06: **Scientific misconduct and bias**

a.k.a. Responsible conduct of research

February 17, 2012

Comments on the literature search assignment

- Common reasons for point deductions:
  - insufficient justification of journals, like "my labmate recommended it", "best IEEE journal for my topic", "previous work was published there" à when you decide where to publish you need to know what audience you want to target!
  - didn't put search terms in ISI syntax
  - didn't follow directions!
- Advice:
  - use truncation carefully, e.g., no plurals, define root word
  - design searches to return a reasonable number of references, some too broad even so you get unexpected hits
- I didn't follow a numerical rubric, considering the variety of topics and small number of assignments, but this will have no effect considering the grading policy of the course

Announcements

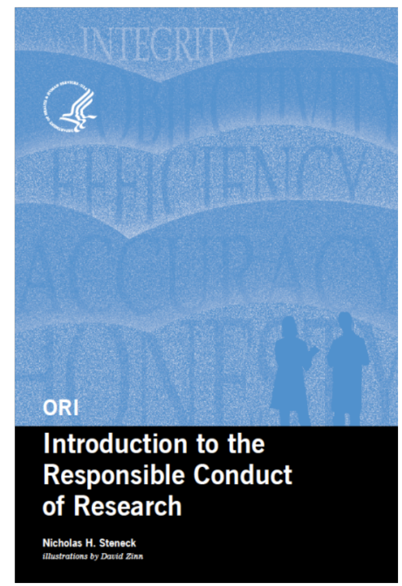
- Background reports due 2pm next Friday (Feb/24)
  - Submit on ctools
  - I'll make comments using track changes, so word is best but PDF is fine if you use latex
- No class next Friday → next class Friday Mar/9

What is responsible conduct of research?

"Research integrity is essentially a matter of behavior. It is embodied in the actions and decisions of scientists, rather than in the standards, codes, regulations, and norms that aim to shape behavior."

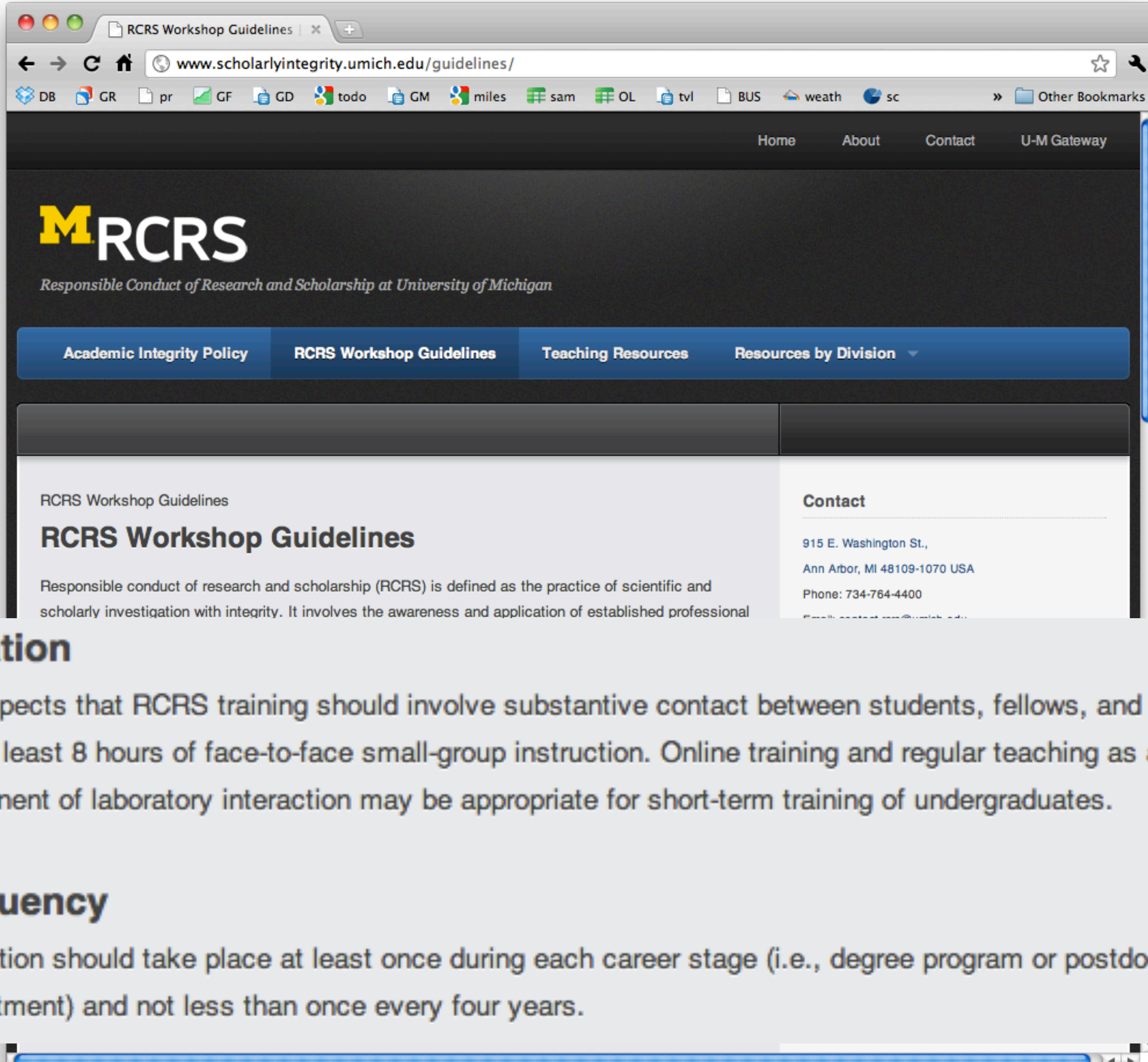
-M.S. Anderson (U. Minnesota)

In general terms, responsible conduct in research is simply good citizenship applied to professional life.



Nine Core Areas

1. Data acquisition, management, sharing, and ownership
2. Mentor/trainee responsibilities
3. Publication practices and responsible authorship
4. Peer review
5. Collaborative science
6. Human subjects
7. Research involving animals
8. Research misconduct
9. Conflict of interest and commitment



Duration

NIH expects that RCRS training should involve substantive contact between students, fellows, and faculty, with at least 8 hours of face-to-face small-group instruction. Online training and regular teaching as a component of laboratory interaction may be appropriate for short-term training of undergraduates.

Frequency

Instruction should take place at least once during each career stage (i.e., degree program or postdoctoral appointment) and not less than once every four years.

CoE RCRS workshops

- Required for all new PhD students and postdocs, effective Fall 2011
- Who's attended?

- A: Sources, Authorship, and the Publication Process [Hart/Boukai]
- B: Data Management and Falsification
- C: Collaborative Research, Conflicts of Interest (COI), Supervisory and Mentoring Relationships

Goals of Today

- Review some key topics related to RCRS (assuming you've attended the workshops already)
- Enhance our understanding of these issues via discussion
- Realize the heterogeneity among individual/group/disciplinary perspectives toward everyday issues of RCRS, like authorship and collaboration

- Some optional readings related to today's discussion (now on ctools)
  - Lehrer, "The truth wears off"
  - Maher, "Sabotage"

Who says yes to any questions #4-11?

1. Which of the following best describes your position?
   ____ Grad student ____ Postdoc ____ Faculty ____ Staff

2. Which of the following best describes your experience in research?
   ____ None ____ <1 year ____ 1–5 years ____ >5 years

3. Have you ever been the author of a published paper or abstract?
   ____ Yes ____ No

4. Has your name been omitted from a paper for which you made a substantial contribution?
   ____ Yes ____ No

5. Have you been an author on a paper for which any of the authors had not made a sufficient contribution to warrant credit for the work?
   ____ Yes ____ No

6. Do you have firsthand knowledge of scientists plagiarizing the work of someone else?
   ____ Yes ____ No

7. Have you ever plagiarized the work of someone else?
   ____ Yes ____ No

8. Do you have firsthand knowledge of scientists intentionally falsifying or fabricating research or experimental results for the purpose of publication?
   ____ Yes ____ No

9. Do you have firsthand knowledge of scientists intentionally falsifying or fabricating research or experimental results to enhance a grant application?
   ____ Yes ____ No

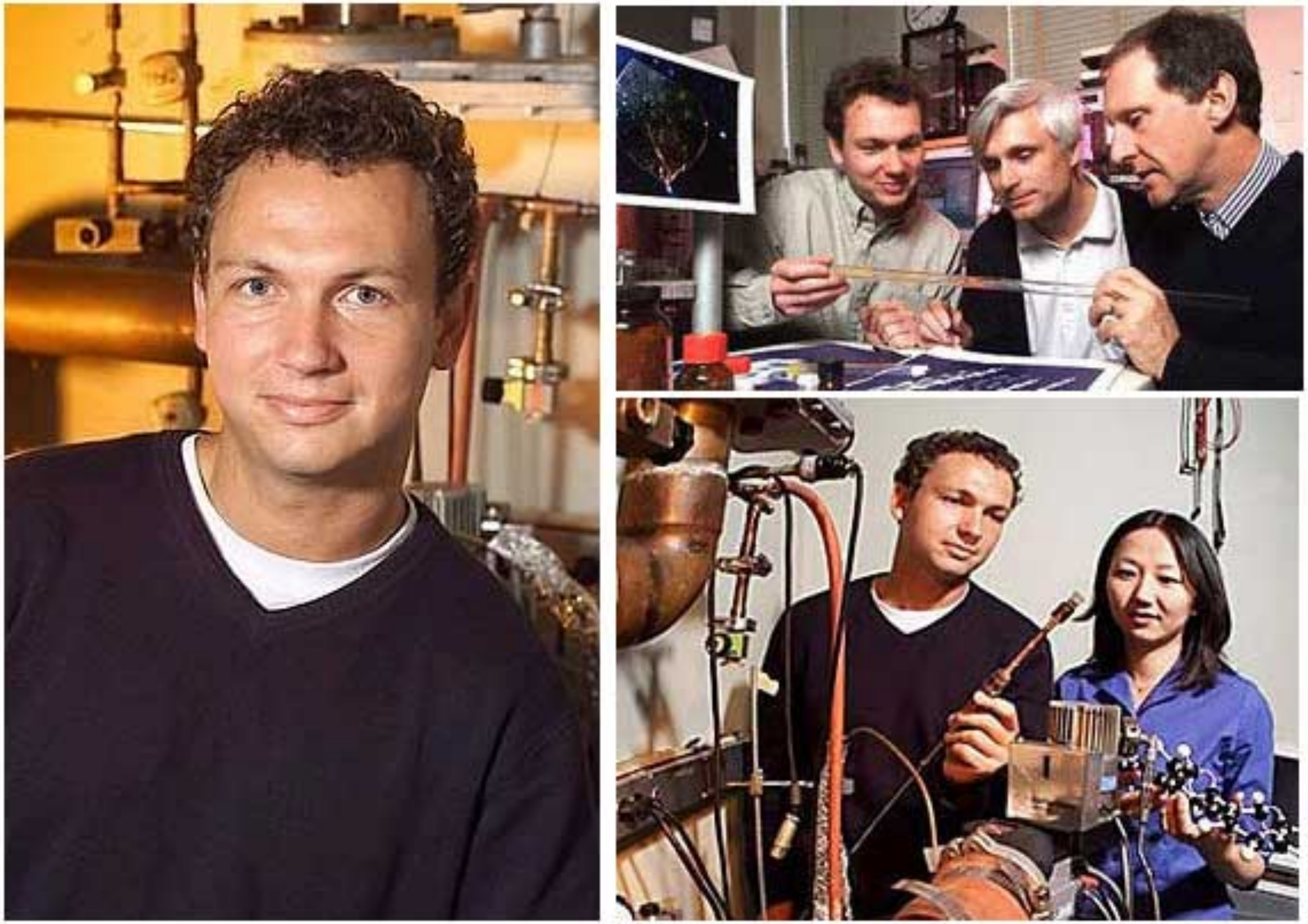
10. Have you ever falsified or fabricated research or experimental results for the purpose of publication or a grant application?
    ____ Yes ____ No

11. Have you ever reported research or experimental results that you knew to be untrue?
    ____ Yes ____ No

12. Would you report a coworker who you believe has violated scientific integrity standards?
    ____ Yes ____ No

13. Would you report your supervisor/advisor who you believe has violated scientific integrity standards?
    ____ Yes ____ No

from Macrina, Scientific Integrity



Jan Hendrik Schon

4 years after his Ph.D. (1997→2001), Schon was listed as an author on a new paper every 8 days.

but others couldn't reproduce his results, and then found suspicious things in Schon's papers, like 2 curves with the same noise

http://www.artgazine.com/shoutouts/viewtopic.php?p=3831

By all accounts, Hendrik Schön is a hard working and productive scientist. If valid, the work he and his coauthors report would represent a remarkable number of major breakthroughs in condensed-matter physics and solid-state devices.

Except for the provision of starting materials by others, all device fabrication, physical measurement and data processing in the work in question were carried out (with minor exceptions) by Hendrik Schön alone, with no participation by any coauthor or other colleague. None of the most significant physical results was witnessed by any coauthor or other colleague.

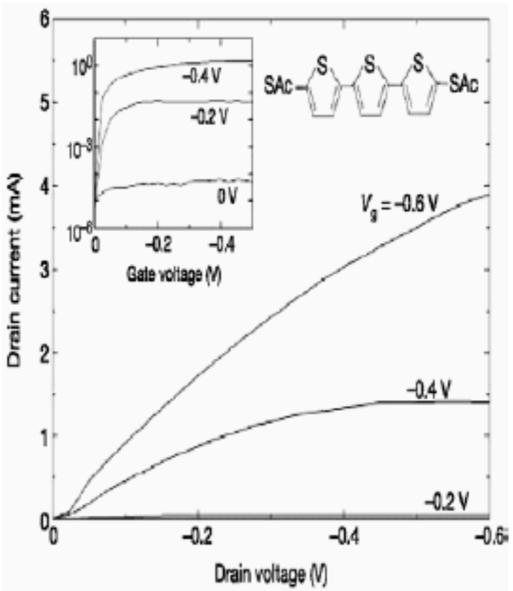
Proper laboratory records were not systematically maintained by Hendrik Schön in the course of the work in question. In addition, virtually all primary (raw) electronic data files were deleted by Hendrik Schön, reportedly because the old computer available to him lacked sufficient memory. No working devices with which one might confirm claimed results are presently available, having been damaged in measurement, damaged in transit or simply discarded. Finally, key processing equipment no longer produces the unparalleled results that enabled many of the key experiments. Hence, it is not possible to confirm or refute directly the validity of the claims in the work in question.

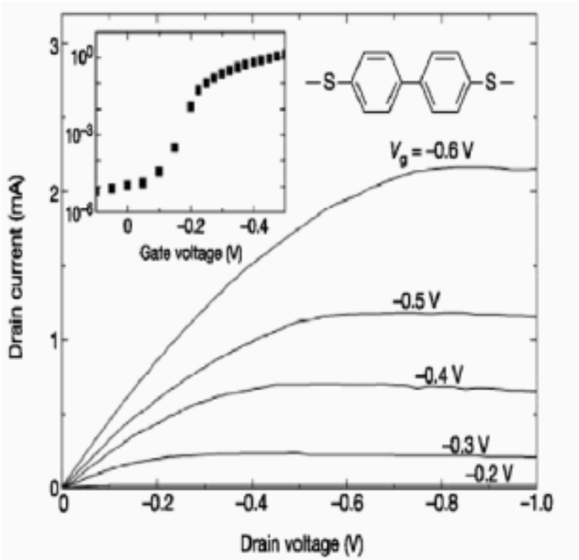
The most serious allegations regarding the work in question relate to possible manipulation and misrepresentation of data. These allegations speak directly to the question of scientific misconduct. The Committee carefully investigated each of these allegations and came to a specific conclusion in each case.

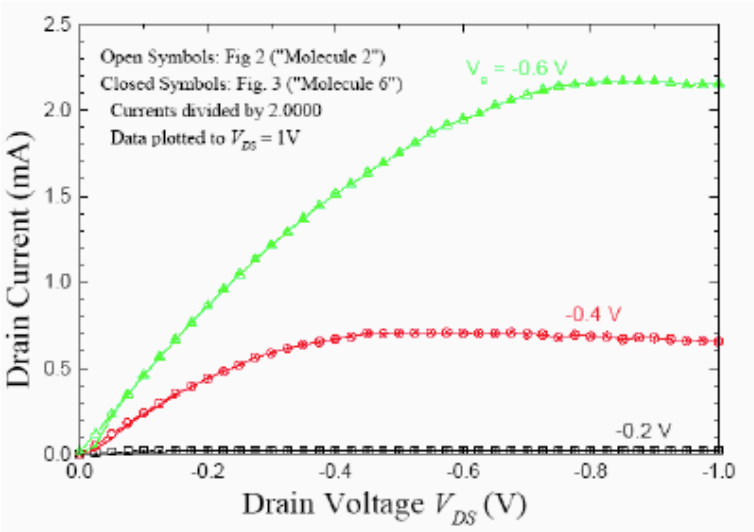
The evidence that manipulation and misrepresentation of data occurred is compelling. In its mildest form, whole data sets were substituted to represent different materials or devices. Hendrik Schön acknowledges that the data are incorrect in many of these instances. He states that these substitutions could have occurred by honest mistake. The recurrent nature of such mistakes suggests a deeper problem. At a minimum, Hendrik Schön showed reckless disregard for the sanctity of data in the value system of science. His failure to retain primary data files compounds the problem.

More troublesome are the substitutions of single curves or even parts of single curves, in multiple figures representing different materials or devices, and the use of mathematical functions to represent real data. Hendrik Schön acknowledges these practices in many instances, but states that they were done to achieve a more convincing representation of behavior that was nonetheless observed. Such practices are completely unacceptable and represent scientific misconduct.

http://publish.aps.org/reports/lucentrep.pdf



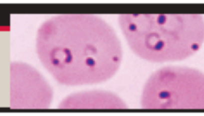




Left: Triode data from "SAMFET" Paper (XII), Fig. 3: "molecule 6". The figure has been compressed laterally for comparison.

Middle:Triode data from "SAMFET" Paper (XII), Fig. 2: "molecule 2"

Right: Original plotting data from middle and left figure ,replotted to illustrate that the data present in both are exactly the same, after dividing the latter by 2. All but a few of the solid symbols are within the open symbols, and agree with each other to five significant figures, although they represent distinct data sets.



SCIENTIFIC MISCONDUCT

Bell Labs Fires Star Physicist Found Guilty of Forging Data

Like the mythical Icarus, whose waxen wings melted when he flew too close to the sun, the soaring career of Jan Hendrik Schön came crashing down to Earth last week. Schön, a 32-year-old physicist at Bell Laboratories in Murray Hill, New Jersey, faked experimental results in at least 17 published papers, according to a report released 25 September by a panel of independent investigators. Schön had been fired from Bell Labs the previous evening, after officials there received the report. The findings mark this as one of the most extensive cases of scientific misconduct in modern history and signal a low-water mark for Bell Labs, an institution already reeling from economic troubles of its parent company, Lucent Technologies.

"It's a big train wreck and very sad," says Lydia Sohn, a Princeton University physicist who was one of the first to point out Schön's apparent manipulation of data. "But this shows that the system of checks and balances in science works." Others were less consoled. "If this guy [had been] a little less blatant, he could have succeeded. That's the terrifying thing," says Paul McEuen, a physicist at Cornell University in Ithaca, New York.

The panel cleared Schön's co-authors of any direct scientific misconduct. But it left open questions that are likely to reverberate through scientific circles for years to come. Chief among them are whether papers Schön co-authored that were not reviewed by the committee are valid and whether Schön's co-authors, the journals that published his papers, or scientific referees should have caught the fraud earlier. "There are other questions, and they are for others to address," says Stanford University physicist Malcolm Beasley, who chaired the panel.

Bell Labs hired Schön as a postdoctoral researcher in 1998 to work with Bertram Batlogg—then Bell's head of solid state physics research—on investigating how electrical charges move through crystals of organic semiconductors. Working with crystal grower Christian Kloc, Schön and Batlogg made rapid progress. Early on, they reported a new way to inject large electric currents into their organic crystals. That advance produced an extraordinary string of effects, including superconductivity, the fractional quantum Hall effect, and laserlike behavior. "He rediscovered everything in condensed matter physics in the last 60 years" in organic materials, Sohn says.

In his 4-year career at Bell Labs, Schön's steady stream of stunning breakthroughs promised to revolutionize the fields of organic electronics, superconductivity, and nanotechnology. By the beginning of this year he had produced a string of more than 90 papers, most of which listed him as the lead author. In 2001, Schön churned out a new paper on average every 8 days, a level of productivity nearly unheard of in physics.

Image not available for online use.

Shattered trust. Panel fingered Schön (left) for misconduct but cleared former partners Kloc and Batlogg.

To researchers watching from the wings, Schön seemed to be a Tiger Woods of physics, a young prodigy overwhelming the competition. "These papers came out and you'd say, 'Oh, no,'" recalls Arthur Ramirez, a physicist at Los Alamos National Laboratory in New Mexico. "It would be a monthly demonstration of how stupid you are. He was creating a new field every 2 months."

Late last year, two of Schön's breakthroughs rocked the nascent community of nanotechnologists. In the 18 October 2001 issue of *Nature*, Schön, working with Bell Labs colleagues Zhenan Bao and Hong Meng, reported a novel transistor in which a single layer of molecules carried out the critical role of switching between two electronic states, the foundation of more-complex computer technology. In the 7 December 2001 issue of *Science* they went further, reporting evidence of a single molecule acting as a switch.

The sensational results were hailed as a triumph of nanotechnology and a key step toward the ultimate in miniaturization of computer technology. In April, Schön received the Outstanding Young Investigator award and $3000 in prize money from the Materials Research Society. *Technology Review* magazine named him one of science's top young innovators in its June issue, which went to the printers before the allegations of misconduct surfaced in May. Around the same time, Schön was also being considered for the directorship of the Max Planck Institute for Solid State Research in Stuttgart, Germany.

But Schön's bold results turned out to be his undoing, attracting intense scrutiny to his work. In April, outside researchers noticed that a figure in the *Nature* paper on the molecular-layer switch also appeared in a paper *Science* had just published on a different device. Schön promptly sent in a corrected figure for the *Science* paper. But the incident disturbed McEuen, who says he was already suspicious of results reported in the two papers. On 9 May, McEuen compared figures in some of Schön's other papers and quickly found other apparent duplications. The next day, he alerted officials at Bell Labs, who immediately organized a five-member panel to review the allegations and a host of others that poured in shortly after (*Science*, 24 May, p. 1376; 31 May, p. 1584; 5 July, p. 34).

The panel ultimately focused on 24 allegations of misconduct in 25 separate papers that included 20 co-authors. In its inquiry, the panel sent each co-author a list of questions detailing concerns raised about studies in which they participated. In late July, panel members visited Bell Labs and conducted extensive interviews with Schön and his three primary co-authors, Batlogg, Kloc, and Bao. They also reviewed computer logs and data files. After sifting through all the evidence, they concluded that Schön had either falsified or fabricated data in 16 of the 24 cases. He had also deleted his original data files, making it impossible to check his

PAPERS IN WHICH MISCONDUCT WAS FOUND

"Ambipolar pentacene ...," *Science* (11 February 2000)

"A superconducting field-effect switch," *Science* (28 April 2000)

"An organic solid state injection laser," *Science* (28 July 2000)

"A light-emitting field-effect transistor," *Science* (3 November 2000)

"Superconductivity at 52 K in ... C_{60}," *Nature* (30 November 2000)

"Perylene:A promising ...," *Appl. Phys. Lett.* (4 December 2000)

"Ambipolar organic devices ...," *Synthetic Metals* (2001)

"Gate-induced superconductivity ...," *Nature* (8 March 2001)

"Solution processed CdS ...," *Thin Solid Films* (2 April 2001)

"High-temperature superconductivity in lattice-expanded C_{60}," *Science* (28 September 2001)

"Ballistic hole transport in pentacene with a mean free path exceeding 30 μm," *J. Appl. Phys.* (1 October 2001)

"Self-assembled monolayer organic ...," *Nature* (18 October 2001)

"Superconductivity in $CaCuO_2$ ...," *Nature* (22 November 2001)

"Field-effect modulation ...," *Science* (7 December 2001)

"Fast organic electronic circuits based on ambipolar pentacene ...," *Appl. Phys. Lett.* (10 December 2001)

"Nanoscale organic transistors ...," *Appl. Phys. Lett.* (4 February 2002)

"Sputtering of alumina thin films for field-effect doping," preprint

PROFILE: JOHN ROGERS

Farewell to Flatland

By creating electronic materials that bend and stretch, a pioneering researcher could change the way we light our homes, treat diseases, and power the planet

In the summer of 2000, at age 33, John Rogers was named as one of the youngest department managers ever at the famed invention shop, Bell Laboratories in Murray Hill, New Jersey. But within months, he was caught in the middle of what he calls "a complete disaster." Shortly after Rogers took the helm of his department, a Bell Labs postdoc and physicist named Jan Hendrik Schön joined the lab's full-time staff. Schön was already a hotshot at Bell Labs and beyond. In a series of high-profile papers, Schön and Bell Labs colleagues reported a steady stream of advances illuminating the way electric charges move through organic crystals. They saw superconductivity, the fractional quantum Hall effect, laserlike behavior—each advance more dramatic than the last. Conference invitations poured in. There were even rumors of a possible Nobel Prize.

Then it all came crashing down. In the autumn of 2002, Schön was found to have faked experimental results in at least 17 published papers (including six in *Science*). "It was off-the-charts awful," Rogers recalls. "I hadn't managed a postdoc before, much less a department, much less a monster." His anger over what he considers Schön's betrayal remains fresh.

To make matters worse, Lucent Technologies—then Bell's parent company—was in the process of imploding financially, forcing managers to shed staff members and talent. Rogers says that at the time he wasn't overly concerned that Schön's misdeeds would contaminate him. "I was more concerned about the taint on the lab. It didn't affect Lucent's decisions [to cut research staff members]. But it didn't help."

Shortly after news of the fraud broke in the summer of 2002, Bell Labs investigated and ultimately fired Schön (*Science*, 4 October 2002, p. 30). And in December 2002, Rogers left Bell Labs to take an academic position at the University of Illinois, Urbana-Champaign, in hopes of giving his career a fresh start.

Rogers hasn't just survived—he has thrived. Running a lab with some 40 students and postdocs and working with colleagues and collaborators around the world, Rogers has pioneered a new approach to patterning conventional flat, rigid semiconductors, such as silicon, atop lightweight, flexible surfaces of nearly any type and shape. That advance is ushering in a new era of lighting, medical equipment, and solar cells that are all quickly moving to commercialization and garnering Rogers plenty of attention. Last fall, Rogers won a MacArthur Fellowship, commonly called a genius grant. And others are offering praise as well. "I've been a fan of John's from the beginning," says Michael McAlpine, a chemist at Princeton University, who also works on novel flexible electronic devices. "He's one of the most creative scientists out there."

Science that works

Rogers's knack for finding novel ways to manipulate semiconductors started early. After earning degrees at the University of Texas, Austin, and the Massachusetts Institute of Technology (MIT), Rogers served as a postdoc with George Whitesides, a chemist at Harvard University. Whitesides, a Renaissance scientist with expertise in fields as far-ranging as nanotechnology and the origins of life, was looking for a cheaper alternative to photolithography, the technique used to pattern computer chips. Rogers helped develop a technique called microcontact printing, capable of patterning tiny features using what amounts to advanced rubber-stamping techniques.

While working at Harvard, Rogers also formed a start-up company to commercialize his doctoral work at MIT: a technique for measuring the thickness of metal films with lasers, still used by chipmakers today. Although commercializing a new technology was difficult, Rogers says that seeing his work succeed commercially gave him a taste not just for pushing scientific boundaries but for inventing technology that affects people's lives. After Harvard, Rogers jumped to Bell Labs, where his approach of coupling science and engineering was strongly encouraged. The company had a reputation for backing revolutionary basic research. But with Lucent struggling, managers were desperate to provide potential products for its business units. Rogers came up with a technique for designing miniature heaters on the surfaces of optical fibers to control the way light propagates through them. The technology quickly moved into products and, like the laser thickness meter, is still sold today.

The ordeal with Schön barely dented Rogers's personal success at Bell, but Rogers says the experience left its mark on his approach to science. "It probably underscored my emphasis on engineering," he says. "If you are making a physical thing and send it to a collaborator, it has to work in other people's hands. It takes the issue of fraud off the table."

Stretchy circuits, bright tattoos

The novel stamping techniques Rogers developed with Whitesides proved ideal for patterning the newly popular flexible organic electronics. Rogers himself devel-

CREDIT: THOMPSON-MCCLELLAN

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Published by AAAS

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Breaking news and analysis from the world of science policy

Jan Hendrik Schön Loses His Ph.D.

by Gretchen Vogel on 19 September 2011, 3:45 PM | 0 Comments

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BERLIN—A German court has ruled that it is legal to revoke the Ph.D. of disgraced physicist Jan Hendrik Schön. Schön was the center of a spectacular scandal in 2002, and the University of Konstanz revoked his Ph.D. in 2004. Although a university investigation turned up no evidence that Schön had committed misconduct while at the university, university officials asked Schön to return his doctoral certificate based on a state law that allows degrees to be revoked when the recipient proves "unworthy." Schön was found to have faked data in at least 17 papers while he was a researcher at Bell Laboratories in Murray Hill, New Jersey.

Schön sued the university, and last year a court ruled in his favor. The university appealed, however, and last week the Administrative Court of Baden-Württemberg in Mannheim ruled that the university was within its rights to rescind the degree. The awarding of a doctorate is a confirmation of the recipient's ability to conduct independent scientific research, Judge Reinhard Schwan said in his oral explanation of the verdict last week. A Ph.D. brings with it the public perception of being a member of the scientific community and a presumed high level of trustworthiness, the judge said. When a recipient has violated basic principles of good scientific practice, the title is no longer applicable and should be corrected, he said. He also noted that Schön can still find work as a physicist without a Ph.D. title. Schön is reportedly employed as a process engineer for a company in Germany.

The Baden-Württemberg court said that it would not hear an appeal of its ruling. Schön has 1 month to appeal that decision to a federal court. His lawyer has told German media that he won't rule out an appeal, but Schön's chances of success are considered slim.

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Posted in Education | Europe

http://news.sciencemag.org/scienceinsider/2011/09/jan-hendrik-schon-loses-his-phd.html

Duplicate Publication: for real!

- Two papers published in top-level journals, within one year
- Significant duplication of figures (data) and results
- Same authors, different order, different corresponding author
- Paper #1 was published before paper #2 was submitted
- Paper #2 does not cite paper #1

Paper #1

For the CNT-reinforced sandwich beam, the analysis shows good correlation with test data for a damping ratio (Z_b) of 0.3 and a cross-sectional stiffness (EI) of 87.7×10^{-3} N m^2. Therefore, we conclude that carbon nanotube reinforcement results in a 200 % increase in the baseline structural damping (due to the frictional energy dissipation during the movement of individual nanotubes in the film) and a 30 % increase in the baseline bending stiffness (due to stiffening of the 2 mm adhesive sub-layer). Based on the observed increase in cross-sectional stiffness of the laminate from 65.1×10^{-3} N m^2 to 87.7×10^{-3} N m^2, the modulus of the carbon nanotube film was estimated using the Bernoulli–Euler theory as 41.2×10^6 psi (284 GPa). Table 2 compares the properties and operating conditions of the carbon nanotube film with commercially available viscoelastic damping polymers such as 3M1SD-112[20] and Soundcoat Dyad-606.[21]

Paper #1

For the CNT-reinforced sandwich beam, the analysis shows good correlation with test data for a damping ratio (Z_b) of 0.3 and a cross-sectional stiffness (EI) of 87.7×10^{-3} N m^2. Therefore we conclude that carbon nanotube reinforcement results in a 200% increase in the baseline structural damping (due to energy dissipation during the deformation of nanotube clusters within the film) and a 30% increase in the baseline bending stiffness (due to stiffening of the 0.05 mm epoxy sub-layer). These results are summarized in Table 2. Based on the observed increase in cross-sectional stiffness of the laminate from 65.1×10^{-3} to 87.7×10^{-3} N m^2, the modulus of the carbon nanotube film was estimated using Bernoulli–Euler theory as 284 GPa. Table 3 compares the properties and operating conditions of the carbon nanotube film with commercially available visco-elastic damping polymers such as Soundcoat Dyad-606 [4] and 3M 1SD-112 [5]. While the damping properties of all three films are comparable at room temperature, for high temperature applications the carbon nanotube based films are expected to provide superior performance and reliability.

Duplicate Publication: for real!

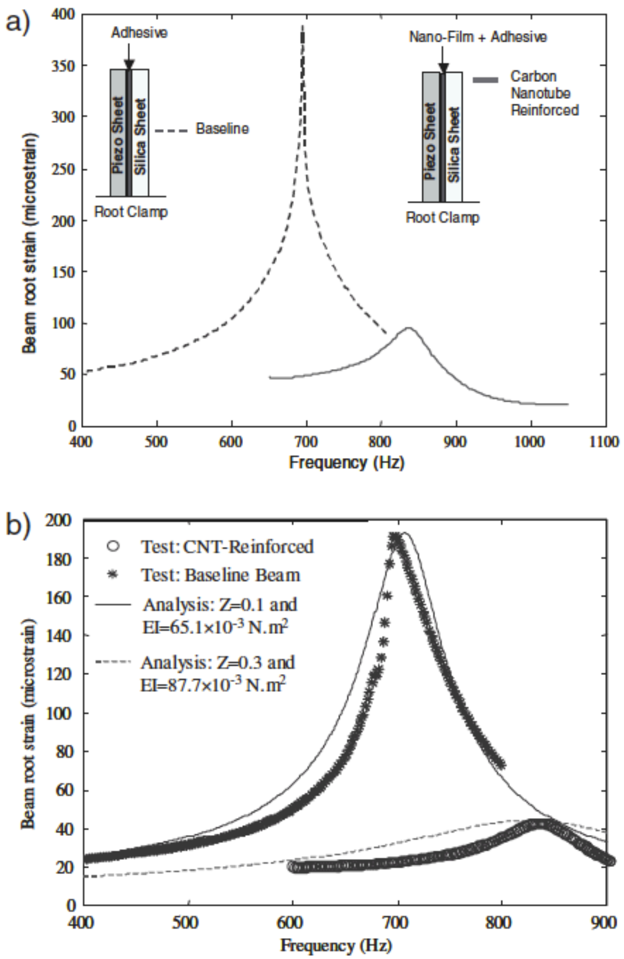


Fig. 2. a) Comparison of the dynamic response of the baseline beam and the nanotube reinforced sandwich beam for a frequency-sweep test at 50 V rms. (cantilevered length: 22.86 mm). The nanotube reinforced sandwich beam shows a very significant increase both in the damping and in the stiffness, compared to the baseline beam. b) Comparison of simulation and experimental results (Input to piezoelectric sheet: 25 V rms) shows good correlation between simulated results and test data.

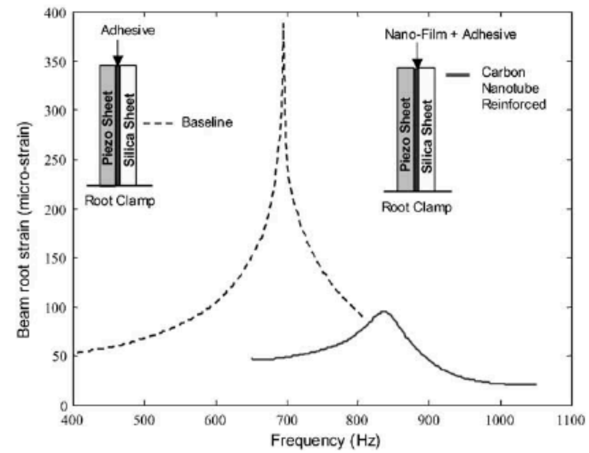


Fig. 5. Comparison of the dynamic response of the baseline beam and the nanotube reinforced sandwich beam for a frequency-sweep test at 50 Vrms (cantilevered length: 22.86 mm).

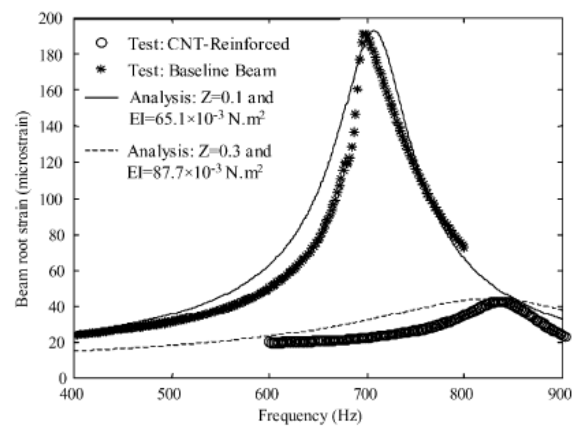
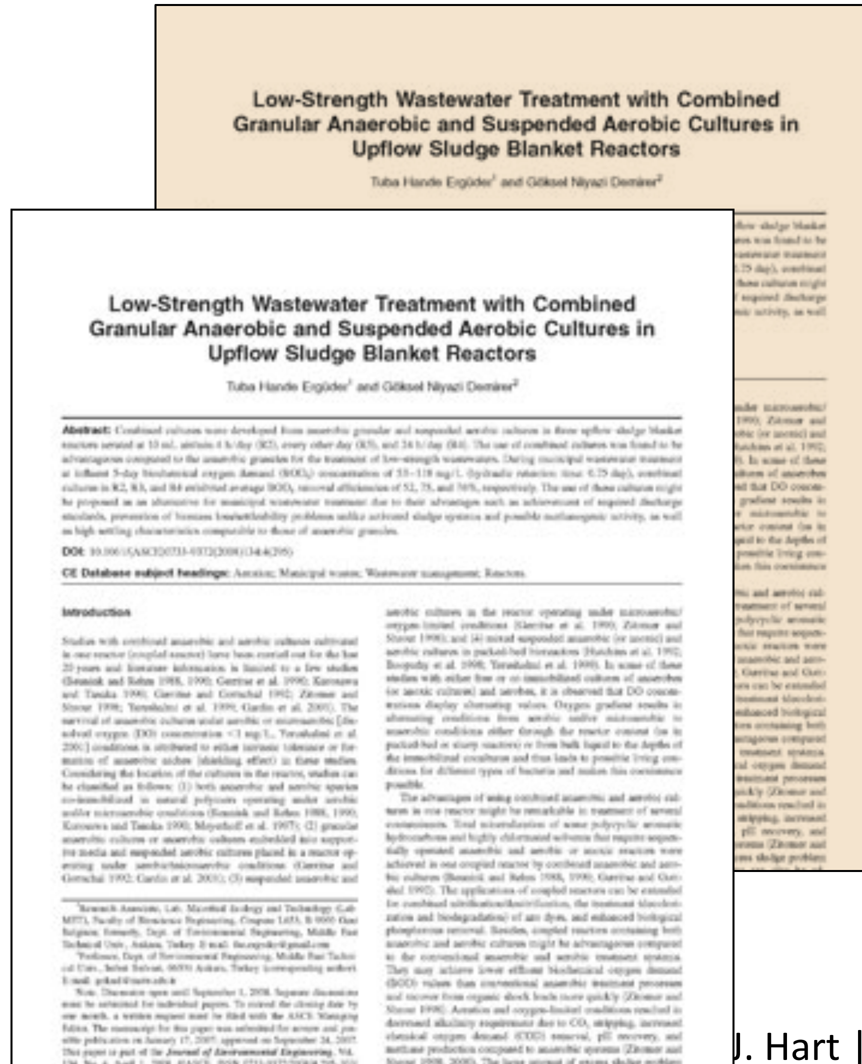


Fig. 6. Comparison of simulation and experimental results (input to piezoelectric sheet: 25 Vrms, cantilevered length: 22.86 mm).

Duplication and self-plagiarism

- At best, it is unethical, at worst it is illegal! (Especially if copyright has been assigned to someone else.)
- Exceptions
  - Symposium results reported first and then published later in a journal is accepted practice.
  - Proposals may be duplicated for submission to multiple agencies. Once one is funded, the PI must inform the other agencies.



Low-Strength Wastewater Treatment with Combined Granular Anaerobic and Suspended Aerobic Cultures in Upflow Sludge Blanket Reactors

Tuba Hande Ergüder[1] and Göksel Niyazi Demirer[2]

SABOTAGE!

Postdoc Vipul Bhrigu destroyed a colleague's experiments to get ahead. It took a hidden camera to expose a little-known, malicious side of science.

BY BRENDAN MAHER

It is sentencing day at Washtenaw County Courthouse, a drab structure of stained grey stone and tinted glass a few blocks from the main campus of the University of Michigan in Ann Arbor. Judge Elizabeth Pollard Hines has doled out probation and fines for drunk and disorderly conduct, shoplifting and other mundane crimes on this warm July morning. But one case, number 10-0596, is still waiting. Vipul Bhrigu, a former postdoc at the university's Comprehensive Cancer Center, wears a dark-blue three-buttoned suit and a pinched expression as he cups his pregnant wife's hand in both of his. When Pollard Hines calls Bhrigu's case to order, she has stern words for him: "I was inclined to send you to jail when I came out here this morning."

Bhrigu, over the course of several months at Michigan, had meticulously and systematically sabotaged the work of Heather Ames, a graduate student in his lab, by tampering with her experiments and poisoning her cell-culture media. Captured on hidden camera, Bhrigu confessed to university police in April and pleaded guilty to malicious destruction of personal property, a misdemeanour that apparently usually involves cars: in the spaces for make and model on the police report, the arresting

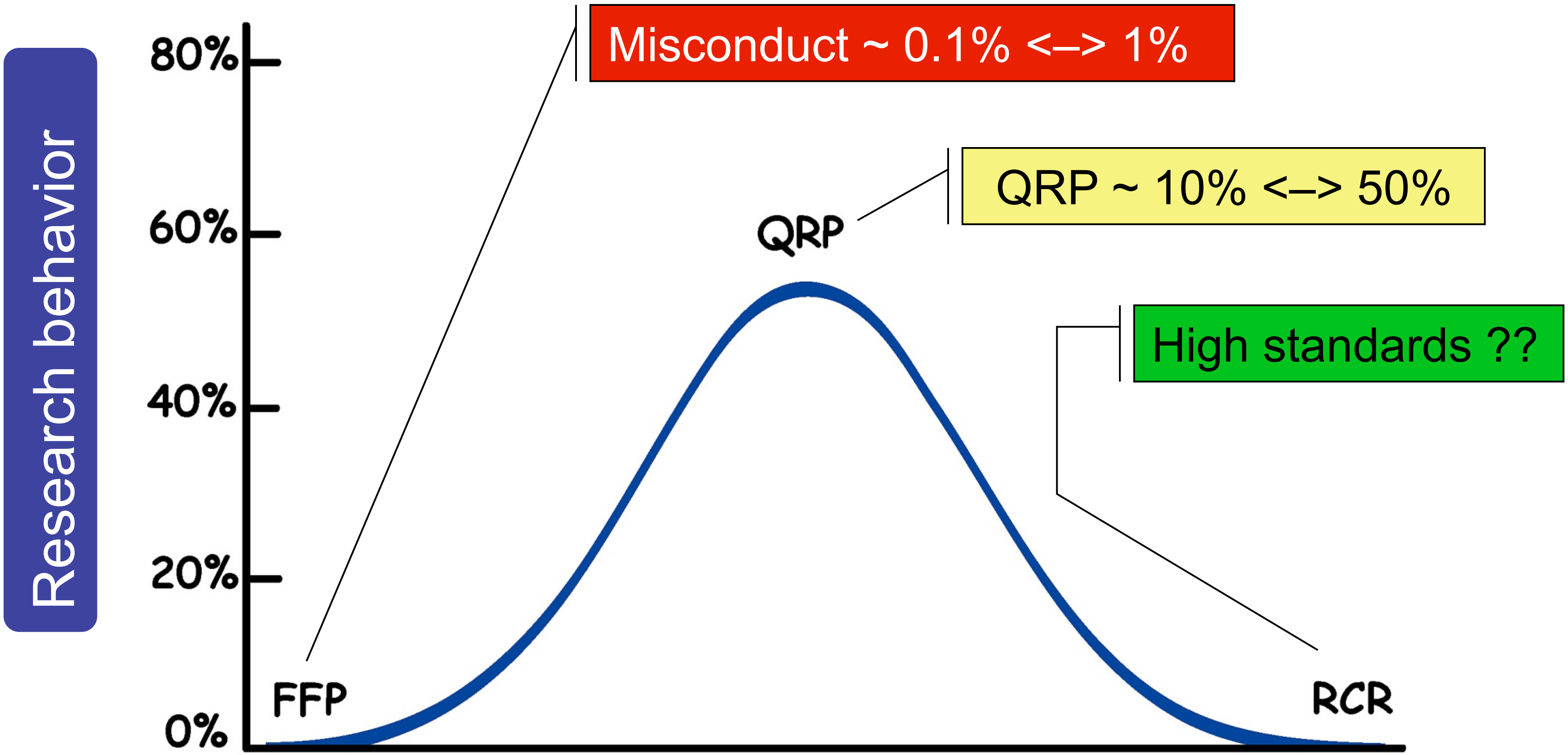
Bhrigu says that he felt pressure in moving from the small college at Toledo to the much bigger one in Michigan. He says that some criticisms he received from Ross about his incomplete training and his work habits frustrated him, but he doesn't blame his actions on that. "In any kind of workplace there is bound to be some pressure," he says. "I just got jealous of others moving ahead and I wanted to slow them down."

There can be little doubt about the fraudulent nature of fabrication, but falsification is a more problematic category. Scientific results can be distorted in several ways, which can often be very subtle and/or elude researchers' conscious control. Data, for example, can be "cooked" (a process which mathematician Charles Babbage in 1830 defined as "an art of various forms, the object of which is to give to ordinary observations the appearance and character of those of the highest degree of accuracy"[12]); it can be "mined" to find a statistically significant relationship that is then presented as the original target of the study; it can be selectively published only when it supports one's expectations; it can conceal conflicts of interest, etc… [10,11,13,14,15]. Depending on factors specific to each case, these misbehaviours lie somewhere on a continuum between scientific fraud, bias, and simple carelessness, so their direct inclusion in the "falsification" category is debatable, although their negative impact on research can be dramatic [11,14,16]. Henceforth, these misbehaviours will be indicated as "questionable research practices" (QRP, but for a technical definition of the term see [11]).

Ultimately, it is impossible to draw clear boundaries for scientific misconduct, just as it is impossible to give a universal definition of professional malpractice [10]. However, the intention to deceive is a key element. Unwilling errors or honest differences in designing or interpreting a research are currently not considered scientific misconduct [10].

Fanelli. *PLoS ONE* 5(4):e5738, 2009.

Significant gap between ideal (high standards) and actual standards for integrity in research



Scientists behaving badly

To protect the integrity of science, we must look beyond falsification, fabrication and plagiarism, to a wider range of questionable research practices, argue **Brian C. Martinson**, **Melissa S. Anderson** and **Raymond de Vries**.

Major question: “have you done X… during the past three years?”

Ten Top Behaviors (Martinson, *Nature*, June 05)	All	Mid	Early
1. Falsifying or ‘cooking’ research data	0.3	0.2	0.5
2. Ignoring major aspects of human-subject requirements	0.3	0.3	0.4
3. Not properly disclosing involvement in firms whose products are based on one ‘s own research	0.3	0.4	0.3
4. Relationships with students, research subjects or clients that may be interpreted as questionable	1.4	1.3	1.4
5. Using another’s ideas without obtaining permission or giving due credit	1.4	1.7	1.0
6. Unauthorized use of confidential information	1.7	2.4	0.8
7. Failing to present data that contradict one’s own previous research	6.0	6.5	5.3
8. Circumventing certain minor aspects of human-subject requirements	7.6	9.0	6.0
9. Overlooking others' use of flawed data or questionable interpretation	12.5	12.2	12.8
10. Changing the design, methodology or results of a study in response to pressure from a funding source	15.5	20.6	9.5

(red) = Federal definition of misconduct

(some) types of scientific misconduct

- Plagiarism
  - "When an author duplicates his or her or another's written words from another body of text without reference to the original source"
- Use of information without consent
- Data fabrication
- Data manipulation
- Duplication of data in two manuscripts
- Inaccurate citations;
  - Skews reader's/reviewer's view of the "truth"
- Failure to give appropriate credit
- Mishandling of grant funds

How do people respond to possible misconduct?

Table 2. Actions taken against misconduct.

ID	N cases	Action taken	%
Tangney, 1987 [32]	78	Took some action to verify their suspicions of fraud or to remedy the situation	46
Rankin, 1997 [57]	31 [ffp]	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 [46]	49	I interfered to prevent it from happening	28.6
		I reported it to a relevant person or organization	22.4
Kattenbraker, 2007 [61]	33	Confronted individual	55.5
		Reported to supervisor	36.4
		Reported to Institutional Review Board	12.1
		Discussed with colleagues	36.4
Titus, 2008 [31]	115 [ffp]	The suspected misconduct was reported by the survey respondent	24.4
		The suspected misconduct was reported by someone else	33.3

Abbreviations: "N cases" is the total number of cases of misconduct observed by respondents, [ffp] indicates that the number includes cases of plagiarism, "%" is the percentage of cases that had the specified action taken against them. All responses are mutually exclusive except in Kattenbraker 2007.
doi:10.1371/journal.pone.0005738.t002

Fanelli. *PLoS ONE* 5(4):e5738, 2009.

Pressures against responsible conduct

- Deadlines
- Competition
- Pressure from peers/advisor
- Unawareness of standards
- Perceptions of what's needed to be successful
- Simply being on "the frontier"

  - "The use of new research techniques and the generation of new knowledge create difficult questions about the interpretation of data, the application of rules, and proper relationships with colleagues."

    - De Vries, Martin, Anderson

“survival skills” → misconduct

Our empirical results show that some forms of mentoring indeed prove salutary: those with mentoring in the ethics, research and personal categories were less likely to engage in misbehavior [2]. Problems showed up, however, in relation to mentoring for survival in science, that is, mentoring on what it takes to succeed in science. This kind of mentoring is associated with a greater likelihood of misbehavior of several kinds.

We can imagine a mentor quietly telling a student what he or she needs to do to get ahead. Such advice would not necessarily constitute an endorsement of FFP, but might instead suggest the utility of taking methodological shortcuts, providing incomplete methodological details in papers, maintaining a generous interpretation of allowable expenses in funding categories, or short-changing peer-review duties. That these behaviors are associated with survival mentoring but not instruction suggests that students learn about them in confidential, rather than in public, settings.

Anderson. *Sci Eng Ethics* 13:387-394, 2007.

Does pressure to publish increase bias?

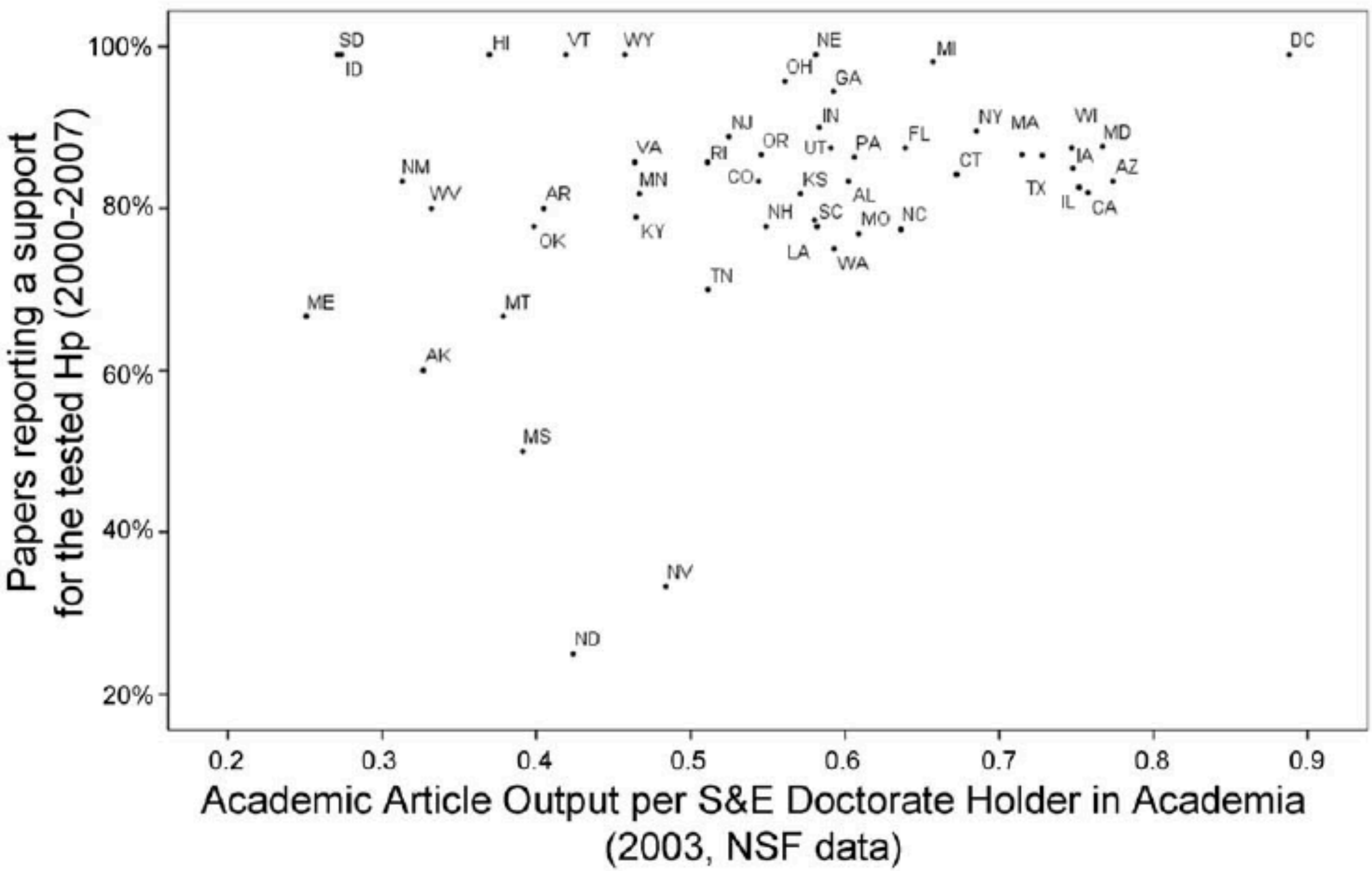


Figure 2. "Positive" results by per-capita publication rate. Percentage of papers supporting a tested hypothesis in each US state plotted against the state's academic article output per science and engineering doctorate holder in academia in 2003 (NSF data). Papers were published between 2000 and 2007 and classified by the US state of the corresponding author. US states are indicated by official USPS abbreviations. For abbreviations legend, see Figure 1.

doi:10.1371/journal.pone.0010271.g002

Fanelli. *PLoS ONE* 5(4):e10271, 2010.

“Positivity” of results depends on discipline

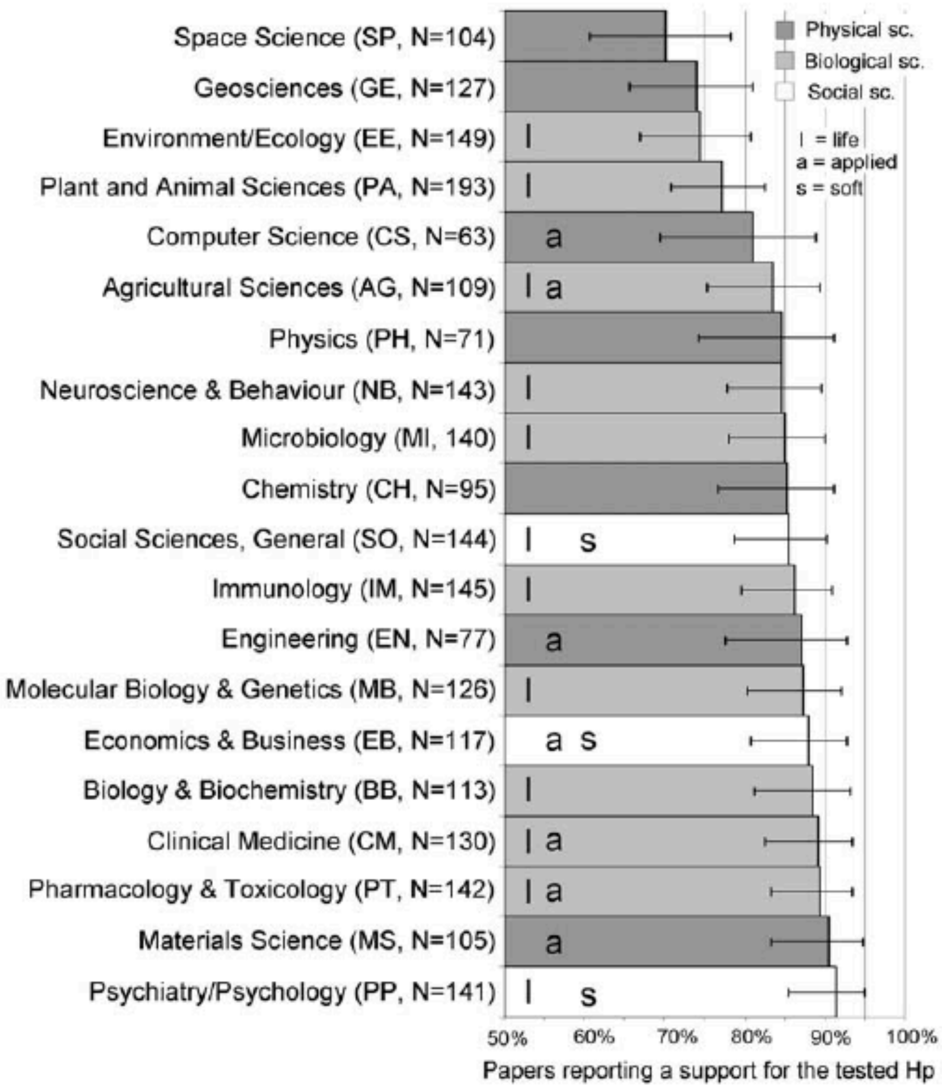


Figure 1. Positive Results by Discipline. Name of discipline, abbreviation used throughout the paper, sample size and percentage of “positive” results (i.e. papers that support a tested hypothesis). Classification by discipline was based on the Essential Science Indicators database, the hard/soft, pure/applied and life/non-life categories were based on previous literature (see text for details). Error bars represent 95% logit-derived confidence interval.
doi:10.1371/journal.pone.0010068.g001

Fanelli. *PLoS ONE* 5(4):e10068, 2010.

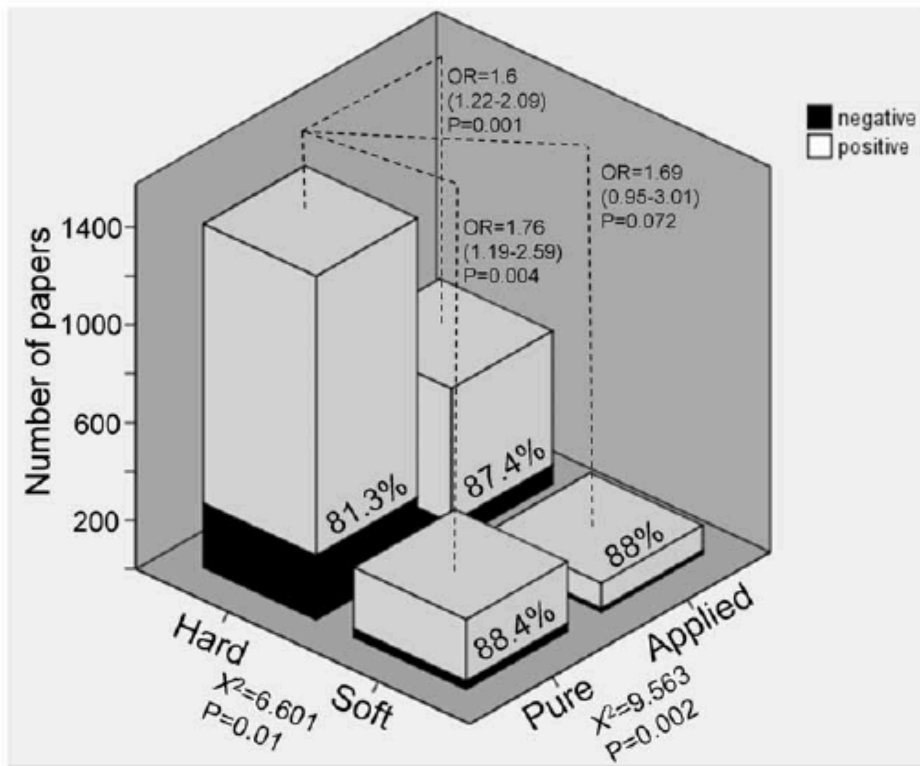


Figure 2. Positive Results by Disciplinary Dimension. Number of papers that supported (white) or failed to support (black) a tested hypothesis, classified by disciplinary categories based on dimensions identified by previous studies (see text for explanations). Percentage in each bar refers to positive results. OR = Odds Ratio (and 95%Confidence Interval) of reporting a positive result compared to the reference category of Hard/Pure disciplines. Chi square was calculated for each dimension separately (for category composition see Fig. 1).
doi:10.1371/journal.pone.0010068.g002

Should the validation of hypotheses always be this likely? What does this mean about how we do research?

Fanelli. *PLoS ONE* 5(4):e10068, 2010.

Working with data

"Okay, you got the expected results three times on week one on the same preparation, and then you say, oh, great. And you go to publish it and the reviewer comes back and says, 'I want a clearer picture,' and you go and you redo it—guess what, you can't replicate your own results. . . . Do you go ahead and try to take that to a different journal . . . or do you stop the publication altogether because you can't duplicate your own results? . . .Was it false? Well, no, it wasn't false one week, but maybe I can't replicate it myself. . . there are a lot of choices that are gray choices. . .They're not really falsification."

Fanelli. *PLoS ONE* 5(4):e10271, 2010.

The importance of repeatability and the dilemma of uncontrolled factors

THE NEW YORKER

ANNALS OF SCIENCE

THE TRUTH WEARS OFF

Is there something wrong with the scientific method?

by Jonah Lehrer

DECEMBER 13, 2010

Many results that are rigorously proved and accepted start shrinking in later studies.

On September 18, 2007, a few dozen neuroscientists, psychiatrists, and drug-company executives gathered in a hotel conference room in Brussels to hear some startling news. It had to do with a class of drugs known as atypical or second-generation antipsychotics, which came on the market in the early nineties. The drugs, sold under brand names such as Abilify, Seroquel, and Zyprexa, had been tested on schizophrenics in several large clinical trials, all of which had demonstrated a dramatic decrease in the subjects' psychiatric symptoms. As a result, second-generation antipsychotics had become one of the fastest-growing and most profitable pharmaceutical classes. By 2001, Eli Lilly's Zyprexa was generating more revenue than Prozac. It remains the company's top-selling drug.

But the data presented at the Brussels meeting made it clear that something strange was happening: the therapeutic power of the drugs appeared to be steadily waning. A recent study showed an effect that was less than half of that documented in the first trials, in the early nineteen-nineties. Many researchers began to argue that the expensive pharmaceuticals weren't any better than first-generation antipsychotics, which have been in use since the fifties. "In fact, sometimes they now look even worse," John Davis, a professor of psychiatry at the University of Illinois at Chicago, told me.

Before the effectiveness of a drug can be confirmed, it must be tested and tested again. Different scientists in different labs need to repeat the protocols and publish their results. The test of replicability, as it's known, is the foundation of modern research. Replicability is how the community enforces itself. It's a safeguard for the creep of subjectivity. Most of the time, scientists know what results they want, and that can influence the results they get. The premise of replicability is that the scientific community can correct for these flaws.

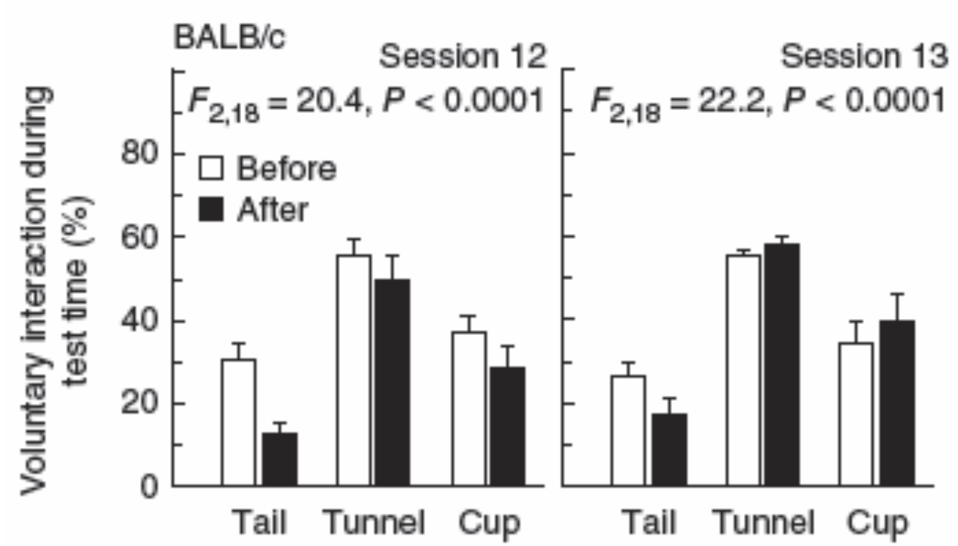
But now all sorts of well-established, multiply confirmed findings have started to look increasingly uncertain. It's as if our facts were losing their truth: claims that have been enshrined in textbooks are suddenly unprovable. This phenomenon doesn't yet have an official name, but it's occurring across a wide range of fields, from psychology to

…a lot of extraordinary scientific data are nothing but noise. The hyperactivity of those coked-up Edmonton mice wasn't an interesting new fact—it was a meaningless outlier, a by-product of invisible variables we don't understand. The problem, of course, is that such dramatic findings are also the most likely to get published in prestigious journals, since the data are both statistically significant and entirely unexpected. Grants get written, follow-up studies are conducted. The end result is a scientific accident that can take years to unravel.

Taming anxiety in laboratory mice

Jane L Hurst & Rebecca S West

Routine laboratory animal handling has profound effects on their anxiety and stress responses, but little is known about the impact of handling method. We found that picking up mice by the tail induced aversion and high anxiety, whereas use of tunnels or open hand led to voluntary approach, low anxiety and acceptance of physical restraint. Using the latter methods, one can minimize a widespread source of anxiety in laboratory mice.



What to do?

- Ask yourself: how do you know when you've done a sufficient number of experiments?
- Don't eliminate outliers unless you're sure why they happened and you can explain it
- Don't edit images beyond accepted practices

- Always describe your methods in full
- Understand the sources of bias/error in your experiments
- Be frustrated when papers don't report statistics (error bars), or don't talk about the disadvantages/consistency of their findings

→ What about unknown variables (the mouse example)?

Authorship – what do you think?

Please use the scale below to rank the level of your agreement or disagreement with each of the following statements.

1 Strongly disagree
2 Disagree
3 Neither agree nor disagree
4 Agree
5 Strongly agree

Authorship is appropriate for someone who has approved the final manuscript a

3. provided the idea for a critical experiment. ____
4. provided unique materials, critical to the experiments reported in the paper. ____
5. provided large amounts of unskilled work needed to complete the project. ____
6. performed an experiment using specialized equipment. ____
7. provided unpublished data to augment data obtained for the paper. ____
8. provided statistical analysis of data presented in the paper. ____
9. organized the results and wrote the first draft of the paper. ____

Authorship is not appropriate

10. for someone who contributed to the work only on a fee-for-service basis. ____
11. solely to advance a student's career. ____
12. solely to recognize leadership of the research group. ____
13. solely to increase chances for publication because of name association. ____
14. for someone who cannot scientifically defend all data presented in the paper. ____
15. for someone who has not read and approved the final manuscript. ____

from Macrina, Scientific Integrity

Authorship

- What justifies authorship on a paper?
- What is the role of the first author?
- What are the responsibilities of all authors?
- What determines the order of authors?

"An author must make a significant intellectual or practical contribution to the work reported in the paper"

"The first author is the person who participated significantly in the work by (i) doing experiments and collecting the data, (ii) interpreting the results, and (iii) writing the first draft of the manuscript"

-F.L. Macrina

Anatomy of an author list

nature chemistry

ARTICLES

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Photoelectrochemical complexes for solar energy conversion that chemically and autonomously regenerate

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Short description of each author's contribution.

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Author contributions

M.H.H., J.H.C., A.A.B. and M.S.S. designed the research. M.H.H., J.H.C., A.A.B., R.A.G. and D.A.H. synthesized the complexes. M.H.H. performed the photoelectrochemical experiments. J.H.C. purified the complexes and performed the spectroscopic experiments with A.C.C. A.A.B. performed kinetic modelling of complex formation. E.S.J. performed modelling of the DMPC configuration on the SWNT. A.M. and C.A.W. supplied the photosynthetic reaction centres. Y.V.G. and S.G.S. supplied the membrane scaffold proteins and conducted initial reconstitution experiments. T.H.B., A.S.Z. and K.J.V. performed AFM measurements. E.K.H. performed SANS measurements. M.S.S. originated the concept for the paper. M.H.H., J.H.C., A.A.B. and M.S.S. co-wrote the manuscript with input from S.G.S. and C.A.W.

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Continued on Page 2

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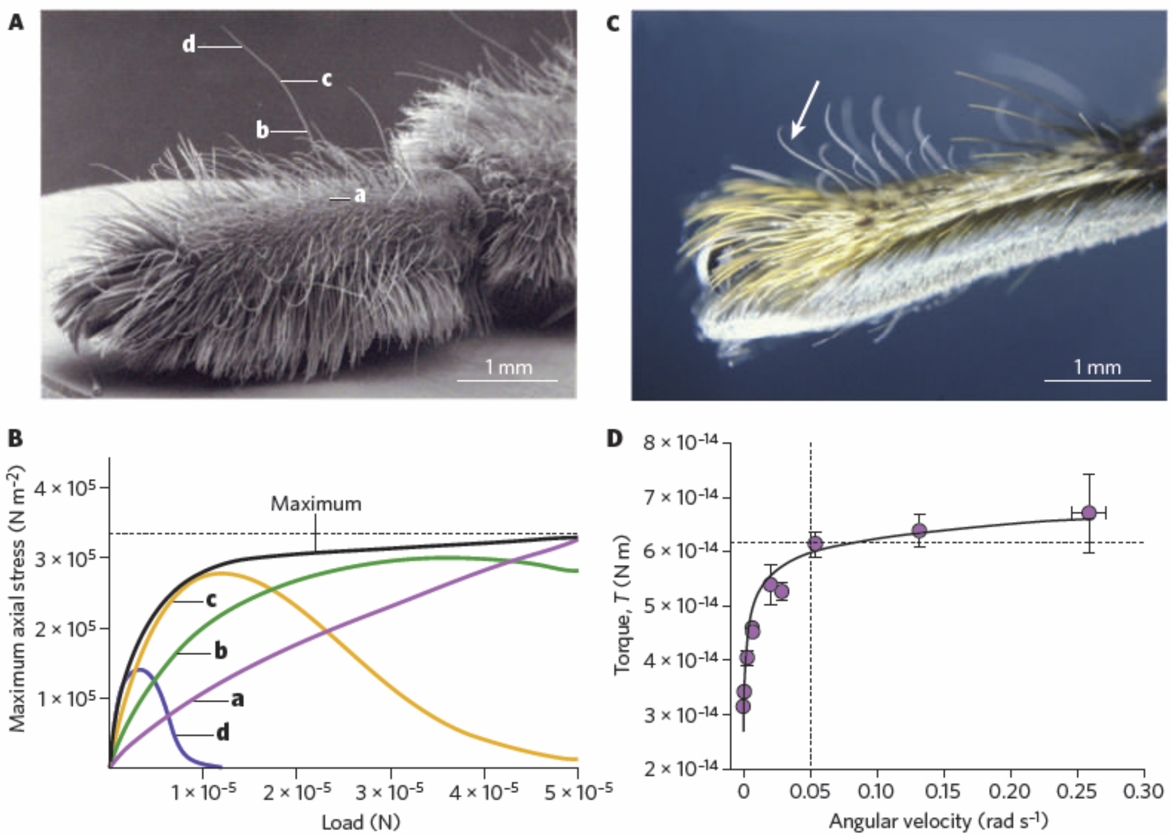

Figure 2 | Sensory hairs: tactile and airflow sensors. A, Final segment of a spider leg, with points on the tactile hair[26] indicated by letters, which refer to the curves in **B**. **B**, Dependence on increasing stimulus force (load) of maximum axial stresses at different positions along the hair[26]. **C**, Airflow sensor (arrow) on the final segment of the spider leg[14]. **D**, Torque measured when deflecting the hair, as a function of angular velocity. The dashed lines show the transition towards asymptotic behaviour. Errors, 1 s.d. (Panels **A** and **B**, reproduced, with permission, from ref. 26. Panel **C**, reproduced, with permission, from ref. 14. Panel **D** reproduced, with permission, from ref. 35.)

Other times when you credit others

- References, of course
- Acknowledgements
  - In a paper
  - In your thesis (X helped with this, built this)
  - During a presentation
- Always give credit where credit is due!

Who should (not) peer review your paper?

Matters relating to the peer review of the manuscript often are found in the "Instructions to Authors" section. Some journals allow authors to suggest the names of impartial reviewers, either ad hoc referees or members of the editorial board. This helps the editors do their job, and it is wise to take advantage of the opportunity. Who qualifies as an impartial reviewer? Opinions vary, and criteria are subjective. Often excluded as impartial reviewers are (i) people at the author's institution, (ii) people who have been associated with the author's laboratory, and (iii) the author's collaborators or coauthors at other institutions. Individuals in the latter two categories are considered in view of the time that has elapsed since the author's last interactions with them.

from Macrina, Scientific Integrity

Buying authorship?

Shiny. King Abdulaziz University's steps to gain visibility are controversial.

CITATION IMPACT

Saudi Universities Offer Cash In Exchange for Academic Prestige

Two Saudi institutions are aggressively acquiring the affiliations of overseas scientists with an eye to gaining visibility in research journals

At first glance, Robert Kirshner took the e-mail message for a scam. An astronomer at King Abdulaziz University (KAU) in Jeddah, Saudi Arabia, was offering him a contract for an adjunct professorship that would pay $72,000 a year. Kirshner, an astrophysicist at Harvard University, would be expected to supervise a research group at KAU and spend a week or two a year on KAU's campus, but that requirement was flexible, the person making the offer wrote in the e-mail. What Kirshner would be required to do, however, was add King Abdulaziz University as a second affiliation to his name on the Institute for Scientific Information's (ISI's) list of highly cited researchers.

"I thought it was a joke," says Kirshner, who forwarded the e-mail to his department chair, noting in jest that the money was a lot more attractive than the 2% annual raise professors typically get. Then he discovered that a highly cited colleague at another U.S. institution had accepted KAU's offer, adding KAU as a second affiliation on ISIhighlycited.com.

Kirshner's colleague is not alone. *Science* has learned of more than 60 top-ranked researchers from different scientific disciplines—all on ISI's highly cited list—who have recently signed a part-time employment arrangement with the university that is structured along the lines of what Kirshner was offered. Meanwhile, a bigger, more prominent Saudi institution—King Saud University in Riyadh—has climbed several hundred places in international rankings in the past 4 years largely through initiatives specifically targeted toward attaching KSU's name to research publications, regardless of whether the work involved any meaningful collaboration with KSU researchers.

Academics both inside and outside Saudi Arabia warn that such practices could detract from the genuine efforts that Saudi Arabia's universities are making to transform themselves into world-class research centers. For instance, the Saudi government has spent billions of dollars to build the new King Abdullah University of Science and Technology in Thuwal, which boasts state-of-the-art labs and dozens of prominent researchers as full-time faculty members (*Science*, 16 October 2009, p. 354).

But the initiatives at KSU and KAU are aimed at getting speedier results. "They are simply buying names," says Mohammed Al-Qunaibet, a professor of agricultural economics at KSU, who recently criticized the programs in an article he wrote for the leading Saudi newspaper, *Al Hayat*. Teddi Fishman, director of the Center for Academic Integrity at Clemson University in South Carolina, says the programs deliberately create "a false impression that these universities are producing great research."

Academics who have accepted KAU's offer represent a wide variety of faculty from elite institutions in the United States, Canada, Europe, Asia, and Australia. All are men. Some are emeritus professors who have recently retired from their home institutions. All have changed their affiliation on ISI's highly cited list—as required by KAU's contract—and some have added KAU as an affiliation on research papers. Other requirements in the contract include devoting "the whole of your time, attention, skill and abilities to the performance of your duties" and doing "work equivalent to a total of 4 months per contract period."

Neil Robertson, a professor emeritus of mathematics at Ohio State University in Columbus who has signed on, says he has no concerns about the offer. "It's just capitalism," he says. "They have the capital and they want to build something out of it." Another KAU affiliate, astronomer Gerry Gilmore of the University of Cambridge in the United Kingdom, notes that "universities buy people's reputations all the time. In principle, this is no different from Harvard hiring a prominent researcher."

Officials at KAU did not respond to *Science*'s request for an interview. But Surender Jain, a retired mathematics professor from Ohio University in Athens who is an adviser to KAU and has helped recruit several of the adjuncts, provided a list of 61 academics who have signed contracts similar to the one sent to Kirshner. The financial arrangements in the contracts vary, Jain says: For instance, some adjuncts will receive their compensation not as salary but as part of a research grant provided by KAU.

Jain acknowledges that a primary goal of the program—funded by Saudi Arabia's Ministry of Higher Education—is to "improve the visibility and ranking of King Abdulaziz University." But he says KAU also hopes the foreign academics will help it kick-start indigenous research programs. "We're not just giving away money," he says. Most recruits will be expected to visit for a total of 4 weeks in a year to "give crash courses"; they will also be expected to supervise dissertations and help KAU's full-time faculty members develop research proposals. Even the "shadows" of such eminent scholars would inspire local students and faculty members, he says.

The recruits *Science* spoke to say they have a genuine interest in promoting research at KAU, even though none of them knew how their individual research plans would match up with the interests and abilities of KAU's faculty members and students. Ray Carlberg, an astronomer at the University of Toronto in Canada who accepted the offer, says he had to Google the university after he received the e-mail. He admits that he was initially con-

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King Abdulaziz University

CONTRACT OF PART-TIME EMPLOYMENT

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King Abdulaziz University

6.2 You are required to amend your ISI highly cited contact and affiliation details at highlycited.com web site to include your employment with King Abdulaziz University at dates and times required by your Employer.

6.3 The address of King Abdulaziz University should be included in your contact details at the ISIhighlycited.com to improve the King Abdulaziz University world visibility.

6.4 You are required to inform the Employer if you ISI highly cited status is changed or modified.

6.5 You agree that you shall, whenever requested by the Employer and in any event on the termination of your employment, promptly return to the Employer all property belonging to the Employer in your possession, custody or control. You acknowledge and agree that, on termination of your employment, you shall not be entitled to retain and shall not retain any property.

6.6 The Employer foresees that, during the course of your employment, you may create, originate, conceive, discover, design, develop and/or make works in or relating to which there may be intellectual property rights. All intellectual property rights in or relating to all or any works made during the course of your employment for work sponsored by King Abdulaziz University shall be the absolute property of both the Employer and Employee. If you publish any paper, article, book or section of a book based on such works you shall indicate the Employer as the joint or sole affiliating institution.

6.7 During the whole Contract period, the Employee shall do his best to publish six to ten papers in the ISI journal.

7. Remuneration

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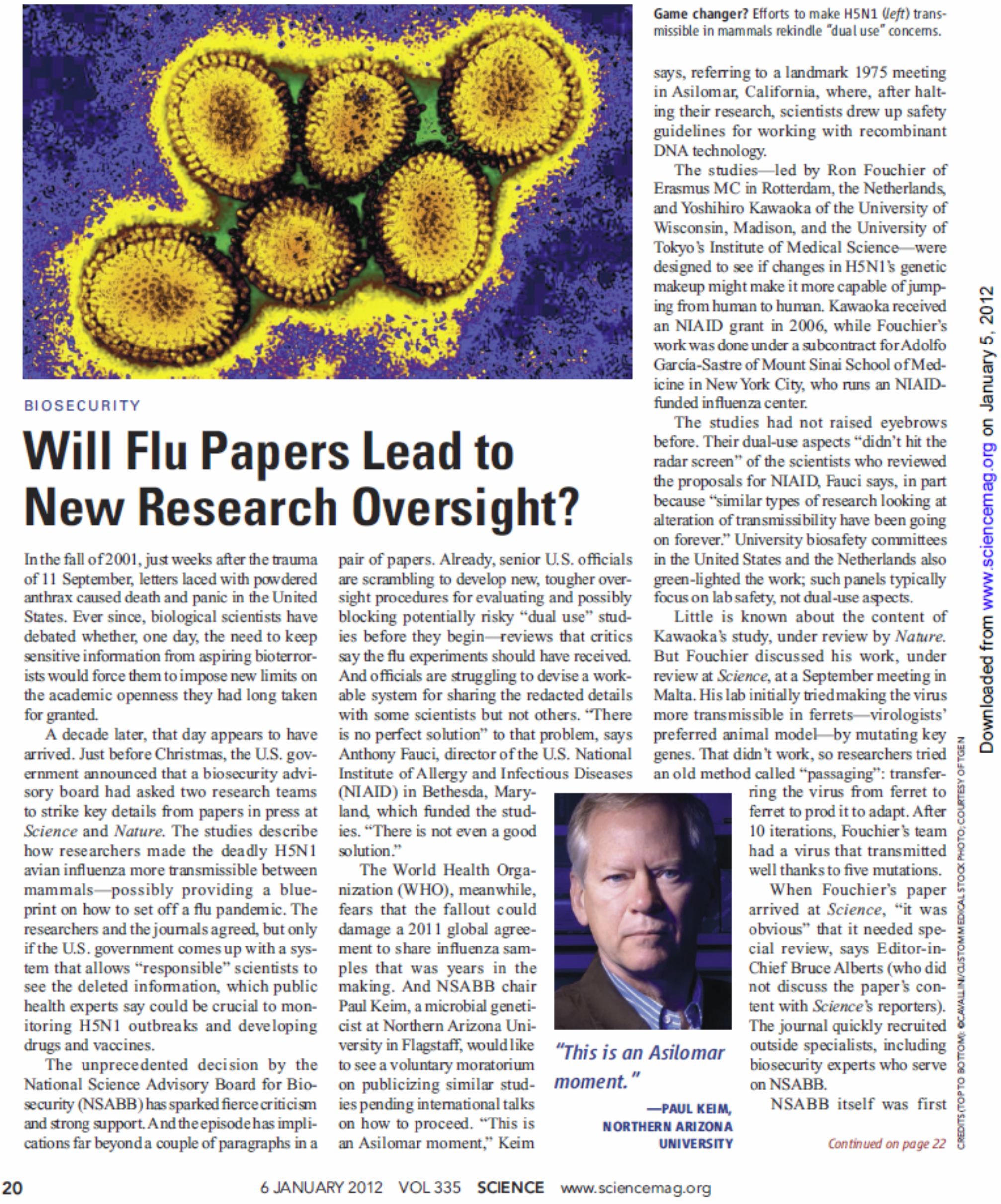
Censorship?


Game changer? Efforts to make H5N1 (*left*) transmissible in mammals rekindle "dual use" concerns.

BIOSECURITY

Will Flu Papers Lead to New Research Oversight?

In the fall of 2001, just weeks after the trauma of 11 September, letters laced with powdered anthrax caused death and panic in the United States. Ever since, biological scientists have debated whether, one day, the need to keep sensitive information from aspiring bioterrorists would force them to impose new limits on the academic openness they had long taken for granted.

A decade later, that day appears to have arrived. Just before Christmas, the U.S. government announced that a biosecurity advisory board had asked two research teams to strike key details from papers in press at *Science* and *Nature*. The studies describe how researchers made the deadly H5N1 avian influenza more transmissible between mammals—possibly providing a blueprint on how to set off a flu pandemic. The researchers and the journals agreed, but only if the U.S. government comes up with a system that allows "responsible" scientists to see the deleted information, which public health experts say could be crucial to monitoring H5N1 outbreaks and developing drugs and vaccines.

The unprecedented decision by the National Science Advisory Board for Biosecurity (NSABB) has sparked fierce criticism and strong support. And the episode has implications far beyond a couple of paragraphs in a pair of papers. Already, senior U.S. officials are scrambling to develop new, tougher oversight procedures for evaluating and possibly blocking potentially risky "dual use" studies before they begin—reviews that critics say the flu experiments should have received. And officials are struggling to devise a workable system for sharing the redacted details with some scientists but not others. "There is no perfect solution" to that problem, says Anthony Fauci, director of the U.S. National Institute of Allergy and Infectious Diseases (NIAID) in Bethesda, Maryland, which funded the studies. "There is not even a good solution."

The World Health Organization (WHO), meanwhile, fears that the fallout could damage a 2011 global agreement to share influenza samples that was years in the making. And NSABB chair Paul Keim, a microbial geneticist at Northern Arizona University in Flagstaff, would like to see a voluntary moratorium on publicizing similar studies pending international talks on how to proceed. "This is an Asilomar moment," Keim says, referring to a landmark 1975 meeting in Asilomar, California, where, after halting their research, scientists drew up safety guidelines for working with recombinant DNA technology.

The studies—led by Ron Fouchier of Erasmus MC in Rotterdam, the Netherlands, and Yoshihiro Kawaoka of the University of Wisconsin, Madison, and the University of Tokyo's Institute of Medical Science—were designed to see if changes in H5N1's genetic makeup might make it more capable of jumping from human to human. Kawaoka received an NIAID grant in 2006, while Fouchier's work was done under a subcontract for Adolfo García-Sastre of Mount Sinai School of Medicine in New York City, who runs an NIAID-funded influenza center.

The studies had not raised eyebrows before. Their dual-use aspects "didn't hit the radar screen" of the scientists who reviewed the proposals for NIAID, Fauci says, in part because "similar types of research looking at alteration of transmissibility have been going on forever." University biosafety committees in the United States and the Netherlands also green-lighted the work; such panels typically focus on lab safety, not dual-use aspects.

Little is known about the content of Kawaoka's study, under review by *Nature*. But Fouchier discussed his work, under review at *Science*, at a September meeting in Malta. His lab initially tried making the virus more transmissible in ferrets—virologists' preferred animal model—by mutating key genes. That didn't work, so researchers tried an old method called "passaging": transferring the virus from ferret to ferret to prod it to adapt. After 10 iterations, Fouchier's team had a virus that transmitted well thanks to five mutations.

When Fouchier's paper arrived at *Science*, "it was obvious" that it needed special review, says Editor-in-Chief Bruce Alberts (who did not discuss the paper's content with *Science*'s reporters). The journal quickly recruited outside specialists, including biosecurity experts who serve on NSABB.

NSABB itself was first

"This is an Asilomar moment."

—PAUL KEIM, NORTHERN ARIZONA UNIVERSITY

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- 2 research groups (one in US, one in Europe) figured out how to make the bird flu virus in the lab
- Papers were submitted independently to *Science* and *Nature*.
- The US National Science Advisory Board for Biosecurity (NSABB) learned about the work (actually members were selected as reviewers) and discussed it.
- "In the end, the board was unanimous: Key details had to go." (they don't have authority but can only make recommendations)
- "By late December, all sides could announce a deal: The journals would publish an incomplete description of the studies—if the government delivered a "transparent plan" for sharing the details."
- But now…

www.bbc.co.uk/news/17066147

16 February 2012 Last updated at 20:25 ET

Journalist's concern over bird flu research

By Pallab Ghosh
Science correspondent, BBC News

The editor of a leading scientific journal has said he is prepared to publish full details of controversial research into the bird flu virus, unless progress is made on how to circulate details of the findings to scientists.

Research into the H5N1 virus has to be carried out in highly controlled conditions

The World Health Organization is expected to announce later its view of how to circulate the research safely to scientists studying the H5N1 virus in humans.

Dr Bruce Alberts, editor of Science, was asked by US security advisers not to publish parts of the work because of concerns it could help terrorists to develop a biological weapon.

But he says it is important to get the research out quickly to scientists and health officials monitoring the virus.

Speaking at the American Association for the Advancement of Science meeting in Vancouver, he said: "Our position is that, in the absence of any mechanism to get the information to those scientists and health officials who need to know and need to protect their populations and to design new treatments and vaccines, our default position is that we have to publish in compete form."

'Academic freedom'

The controversy is centred on two research papers - one of which was submitted to Science, the other to another leading journal, Nature, last year.

Related Stories

Bird flu 'censorship' decision

Mutant bird flu research halted

Terror fear over bird flu reports

The NSABB comprises a group of US scientists and government security officials.

Its role is to identify research that might pose a security threat and recommend redaction where appropriate.

It is the first time that it has done so since it was created in 2005.

Dr Alberts supports the NSABB mechanism because it enables government security advisers to be informed by the scientists who sit on the board.

He suggests that for him and the editor of Nature, Dr Phil Campbell, to simply ignore the recommendations of the NSABB would undermine a system which could be considerably worse.

"Both Science magazine and Nature would both of like to support the mechanism because it's the best mechanism we're ever going to get," he says.

The sticking point though is that the scientific community and governments cannot agree the process by which an applicant for redacted material is deemed to be worthy of receiving it and who should make that judgement.

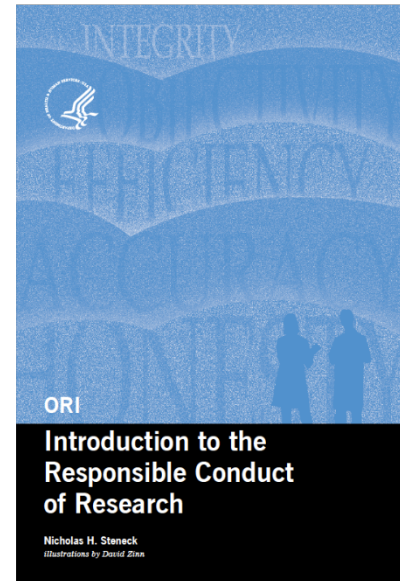
Initially the US government had suggested that US scientists, with the input of some foreign researchers, should administer the distribution process.

But this week at the WHO, international health bodies have said they should be more intimately involved and it would not work to run it through the US government.

"It is our hope that that meeting will lead to an international resolution as to how to get the information selectively to those that need to know and that would allow us to adhere to the NSABB recommendation," says Dr Alberts.

What is responsible conduct of research?

- ✓ **HONESTY** — conveying information truthfully and honoring commitments,
- ✓ **ACCURACY** — reporting findings precisely and taking care to avoid errors,
- ✓ **EFFICIENCY** — using resources wisely and avoiding waste, and
- ✓ **OBJECTIVITY** — letting the facts speak for themselves and avoiding improper bias.



http://ori.hhs.gov/documents/rcrintro.pdf

Important: Collective openness

Collective openness is a principle of interaction within a research group. It is an expectation that all members of the group (senior scientists, postdoctoral fellows, students, technicians) can and will raise questions about any aspect of the work underway at any time. In an open environment, everyone is not only encouraged but expected to question each others' decisions and work, so that mistakes and oversights, as well as misbehavior, will be noticed and corrected. The members of the research team challenge each other's work out of a collective sense of responsibility for the integrity of the work—as a means of verifying the integrity of the work at hand—and they are applauded for doing so. Collective openness makes integrity an explicit and organic part of everyday science. It demands open discussion of decisions, especially those clouded by difficulty, temptation or ambiguity, and encourages the same skeptical stance toward the conduct of research that scientists apply to scientific findings and methods.

Such openness might seem to border on micro-whistleblowing, but in fact it likely reduces the need for whistleblowing by making all members of a team, no matter what their status, more comfortable about raising questions and concerns. It acts as a kind of pressure valve, so that suspicions do not grow into major concerns that require the attention of authorities. Not even the principle of collective openness will deter all misbehavior, but being on a team whose members constantly ask questions about both procedural and ethical matters fosters greater care, watchfulness and attention to the responsible conduct of day-to-day tasks.

Anderson. *Sci Eng Ethics* 13:387-394, 2007.

Encourage discussion of the gray areas

Which of the following topics have been discussed among members of your research group?

14. Methods for proper record keeping ____
15. Responsible ownership, sharing, and retention of research data ____
16. The importance of collaboration and steps to promote successful collaborations ____
17. Principles for responsible use of animal subjects ____
18. Principles for responsible use of human subjects ____
19. Importance of honestly reporting what you find ____
20. Criteria for what and when to publish ____
21. Criteria for authorship ____
22. Risks of conflicts of interest ____
23. Responsibilities of peer reviewers ____
24. Roles and responsibilities of mentors and trainees ____
25. Special ethical concerns for research involving genetic technology ____
26. Responsibility and strategies for action after having witnessed research misconduct ____

from Macrina, Scientific Integrity

Background report

Background report assignment

Due on ctools at 2p Friday, February 24

a. Guided by your literature search, identify the following:
   1. Two or three important (unanswered) questions related to your research topic.
   2. Two or three leading researchers in your field who are working (or have worked) toward answering these questions.
   3. A series of important techniques/achievements/discoveries (e.g., the seminal findings) related to the questions above. The leaders you identify may have made these achievements.

b. Based on the analysis from (a) write a report that:
   1. Introduces your research theme and its significance (1-2 paragraphs).
   2. Defines the questions you identified in (a). These can be listed so they are easy to identify.
   3. Reviews the contributions of the leaders, the seminal findings outlined in (a), and any other knowledge that you think is important to identify the frontier for your topic. There is no specific format for this; however, you should divide your text into subsections according to the key points you make, and make sure your information is presented in a logical order.
   4. Describes future directions, e.g., getting at what you hope to do in your research. Both fundamental (i.e., new scientific knowledge) and practical (i.e., commercial applications, impact on society) significance should be addressed. You don't need to give a detailed description of your research (we'll do that in the proposal).

Your report should be addressed to a general technical audience. Imagine giving it to someone who just joined your research group and wants to learn about your topic. Moreover, the reader should be convinced that it's worth doing research on your topic, and should have a clear idea of the **frontier** for your research. And, keep in mind to address both breadth and depth (like the "T" principle discussed in class).

The report must be no longer than 5 pages and should include at least 10 references. The page limit includes figures, but does not include the bibliography. Make sure the bibliography uses a consistent reference format of your choice, which includes the full title of all journal articles that you cite. Margins must be 1" (left/right/top/bottom), and the text should be single-spaced, 11- or 12-point font.

Small group exercise

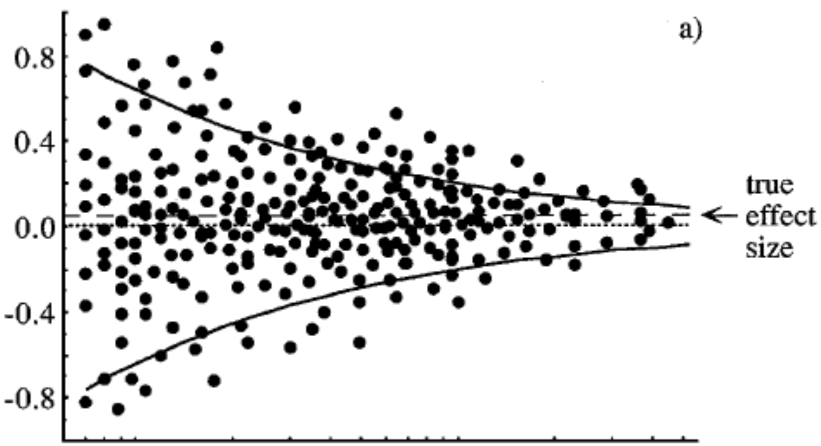
- Teams of three, divided roughly by research theme
- 35 minutes
  - 5 minutes to review the other summaries/questions
- 10 minutes for each interview
  - Advisor describes his/her research and why it's important
  - Students try to imagine doing a PhD on this topic, and ask questions, just like it's prospective student visit day
    - You might focus specifically on follow-up questions to the stated research questions
    - You might want more clarification if the advisor's stated research questions are unclear/vague
    - You might want to probe how well the advisor understands the key achievement and frontier

Homework

- Background report…
- Some readings to be announced by email during/after break.

Extra slides

The funnel graph



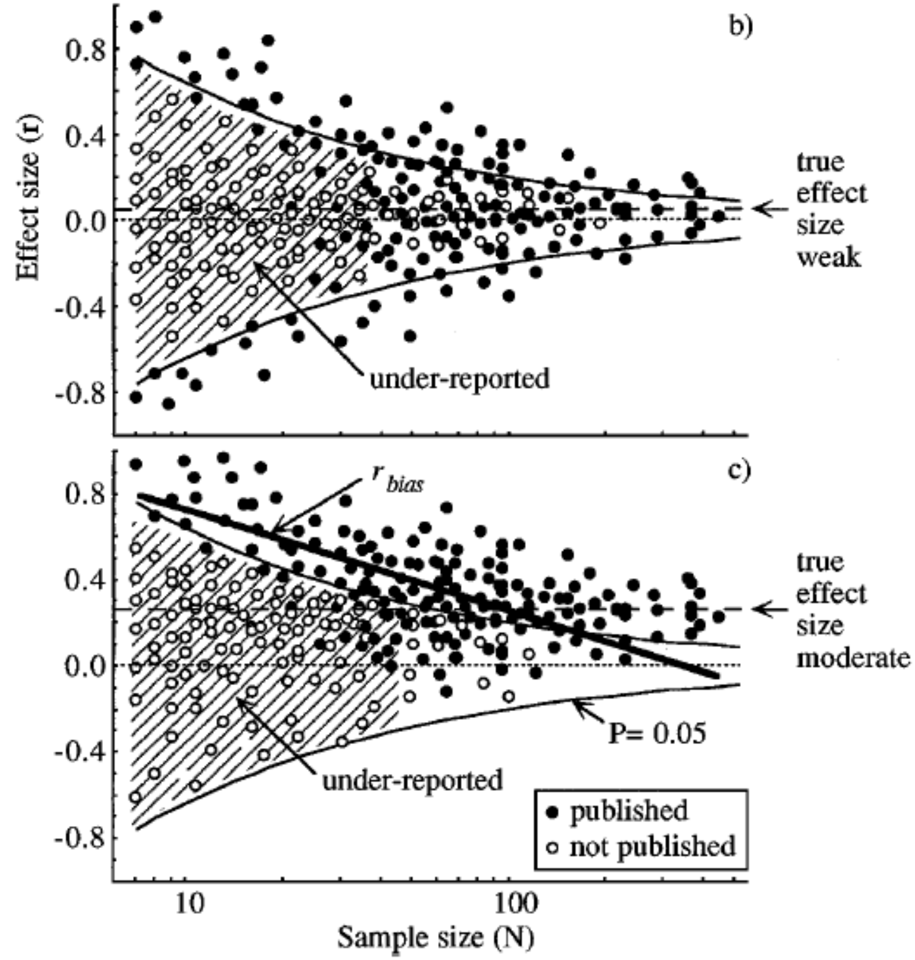


Figure 1 Hypothetical funnel graphs (64)—effect size as a function of sample size (log scale)—as modified in Ref. 80. (*a*) Expected pattern of purely sample size–dependent variation in effect sizes. (*b*) The impact of selective reporting when the true effect size is weak (the classical funnel pattern). (*c*) The impact of selective reporting when the true effect size is moderate (one side of the funnel is missing, and average effect size now depends on sample size). Shaded areas and open circles indicate areas of a reduced likelihood of publication due to selective reporting. Dotted lines indicate the null hypothesis, long-dashed lines indicate overall weighted mean, and curved lines are significance levels for correlation coefficients (P = 0.05) from Table R of Rohlf & Sokal (89). r_{bias} refers to the correlation—sometimes significant statistically—between effect size and sample size (80).

Palmer. *Ann. Rev. Ecol. Syst.* 31:441-80, 2000.

Bias in studies of animal attractiveness?

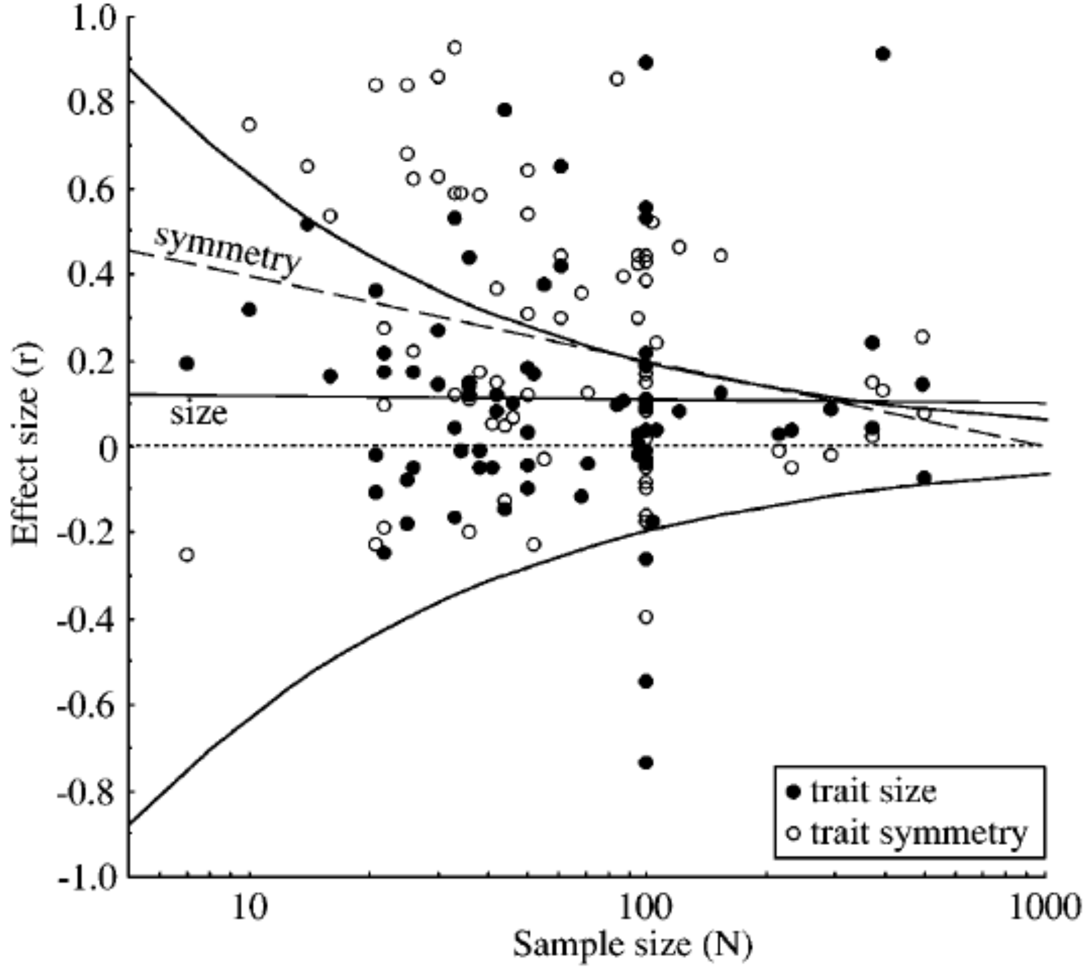


Figure 12 Effect size (correlation coefficient, *r*) as a function of sample size (log scale) for correlations between trait size and individual attractiveness (●) and correlations between symmetry and individual attractiveness (○) (as tabulated in Ref. 104). Dotted line and curved lines as in Figure 1. The solid line indicates the least-squares linear regression for trait size

Palmer. *Ann. Rev. Ecol. Syst.* 31:441-80, 2000.

Titus and Bosch. *Nature* 466:436-7, 2010.

"For as knowledges are now delivered, there is a kind of contract of error between the deliverer and the receiver: for he that delivereth knowledge desireth to deliver it in such a form as may be best believed, and not as may be best examined; and he that receiveth knowledge desireth rather present satisfaction than expectant inquiry; and so rather not to doubt than not to err: glory making the author not to lay open his weakness, and sloth making the disciple not to know his strength."

The Advancement of Learning, Francis Bacon, 1605 (8:170–171)

quoted by Palmer. *Ann. Rev. Ecol. Syst.* 31:441-80, 2000.

Research misconduct

Please use the scale below to rank the level of your agreement or disagreement with each of the following statements.

1 Strongly disagree
2 Disagree
3 Neither agree nor disagree
4 Agree
5 Strongly agree

1. It is never appropriate to report experimental data that have been created without actually having conducted the experiment. ____
2. It is never appropriate to alter experimental data to make an experiment look better than it actually was. ____
3. It is never appropriate to try a variety of different methods of analysis until one is found that yields a result that is statistically significant. ____
4. It is never appropriate to take credit for the words or writing of someone else. ____
5. It is never appropriate to take credit for the data generated by someone else. ____
6. It is never appropriate to take credit for the ideas generated by someone else. ____
7. If you are confident of your findings, it is acceptable to selectively omit contradictory results to expedite publication. ____
8. If you are confident of your findings, it is acceptable to falsify or fabricate data to expedite publication. ____
9. It is more important that data reporting be completely truthful in a publication than in a grant application. ____
10. If you witness someone committing research misconduct, you have an ethical obligation to act. ____
11. If you witnessed a coworker or peer committing research misconduct, you would be willing to report that misconduct to a responsible official. ____
12. If you witnessed a supervisor or principal investigator committing research misconduct, you would be willing to report that misconduct to a responsible official. ____
13. If fabricated data are discovered in a published paper, all coauthors must equally share in the blame. ____
14. If fabricated data are discovered in a published paper, all coauthors must receive the same punishment. ____

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