

A publisher's perspective on reproducibility and robustness in science

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Overview

- **Setting the context and defining the scope**
- **What publishers are doing around rigor and data integrity**
 - things we already do
 - things we are working on/thinking about
 - Problems we're still grappling with
- **Looking forward to the discussion!**

Is Science in Crisis?

The New York Times

Science, Now Under Scrutiny

Believe it or not: how much can we rely on published data on potential drug targets?

Florian Prinz, Thomas Schlaage and Khusru Asadullah



SPECIAL SECTION

Breakdown of the Year: Scientific Fraud

One year ago, as *Science* was assembling its 2005 Breakthrough of the Year issue, the need for a last-minute change became uncomfortably clear. A shadow was creeping across one of this journal's landmark papers, in which a team of South Korean and American researchers, led by Woo-Suk Hwang at Seoul National University, claimed to have created the first-ever human embryonic stem cell lines.

THE CHRONICLE OF HIGHER EDUCATION

Academic Scandal Shakes Japan

By DAVID MCNEILL | THE CHRONICLE OF HIGHER EDUCATION JULY 6, 2014

Los Angeles Times | ARTICLE COLLECTIONS

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Science has lost its way, at a big cost to humanity

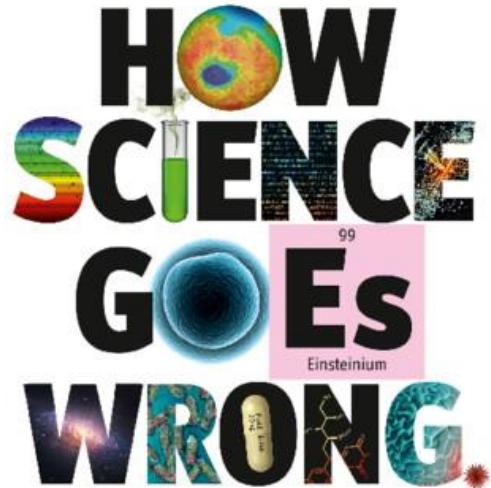
Researchers are rewarded for splashy findings, not for double-checking accuracy. So many scientists looking for career building on ideas that aren't even true.

The Economist

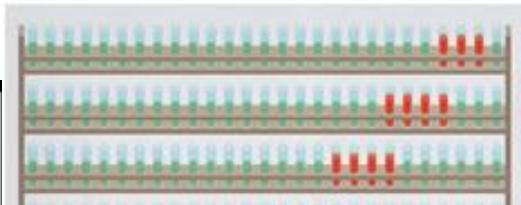
OCTOBER 19TH - 25TH 2013

Economist.com

Washington's lawyer surplus
How to do a nuclear deal with Iran
Investment tips from Nobel economists
Junk bonds are back
The meaning of Sachin Tendulkar



COMMENT



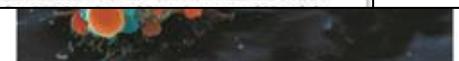
Beware the creeping cracks of bias

Evidence is mounting that research is riddled with systematic errors. Left unchecked, this could erode public trust, warns Daniel Sarewitz.



NIH plans to enhance reproducibility

Francis S. Collins and Lawrence A. Tabak discuss initiatives that is exploring to



Raise standards for preclinical cancer research

C. Glenn Begley and Lee M. Ellis propose how methods, publications and incentives must change if patients are to benefit.

ESSAY

Why Most Published Research Findings Are False

John P. A. Ioannidis

Summary

This is increasing concern that most current published research results are false. The probability that a research claim is true may depend on study size rather than on effect size. This framework suggests that for most current study sizes, there may be too much reliance on statistically significant results.

The Economist

Unreliable research Trouble at the lab

Scientists like to think of science as self-correcting. To an alarming degree, it is not



Everyone's talking, but
what are we really talking about?

Unpacking the issues

What are we really talking about? Defining the terms.

Reproducibility

Other scientists using the same materials & conditions can reproduce the work

Rigor and reliability

Experiments, analysis (statistics) and interpretation hold to accepted standards and best practices. In best case, results hold up to the test of time

Robustness

the holy grail

The results hold true across a reasonable range of conditions, are reliable
AND generalizable

The goal:

to make science more transparent, reliable and robust

Unpacking the issues

Although important issues, for the purpose of today's discussion, we are NOT talking about:

Scientific misconduct: Fraud, fabrication, intent to deceive

The evolving nature of science: deeper knowledge due to new technologies, approaches and insights

A discipline specific problem. Much attention has been on preclinical work and work in animal models, but issues affect all disciplines

Some contributing factors – a long list!

- **Poor practices** around experimental design, execution, analysis and statistics
- **Training and education** (across levels, not just graduate students)
- Lack of clear rigorous, agreed upon **standards**
- **Reagent validation, access and sharing**
- **Data access and sharing**
- **Statistics:** poor basic understanding
- **Big data**, more complex data sets
- Sorting out contributions of **biological variability** from experimental variability
- Blind spots and **biases**
- Human error, **sloppiness**
- **Reporting limitations**—space, format
- **Overstatement of claims**, understatement of caveats---"cartoon science"
- **Publication bias**—negative data; "the file drawer scenario"
- **Record keeping**, data management
- **Incentive structure** of science
- **Social, organizational and cultural contributors**
- **Increased detection/vigilance**



How will we ever unravel this?



Towards a solution

Good news about increased attention:

promise of change, motivation to change

Publications are the output, but this isn't just a publishing problem

This is a problem we all own—researchers, authors, reviewers, students, PIs, funders, publishers...

Collaborative challenge, key stakeholders working together

- Funding agencies: NIH, NSF, etc
- Publishers, publishing industry groups
- Professional societies (eg *SfN*)
- Academic institutions
- Industry/pharma
- Other science funders (HHMI, Wellcome, etc)
- Foundations, NFP focused on sound science and related issues (eg *Center for Open Science, COS*)

How are publishers contributing?

Publishers contribute in many different ways...

- (1) Improving Reporting
- (2) Promoting Sharing (data, materials, analysis methods)
- (3) Evaluation and screening
- (4) Accountability, corrections of the literature
- (5) Training and Education

**All incorporating Innovation and evolution
of our publishing practices**

Reporting: Transparency of methods

Methods: improving organization, setting standards

- Revitalizing the methods section to its full potential
- Discoverability of methods: tagging methods for search
- For some approaches/fields, agreed upon guidelines (eg MIAME, ARRIVE, CONSORT)
***but many fields there are not agreed upon standards/guidelines or are evolving*
- Method specific formats or journals, allow more details, trouble shooting information

Access to reagents and research materials

- Policies/access to materials and reagents for published studies; enforcement
- Encourage reagent deposition into repositories (eg Jackson labs)
- RRIDs-reagent identifiers to improve access/discoverability
- Reagent validation and tracking (eg cell lines, antibodies)- identifiers, validation of source



Protocol/methods repositories

- New publication formats/platforms for methods & protocols



Elsevier
MethodsX



Reporting: Statistics/analytical methods

Improving reporting of statistical methods and meta-information

- Reporting guidelines and policies: Author guidelines, statistical checklists
- Support best practices: Blinding, randomization, statistical sample sizes, etc
- Support best practice guidelines (eg ARRIVE, CONSORT)
- Need to be field and experimentally specific and appropriate
- Enlist statistical reviewers as needed

Open access to analytic methods: code, software

- Like data, transparency of statistics and open access to code & software

Pre-registration of methods and analysis plans

- New journal concept: registered reports. Pre-review of planned experimental methods/analysis (*Cortex Registered Reports*)

Sharing: Data Sharing

Develop and enforce data sharing policies

- Open access of all published data, not optional but a requirement of publication.
 - **Challenge of enforcement. Compliance challenge for some authors/data types
 - **Need cultural shift around data sharing



Support data deposition in repositories

- Field specific repositories (GenBank, PDB, Geo)
- Open digital repositories
- Institutional data management/repositories



Data Publication (discussions around credit for data)

- Discoverability, credit: metadata “descriptors”, DOI, searchable



Stakeholder Discussions around data sharing

- Challenges around complex data sets, standardization, intellectual property, extend to software and code? Field specific needs/issues. Choice of platforms
- Need for pragmatic, as opposed to “one size fits all” policies

Evaluation: Increased vigilance and screening

Screening of publications for image manipulation

- JCB pioneered. All Cell Press journals screen all papers prior to publication
- Limited in types off manipulations which can be picked up by screening
- Interestingly, awareness of screening policy has NOT decreased the number of instances of problems

Setting peer review standards, working with reviewers

- Working with experts to develop informed, field specific standards.
- Working with reviewers to increase vigilance around key issues

Mechanisms for post-publication corrections, evaluations

- Formal corrections, retractions. Clearer policies and more transparency in correction statements, reasons for correction/retraction
- Process for refutations of published papers: Matters Arising format (CP)
- Increase in corrections (and retractions) for sloppiness, image manipulation, poor data management record keeping. Less tolerance for error, sloppiness

Promoting Accountability

New formats, journals for replication studies

- Formats in existing & new journals for replication studies, negative results
- Some journals specifically for replication studies.
- Today, more publication options than ever before—pub options should not be limitation on info exchange

Authorship accountability

- Author contribution statements; digital contributor badges ((CRediT), to indicate specific contributions to a paper- accountability, but also clarify point of contact for interacting with authors

Post-publication: Community led accountability initiatives

- Journal forums for post-publication comments
- Also, beyond the journals, more community vigilance, crowdsourcing of pub errors
Discussion forums and blogs: *PubPeer, Retraction Watch* but also field specific/individually hosted blogs, social media.
- New reproducibility initiatives, : *Reproducibility Project: Cancer Biology* —collaboration *Center for Open Science, Science Exchange* and *eLife*.

Training and Education

Awareness: Content around reproducibility and best practices

- Raising community awareness, commissioning content for education
- Policy statements, editorials on issues related to reproducibility, best practices
- Engaging scientific community; gathering feedback

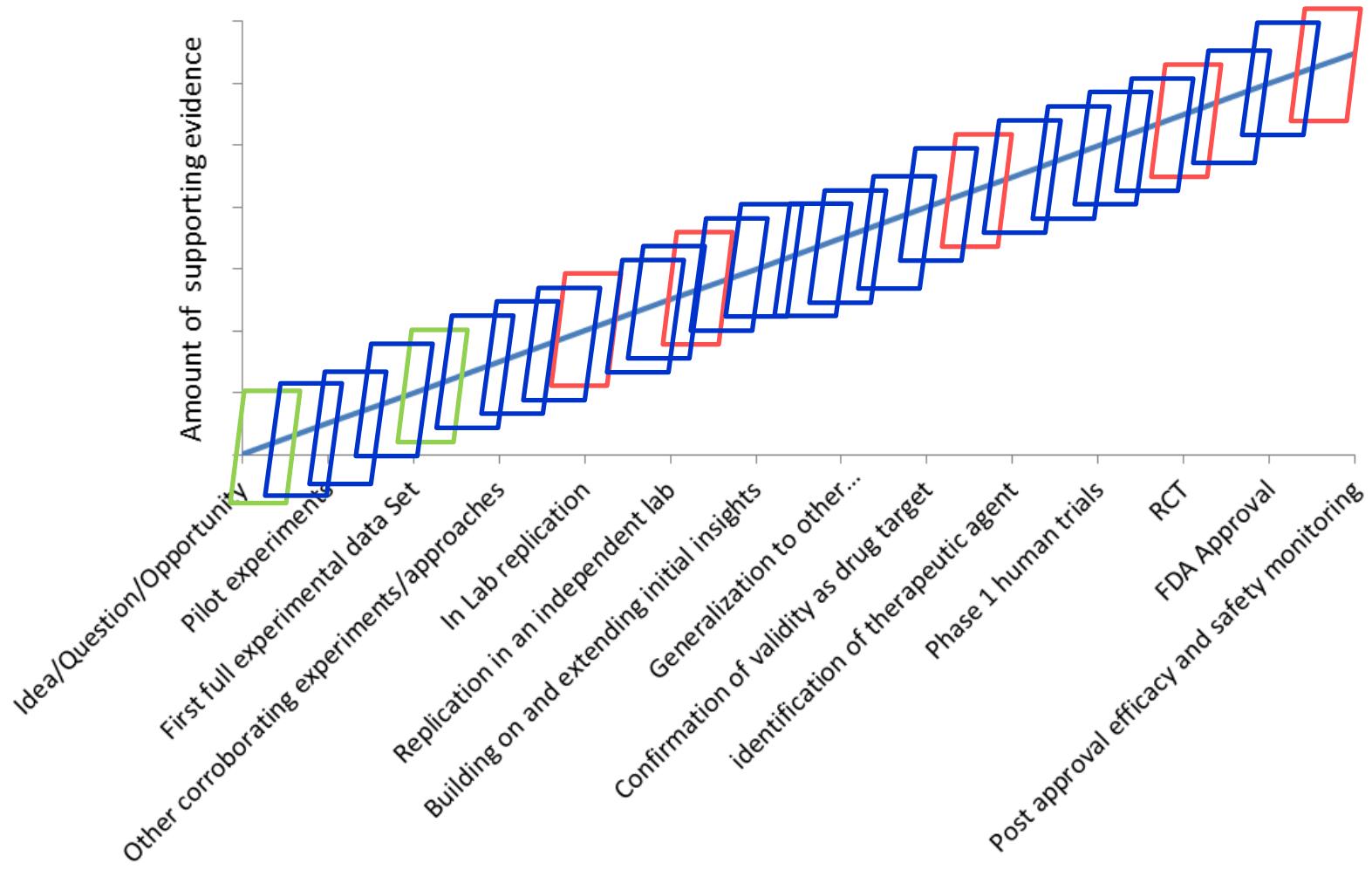
Talks, presentations on related topics

- Talks on publishing process, publishing best practices, ethics
- Work with institutions on courses/workshops on related topics

Working with stakeholders to develop policies and publishing best practices around these issues

- Participate in discussions/workshops with other stakeholders, including other publishers, funders (NIH, foundations, etc), foundations, professional societies, industry, other groups
- Cell Press Endorsement of *2014 NIH Principles and Guidelines for Reporting Preclinical Research*
- We're keen to be a part of the discussions and solutions

Framework for assessing policy impact



Thank you

Cell Press would like to hear from you on these issues.
Please get in touch with feedback.

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"I just feel fortunate to live in a world with so much disinformation at my fingertips."