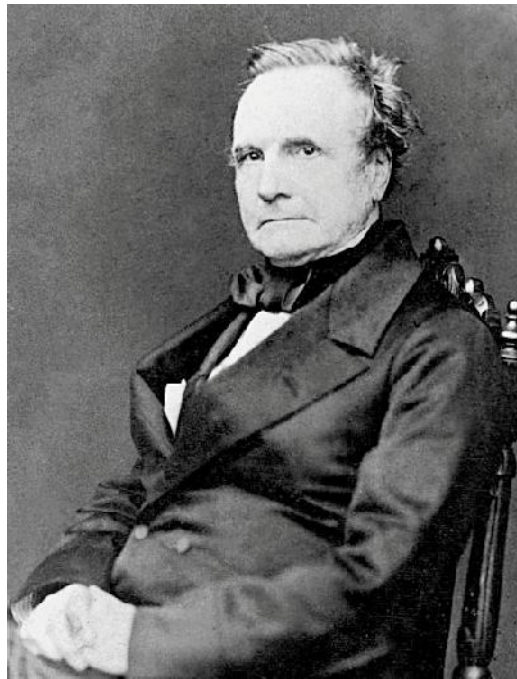
Daniele Fanelli



Scientific Fraud: How it is done, why it is done, and what can be done about it

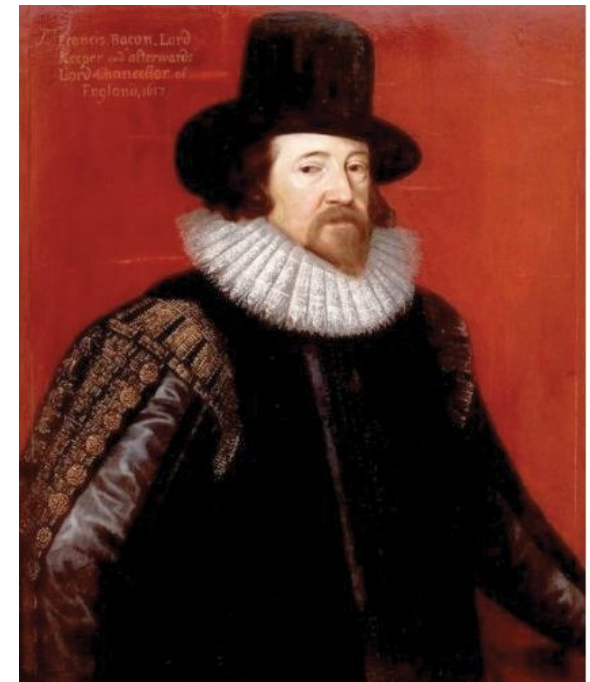
- How Threatening is Fraud to Science? (Pattyn, email April 2012)





- Charles Babbage (1830). *Reflections on the decline of science in England, and on some of its causes*
 - Hoaxing
 - Forging
 - Trimming
 - Cooking

- Francis Bacon (1620) *Novum Organum Scientiarum*
- "Idols of the Tribe" (*Idola tribus*)
- "Idols of the Den" (*Idola specus*)
- "Idols of the Marketplace" (*Idola fori*)
- "Idols of the Theatre" (*Idola theatri*)



How Threatening is Fraud to Science?

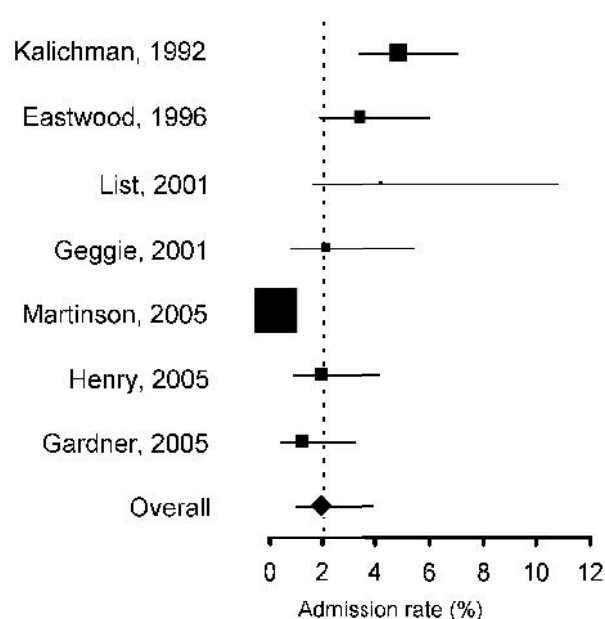
- Misconduct (bias) are physiological to science
 - People (scientists) are imperfect/dishonest
- Scientific method = set of rules to avoid
 - Fooling yourself
 - Being fooled by others
- Preventing such problems is a never ending effort
 - Intrinsic to the scientific enterprise
- **We are all in it together!**
- Exciting times, because scientists increasingly study these problems...scientifically

How it is done, why it is done, and
what can be done about it?

1) How is it done?

How many scientists fabricate/falsify?

Scientists who admit fabrication, falsification, or alteration of results

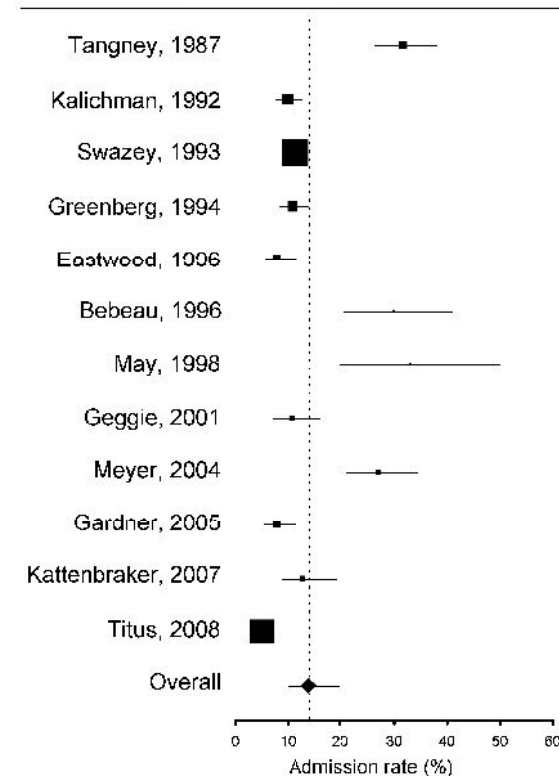


1.97% (N=7, 95%CI: 0.86-4.45)

If only asked “fabrication, falsification”

1.06% (N=4, 95%CI: 0.31-3.51)

Scientists who know a colleague who fabricated, falsified, or altered results



14.12% (N=12, 95% CI: 9.91-19.72)

If only asked “fabrication, falsification”

12.34% (N=11, 95%CI: 8.43-17.71)

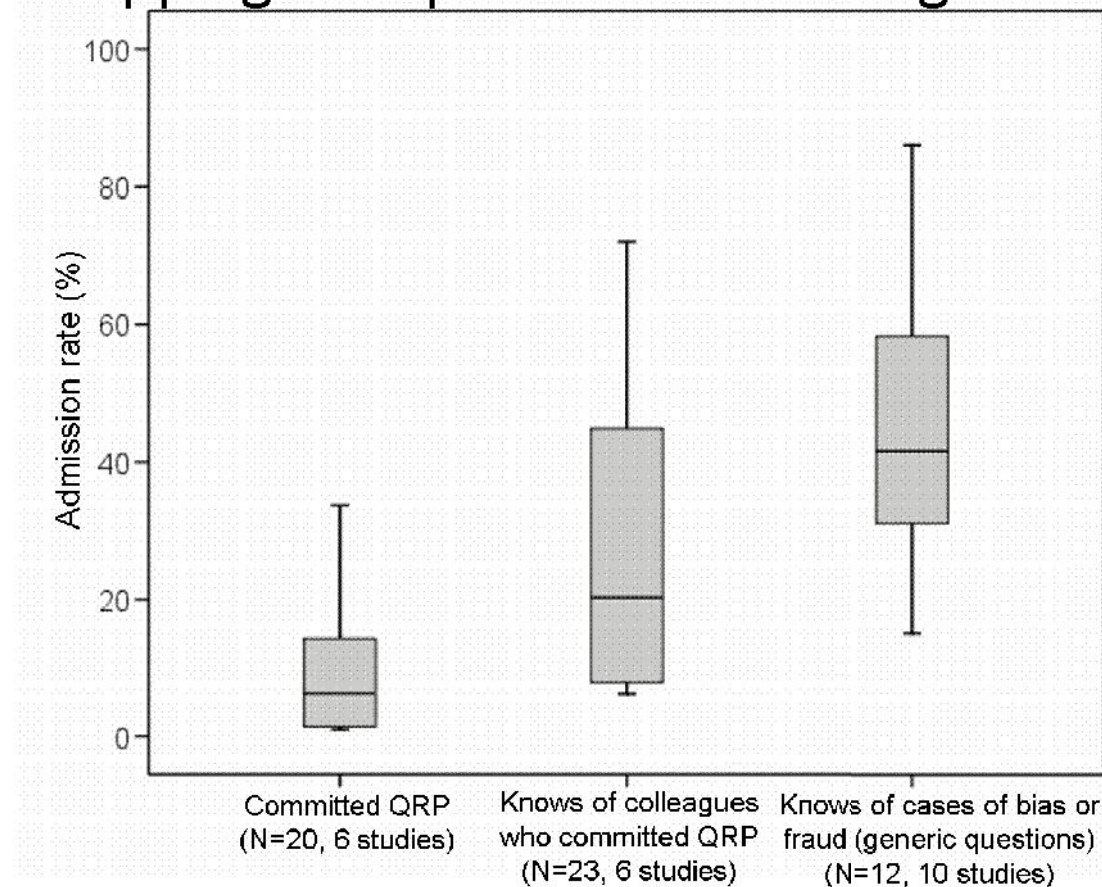
(Fanelli 2009, PLoS ONE, doi:
10.1371/journal.pone.0005738)

How many scientists let bias creep in?

(Questionable research practices)

(e.g. “failing to publish data that contradicts one’s previous research”

“dropping data points based on a gut feeling”)

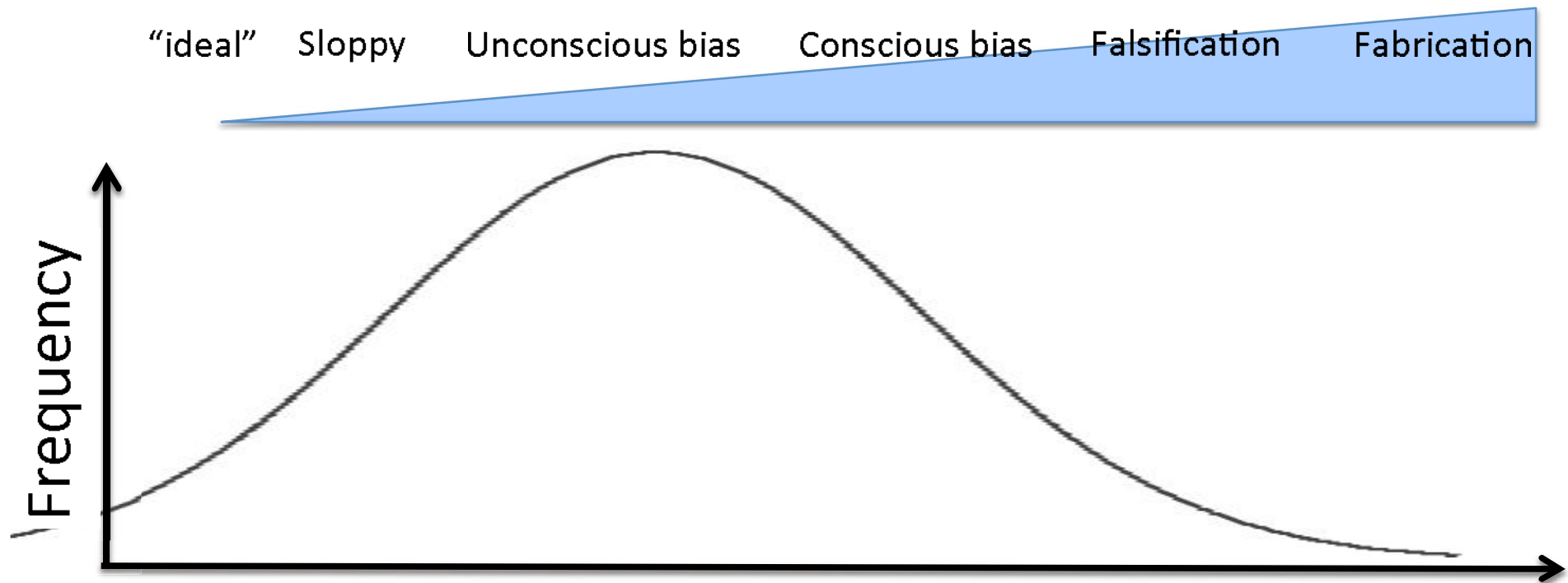


(Fanelli 2009, PLoS ONE, doi:
10.1371/journal.pone.0005738)

How it is done, why it is done, and
what can be done about it?

1) How is it done?

It's a continuum!



How it is done, why it is done, and
what can be done about it?

2) Why is it done?

How many scientists blow the whistle?

ID	N cases	Action taken	%
Tangney, 1987	78	Took some action to verify their suspicions of fraud or to remedy the situation	46
Rankin, 1997	31 (incl. Plag.)	In alleged cases of scientific misconduct a disciplinary action was taken by the dean	32.4
		Some authority was involved in a disciplinary action	20.5
Ranstam, 2000	49	I interfered to prevent it from happening	28.6
		I reported it to a relevant person or organization	22.4
Kattenbraker, 2007	33	Confronted individual	
			36.4
		Reported to Institutional Review Board	12.1
		Discussed with colleagues	36.4
Titus, 2008	115 (incl. Plag.)	The suspected misconduct was reported by the survey respondent	24.4
		The suspected misconduct was reported by someone else	33.3

**Around half of recalled cases had
no action whatsoever taken against them**

(Fanelli 2009, PLoS ONE, doi:
10.1371/journal.pone.0005738)

How it is done, why it is done, and
what can be done about it?

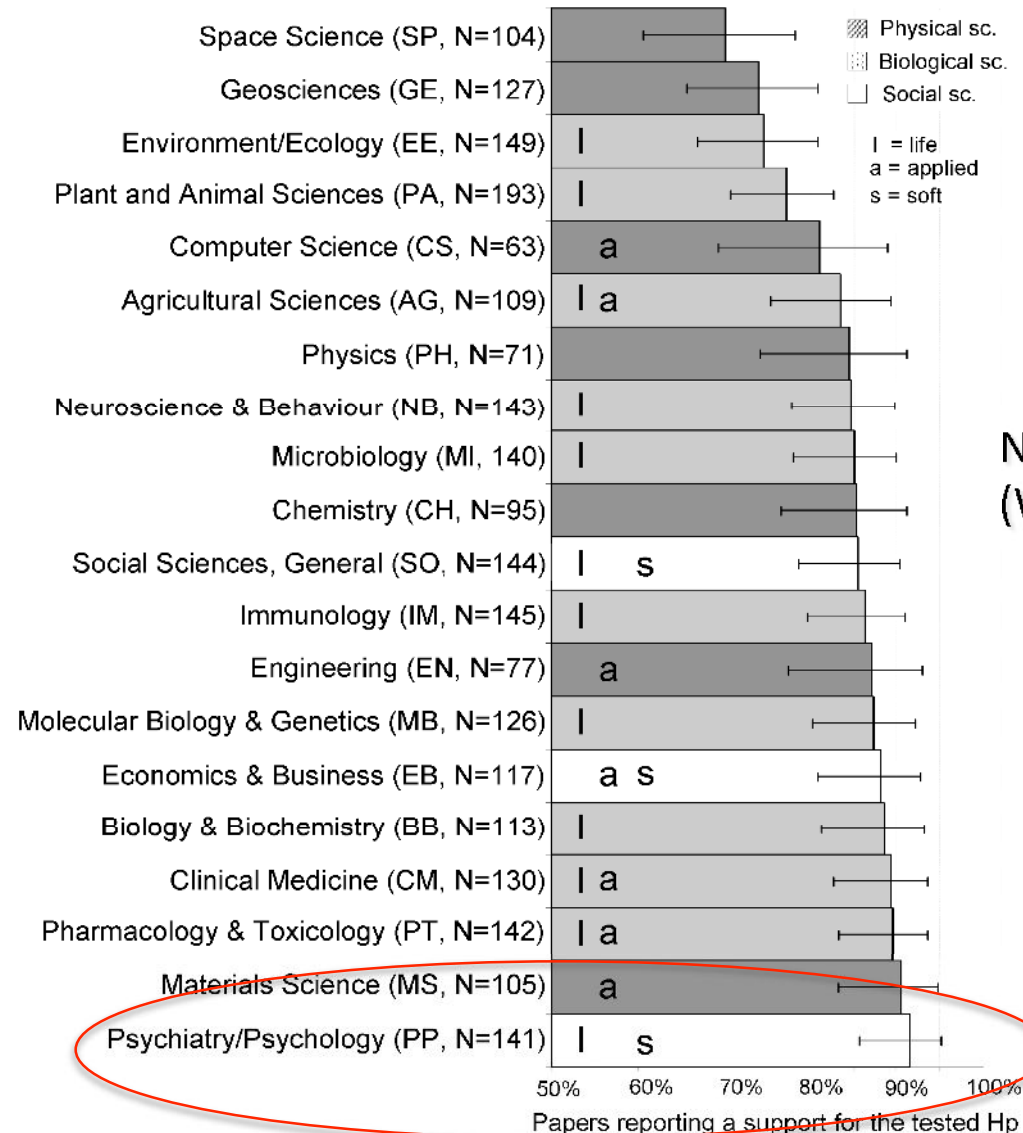
2) Why is it done?

Because it's easy to get away with it

- Few will report scientific misconduct**

Which disciplines are at greater risk of bias?

(frequency of positive results vs null/negative)

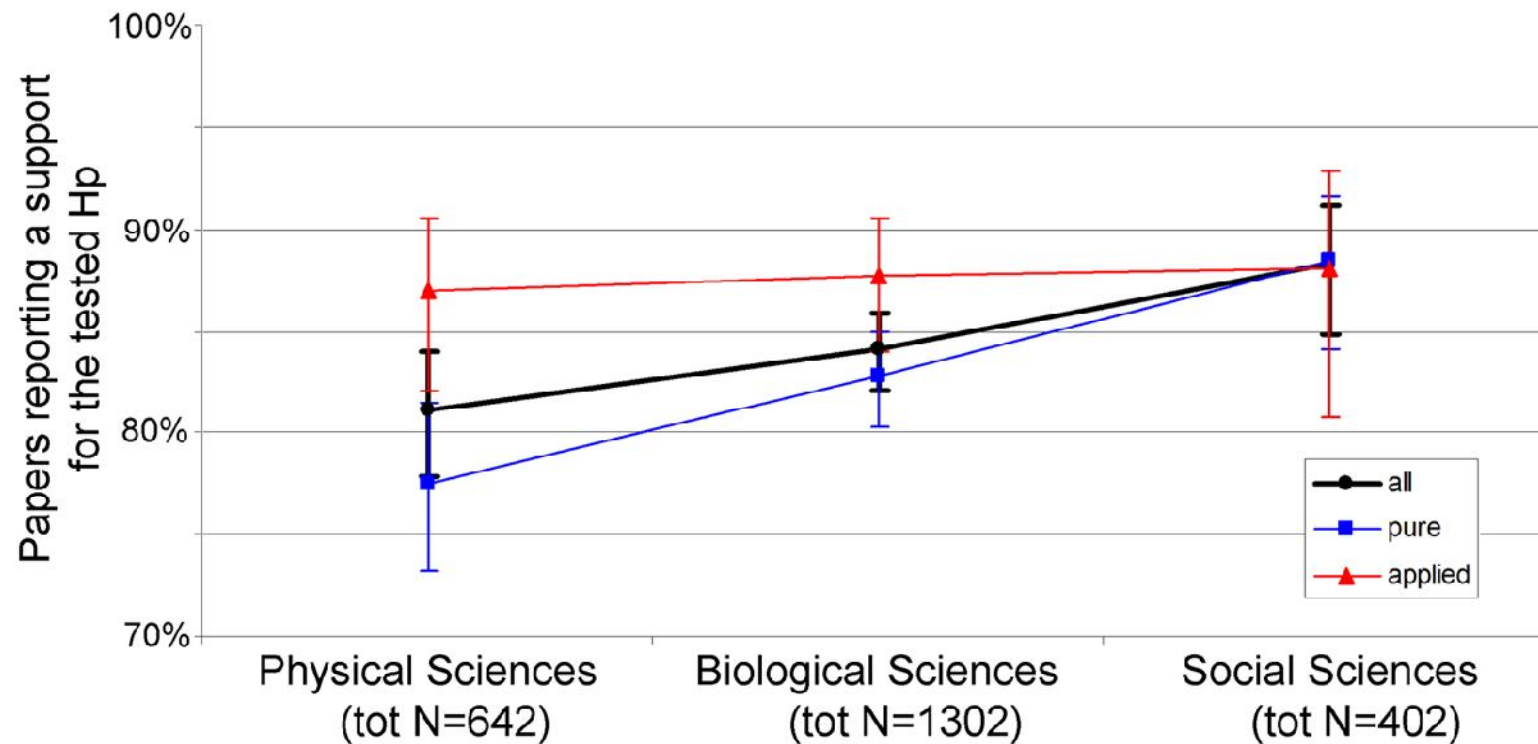


Papers that support a tested Hp
Papers that do not support a tested Hp

N=2,434 papers, ca 150 per discipline
(Web of Science), (2000-2007)

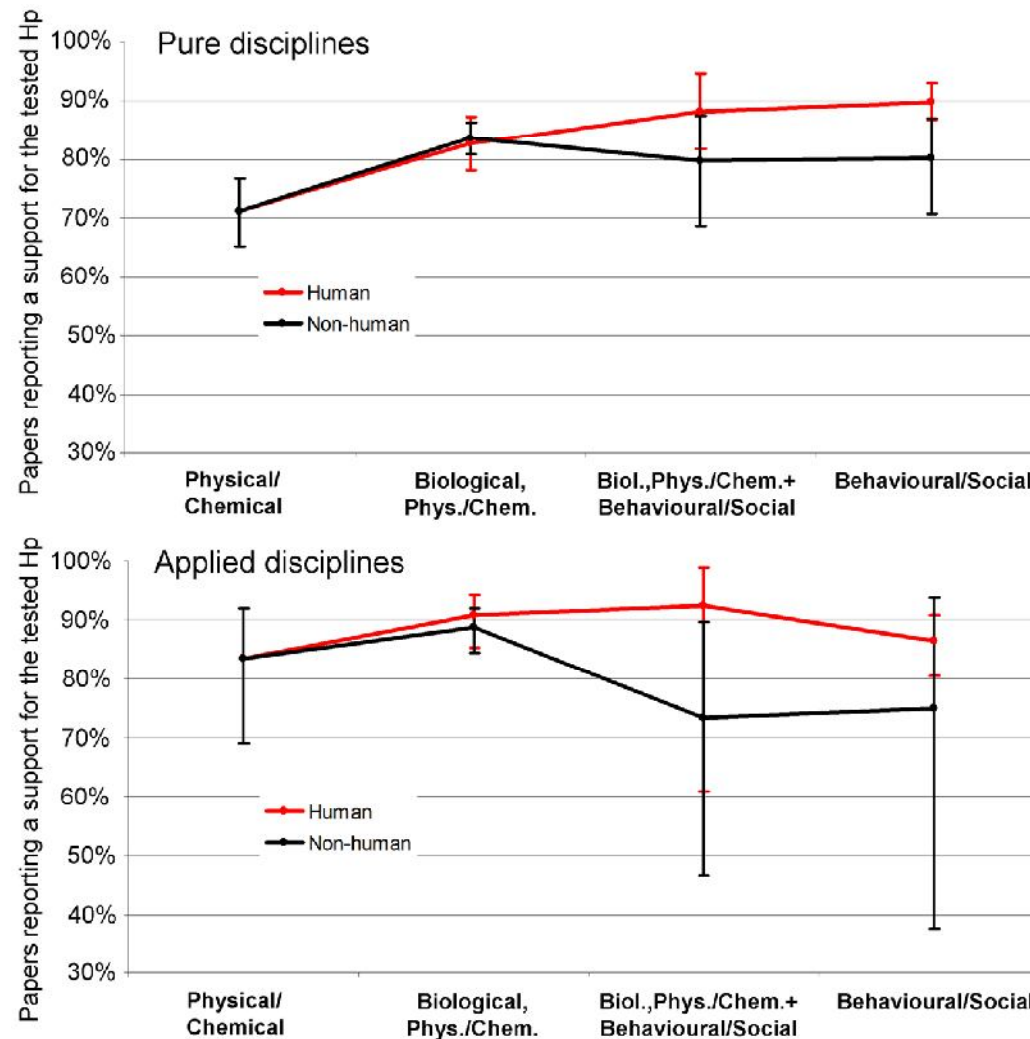
(Fanelli 2010a, PLoS ONE, doi:
10.1371/journal.pone.0010068)

The frequency of positive results increases in 'softer' disciplines



(Fanelli 2010a, PLoS ONE, doi:
10.1371/journal.pone.0010068)

Positive results increase in ‘softer’ methods



(Fanelli 2010a, PLoS ONE, doi: 10.1371/journal.pone.0010068)

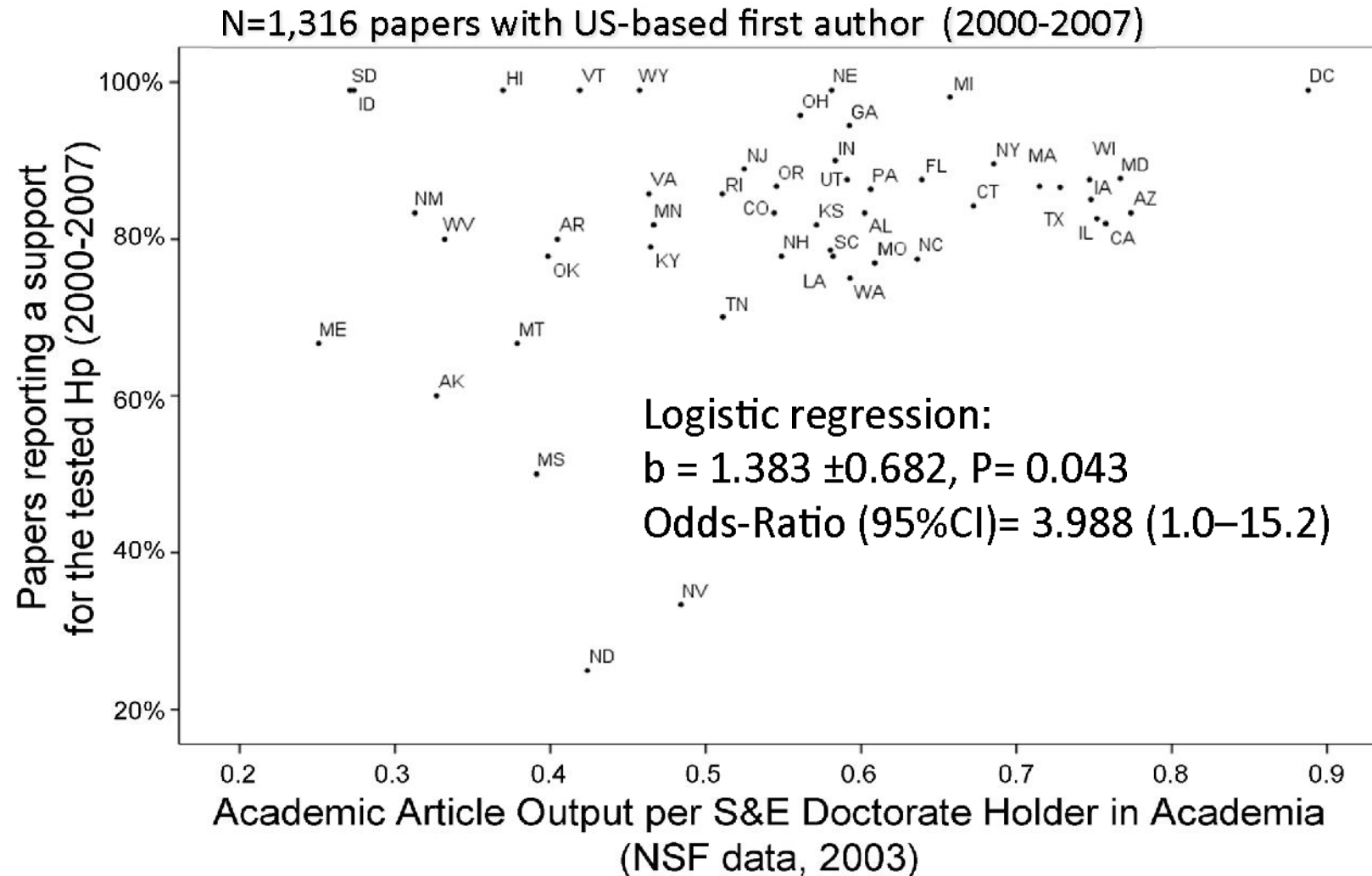
How it is done, why it is done, and what can be done about it?

2) Why is it done?

Because it's easy to get away with it

- Few will report scientific misconduct**
- Few will replicate findings**
- If they do, negative results will be**
 - Not published**
 - Turned into positive – by QRP**
 - Explained away**
 - (especially in “softer” research)**

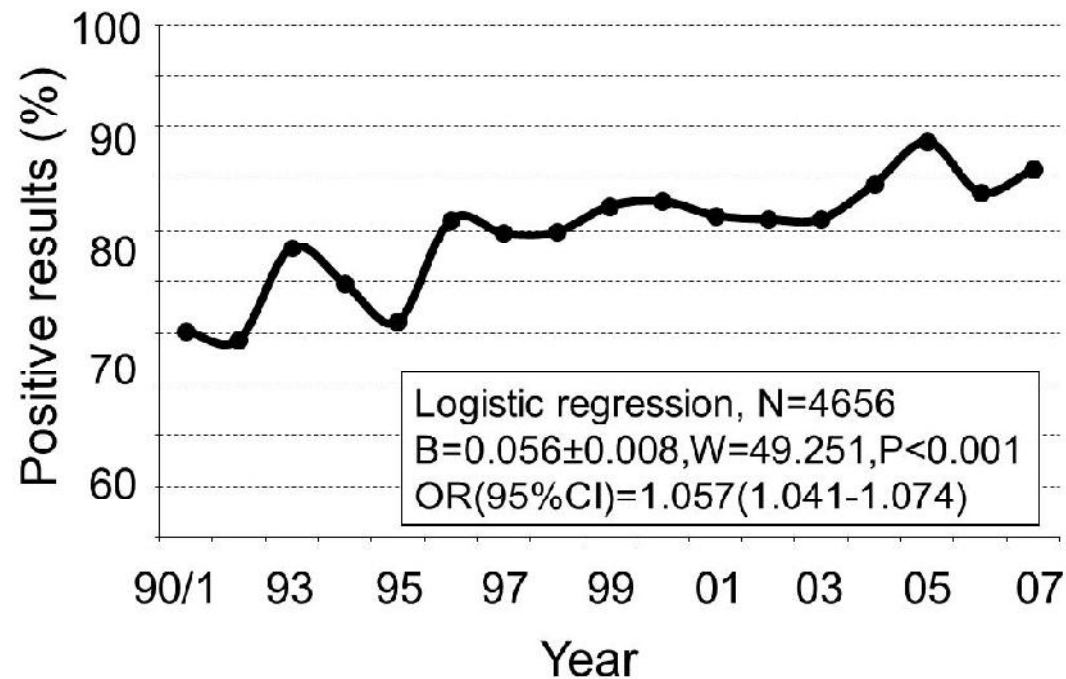
Are pressures to publish responsible?



(Fanelli 2010b, PLoS ONE, doi:
10.1371/ journal.pone.0010271)

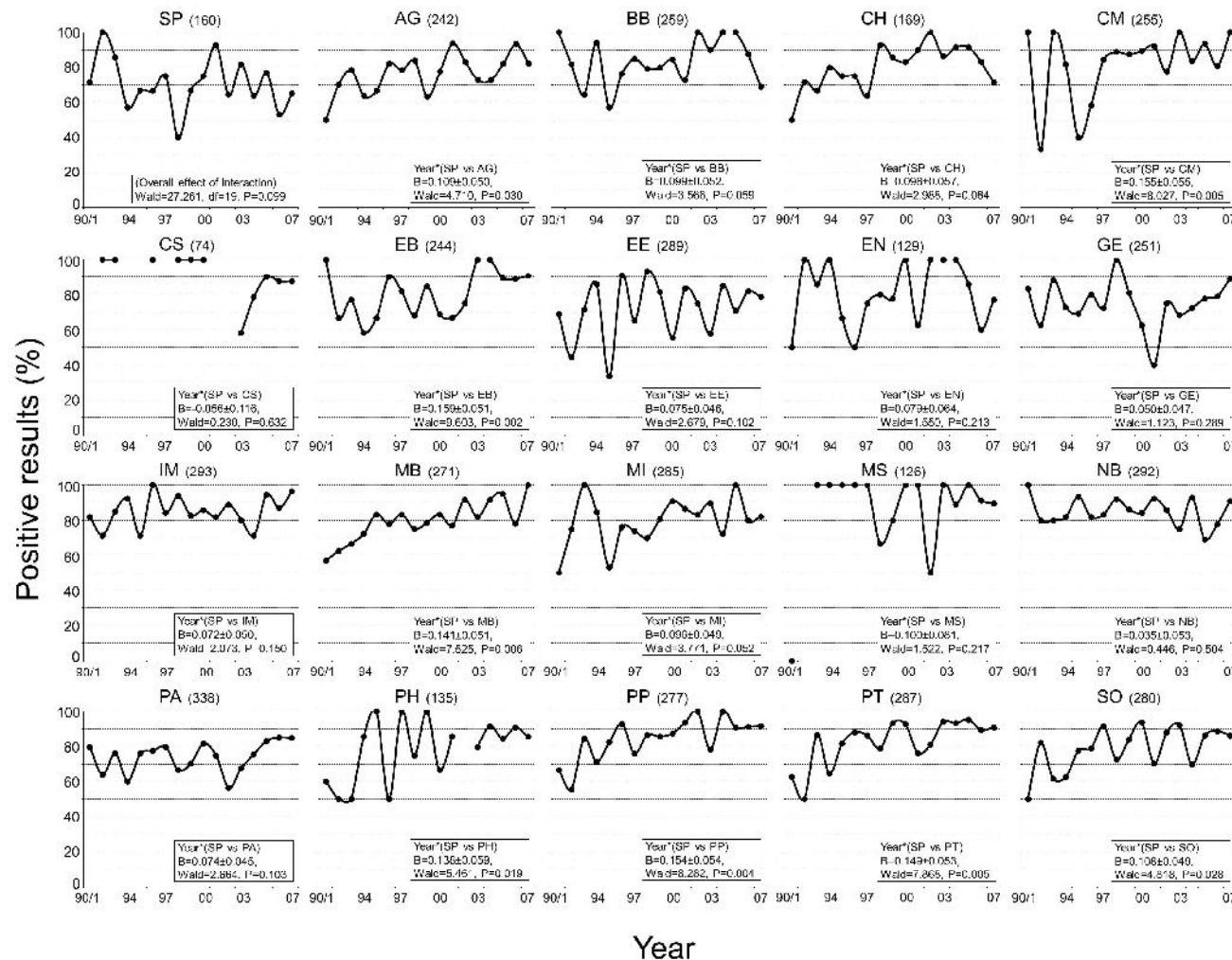
Positive results are increasing

(Web of Science data, independently confirmed)



Fanelli 2011, Scientometrics, doi:
10.1007/s11192-011-0494-

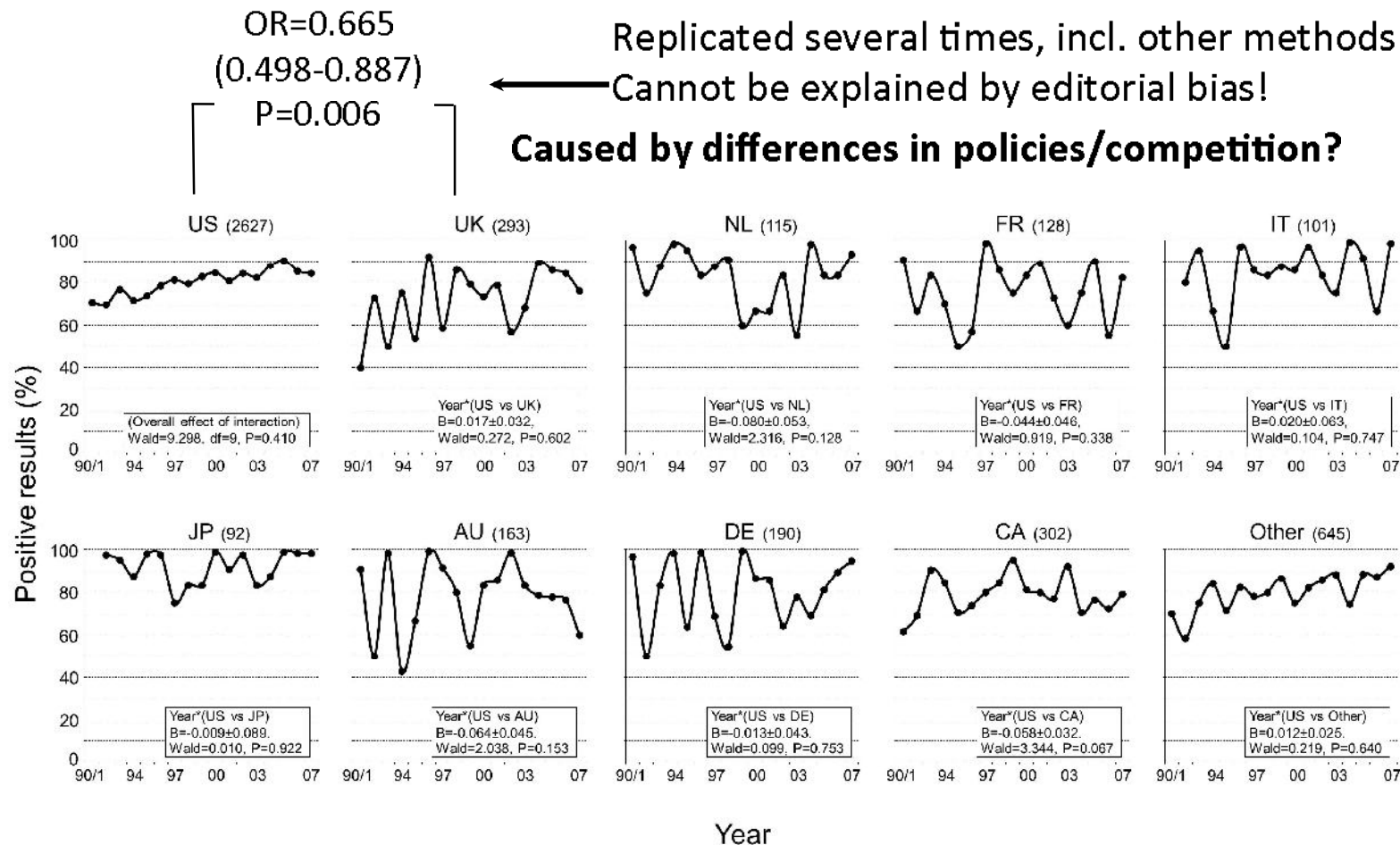
Disciplines: different growth and averages



(Multiple Logistic Regression, various confounders)

Fanelli 2011, Scientometrics,
doi:10.1007/s11192-011-0494-7

Countries (corr. author): Similar growth (ns), different averages



(Multiple Logistic Regression, various confounders)

Fanelli 2011, Scientometrics,
doi:10.1007/s11192-011-0494-7

Independent evidence: growth of bias

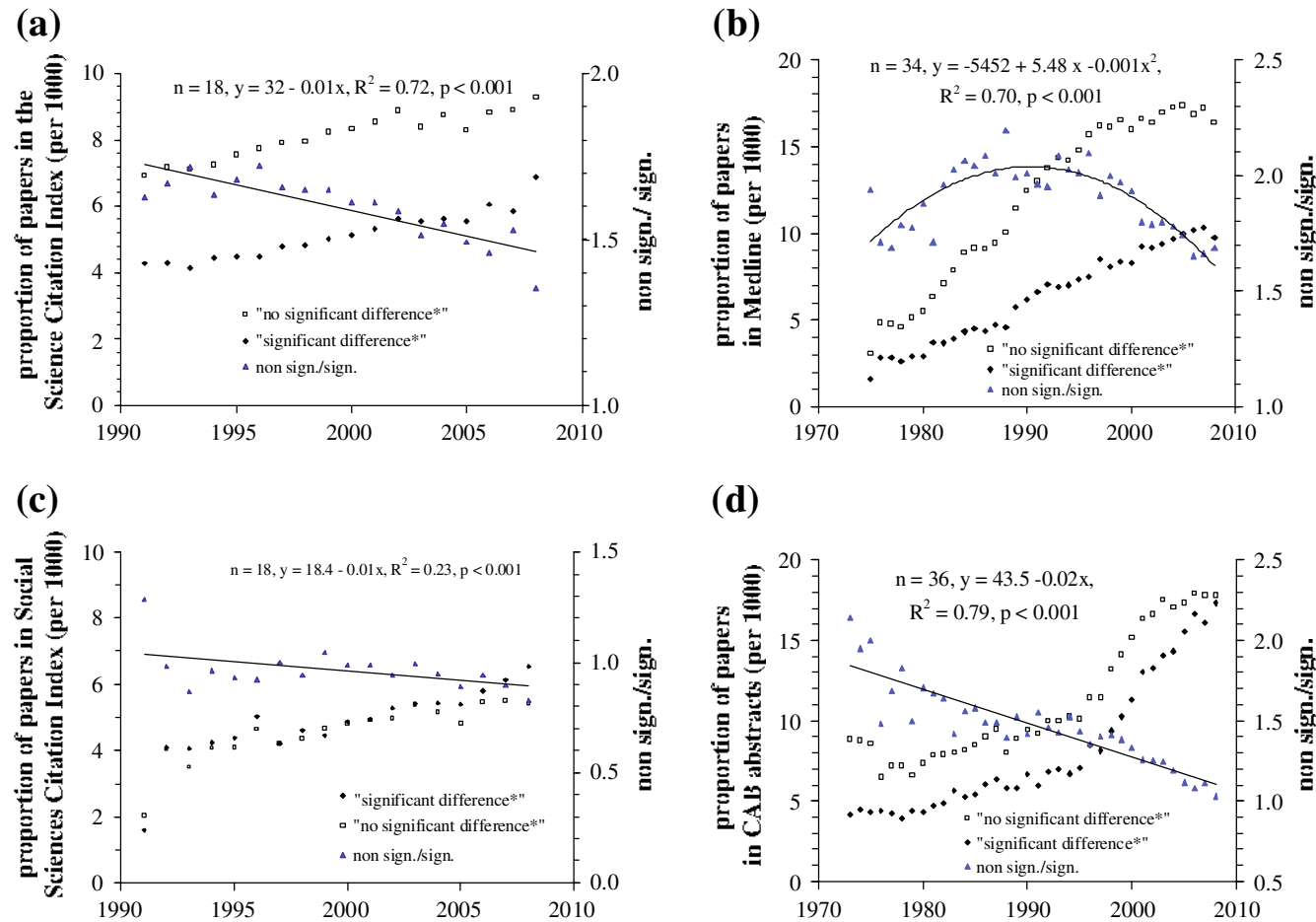


Fig. 2 Proportion of papers (per 1000) in **a** the Science Citation Index, **b** Medline, **c** the Social Science Citation Index, and **d** CAB Abstracts, reporting the absence or presence of significant differences in the title/abstract, as of March 2009. The ratio between the two variables is provided with a regression line (secondary y-axis)

(Pautasso 2010, Scientometrics,
doi: 10.1007/s11192-010-0233-5)

Independent evidence: US-bias

Exaggeration of results

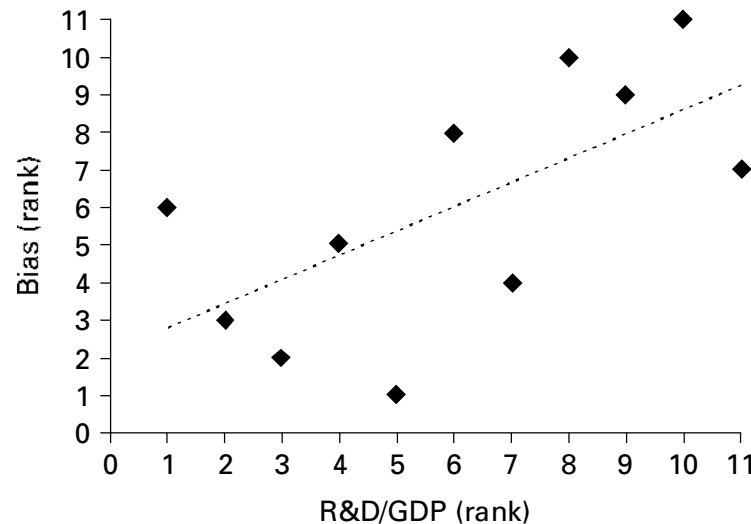


Fig. 1. Bias index and ratio of government research and development (R&D) funding to gross domestic product (GDP). Bias index, ranked in ascending order, is plotted against the ratio of government R&D funding in science and technology to GDP, also ranked in ascending order, for 11 individual countries. There is a strong, positive correlation ($r_s = +0.65$, $p = 0.032$), suggesting that greater research spending is associated with a greater degree of bias. (Source: OECD Main Science and Technology Indicators, 2006.)

“For studies coded as North America [...] there was evidence of a significant over-estimation of the true effect size (OR 1.10, 95% CI 1.02–1.17, $p = 0.009$)”

(Munafo` and Flint 2008
Psychological Medicine, doi:
10.1017/S003329170800353X)

How it is done, why it is done, and
what can be done about it?

2) Why is it done?

There are professional pressures/benefits to do so

- Probably increasing lately**
- Probably higher in some countries (e.g. US)?**

3) What can be done?

Too easy to get away with misconduct -> **Reinforce the system**

- Clearer definitions

National definitions of misconduct: behaviours that are included

country	year	Institution	fabrication and/or falsification and plagiarism	open definition	selective reporting	ghost-guest authorship	misuse of statistics	misrepresenting others' research	sabotaging others' research	biased interpretation of results	mismanaging conflicts of interest	duplicate publication	not following approved protocols	mismanaging/not preserving data	professional credentials	misrepresenting investigations	favouring misc./hampering reviewer	abusing power as a peer reviewer	withholding information or materials	financial misconduct	personal abuse	bad mentorship	harming human or animal subjects	exploiting students or subordinates	other	source
AU	2007	NHMRC et al.	x	x		x					x		x				x			x			x			[29]
CN	2009	CAS	x	x		x			x			x							x	x					x	[30]
CR	2007	CESHE	x		x	x		x	x	x	x	x													x	[31]
DK	2009	DCSD	x	x	x		x			x															x	[27]
FI	2002	TENK	x	x	x		x	x	x	x		x		x											x	[21]
FR	1999	INSERM	x			x					x			x								x			x	[32]
IN	2006	ICMR	x		x	x		x			x	x						x							x	[33]
NL	2001	KNAW et al.	x	x	x	x	x	x		x			x		x						x				x	[34]
NO	2007	NCISM	x	x																						[35]
SW	2004	EGISRM	x	x	x		x																		x	[36]
CH	2003	SAAS	x	x	x	x	x	x	x	x				x			x	x	x						x	[37]
UK	2009	UKRIO	x	x		x							x													[38]
US	2005	PHS	x		x																					[17]

(Fanelli 2010, in "Promoting Research Integrity in a Global Environment",
Available at: <http://www.worldscientific.com/worldscibooks/10.1142/8102>)

3) What can be done?

Too easy to get away with misconduct - **Reinforce the system**

- Clearer definitions
- Protection for whistleblowers
- Clear rules/education

More pressures to do so -> **Change criteria of career/publication**

- Careers: reward replicated results
- Journals: accept based on question and methods (results-blind)

Easy to get away with bias- **Improve reporting standards**

- E.g. EQUATOR, MIBBI – export to other disciplines
- Make this **the essence of scientific method**
- E.g. Re-define misconduct itself: *“any omission or misrepresentation of the information necessary and sufficient to evaluate the validity and significance of a research, at the level appropriate to the context in which the research is communicated”* (Fanelli, 2010, 2012, in prep)