

Reproducible toolbox

Reproducibility in science



Science and reproducibility

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- A hypothesis should be testable by anyone, regardless of time, place, culture, etc. Anyone can double check an experiment!

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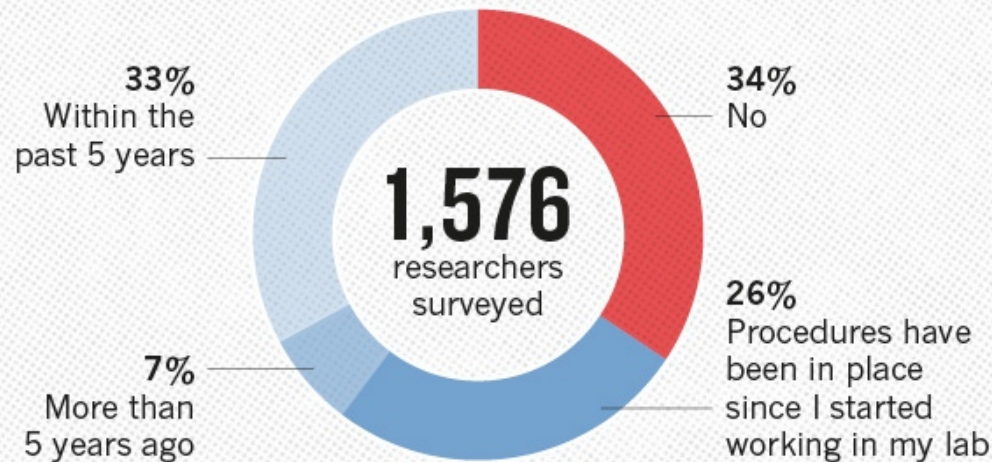
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How often do scientists actually do this?

Survey says...

HAVE YOU ESTABLISHED PROCEDURES FOR REPRODUCIBILITY?

Among the most popular strategies was having different lab members redo experiments.



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Source: M. Baker, "1,500 scientists lift the lid on reproducibility," Nature **533**, 452 (2016)

Reproducibility in practice

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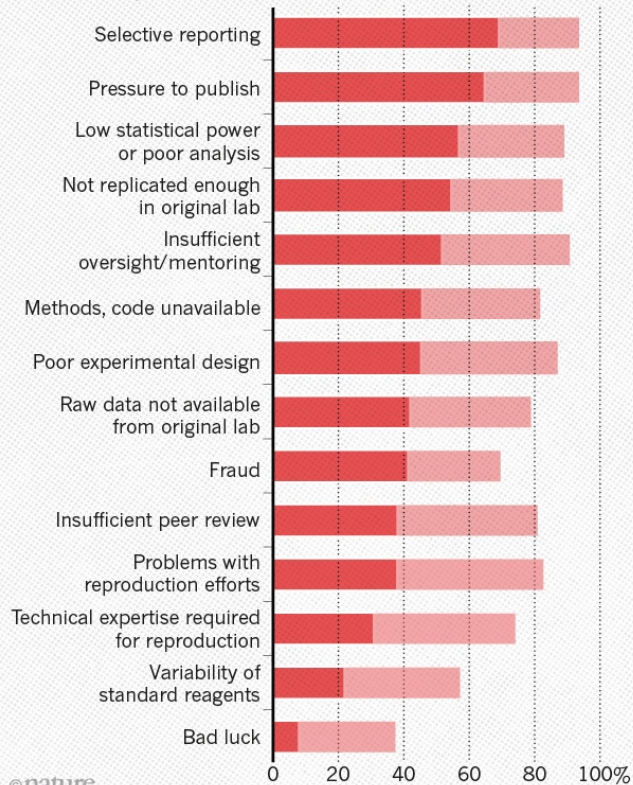
- Lack of funding sources
- Lack of data sharing
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- "Top-tier" journals won't publish
- Vague methods
- And more...

Reproducibility in practice

WHAT FACTORS CONTRIBUTE TO IRREPRODUCIBLE RESEARCH?

Many top-rated factors relate to intense competition and time pressure.

● Always/often contribute ● Sometimes contribute

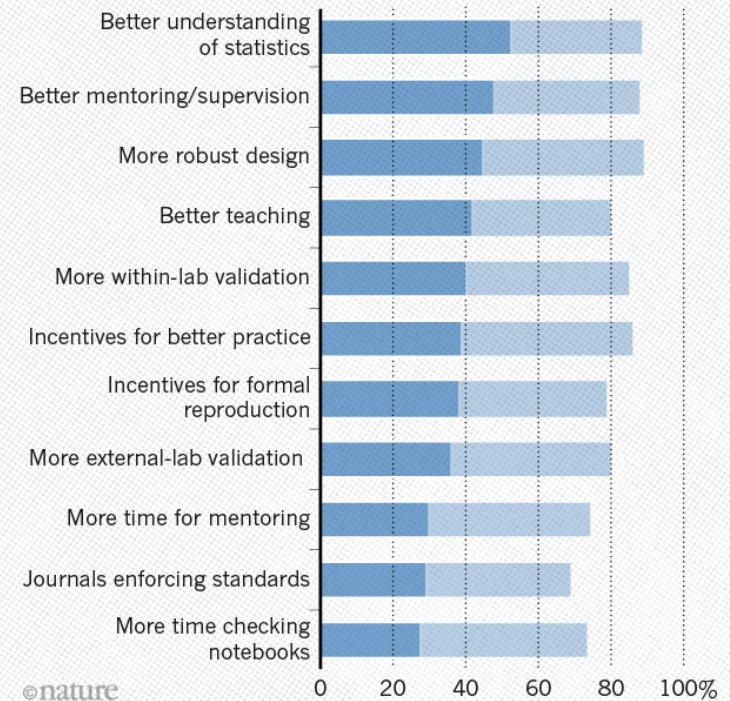


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WHAT FACTORS COULD BOOST REPRODUCIBILITY?

Respondents were positive about most proposed improvements but emphasized training in particular.

● Very likely ● Likely

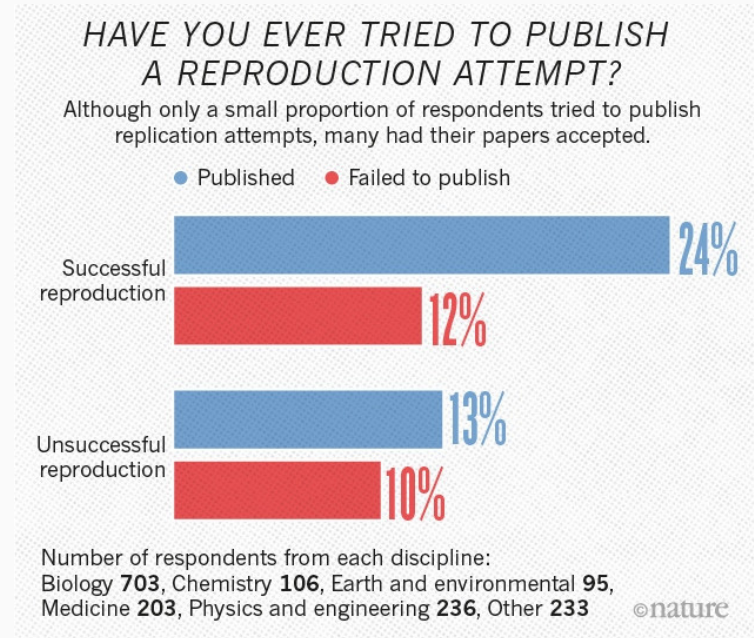
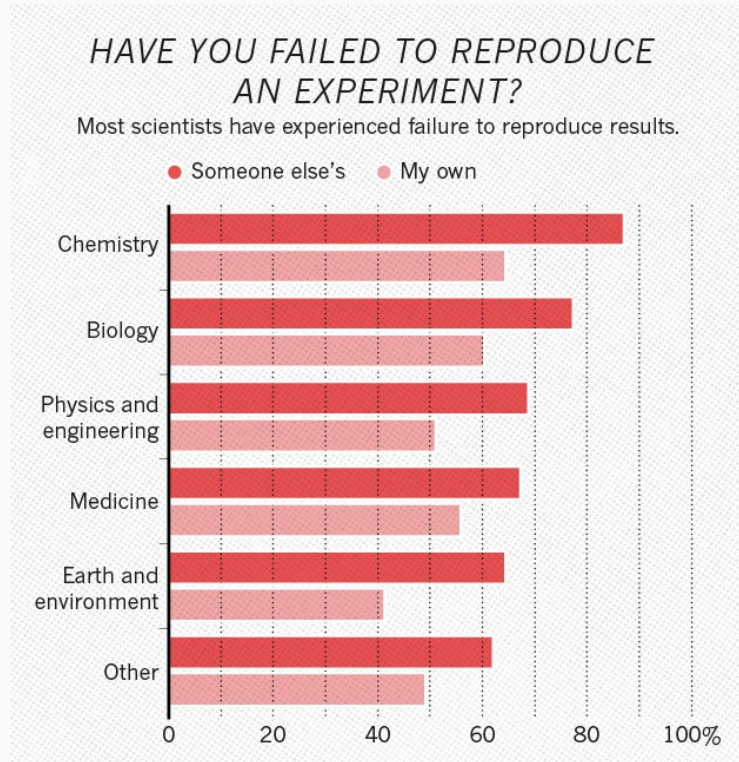


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Reproducibility in practice

It's important that we think about ways to encourage reproducible research, because...

Replicating results: the reality



Source: M. Baker, "1,500 scientists lift the lid on reproducibility," Nature **533**, 452 (2016)

The Reproducibility Project

The screenshot shows the Science journal website interface. At the top, the 'Science' logo is on the left, and navigation links for 'Home', 'News', 'Journals', 'Topics', and 'Careers' are in the center. On the right, there is a search bar and a 'Become a member' button with options to 'Renew my subscription' and 'Sign up for newsletters'. Below the navigation, the article title 'Estimating the reproducibility of psychological science' is displayed. To the left of the title are social media sharing icons for Facebook, Twitter, and Google+, each with a '0' below it. Below the title, it says 'Open Science Collaboration[†]' and 'See all authors and affiliations'. The article's publication details are listed: 'Science 28 Aug 2015; Vol. 349, Issue 6251, aac4716; DOI: 10.1126/science.aac4716'. Below the title and details are tabs for 'Article', 'Figures & Data', 'Info & Metrics', 'eLetters', and a PDF icon. The main text of the article begins with the subheading 'Empirically analyzing empirical evidence' and a paragraph: 'One of the central goals in any scientific endeavor is to understand causality. Experiments that seek to demonstrate a cause/effect relation most often manipulate the postulated causal factor. Aarts *et al.* describe the replication of 100 experiments reported in papers published in 2008 in three high-ranking psychology journals. Assessing whether the replication and the original experiment yielded the same result according to several criteria, they find that about one-third to one-half of the original findings were also observed in the replication study.' Below this paragraph is a link: 'Science, this issue 10.1126/science.aac4716'. On the right side of the article, there is a 'Science' journal cover image and a list of 'ARTICLE TOOLS' including 'Email', 'Print', 'Alerts', 'Citation tools', 'Download Powerpoint', 'Save to my folders', 'Request Permissions', and 'Share'. Below the tools is a 'RELATED CONTENT' section with 'PODCASTS' and a link to 'Science Podcast: 28 August Show', and an 'IN DEPTH' section with a link to 'Many psychology papers fail replication test'.

Brian Nosek of University of Virginia and colleagues sought out to replicate 100 different studies that all were published in 2008. The project pulled these studies from three different [psychology] journals... to see if they could get the same results as the initial findings. [...] Only 36.1% of the studies [were] replicated.

— [Reproducibility Project](#) Wikipedia entry

Science retracts gay marriage paper without agreement of lead author LaCour

In May 2015 Science retracted a study of how canvassers can sway people's opinions about gay marriage published just 5 months ago.

Sources: <http://news.sciencemag.org/policy/2015/05/science-retracts-gay-marriage-paper-without-lead-author-s-consent>,
<https://retractionwatch.com/2015/05/20/author-retracts-study-of-changing-minds-on-same-sex-marriage-after-colleague-admits-data-were-faked/>

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Two Berkeley grad students who attempted to replicate the study quickly discovered that the data must have been faked.

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Is the evidence for austerity based on an Excel spreadsheet error?

- C. Reinhart and K. Rogoff, "Growth in a Time of Debt", Amer. Econ. Rev. **100**, 573-578 (2010)
- Influential economics paper that found that when a country's GDP to debt ratio reaches 90%, GDP growth is cut almost in half.
- Cited as evidence for implementing austerity measures post-2008 financial crisis
- Dataset and analysis were not made public at time of publication

Sources: <https://www.washingtonpost.com/news/wonk/wp/2013/04/16/is-the-best-evidence-for-austerity-based-on-an-excel-spreadsheet-error/>, <http://www.bbc.com/news/magazine-22223190>, <https://www.peri.umass.edu/publication/item/526-does-high-public-debt-consistently-stifle-economic-growth-a-critique-of-reinhart-and-rogo-ff>

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3. Unconventional weighting of summary statistics

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	B	C	I	J	K	L	M
2			Real GDP growth				
3			Debt/GDP				
4	Country	Coverage	30 or less	30 to 60	60 to 90	90 or above	30 or less
26			3.7	3.0	3.5	1.7	5.5
27	Minimum		1.6	0.3	1.3	-1.8	0.8
28	Maximum		5.4	4.9	10.2	3.6	13.3
29							
30	US	1946-2009	n.a.	3.4	3.3	-2.0	n.a.
31	UK	1946-2009	n.a.	2.4	2.5	2.4	n.a.
32	Sweden	1946-2009	3.6	2.9	2.7	n.a.	6.3
33	Spain	1946-2009	1.5	3.4	4.2	n.a.	9.9
34	Portugal	1952-2009	4.8	2.5	0.3	n.a.	7.9
35	New Zealand	1948-2009	2.5	2.9	3.9	-7.9	2.6
36	Netherlands	1956-2009	4.1	2.7	1.1	n.a.	6.4
37	Norway	1947-2009	3.4	5.1	n.a.	n.a.	5.4
38	Japan	1946-2009	7.0	4.0	1.0	0.7	7.0
39	Italy	1951-2009	5.4	2.1	1.8	1.0	5.6
40	Ireland	1948-2009	4.4	4.5	4.0	2.4	2.9
41	Greece	1970-2009	4.0	0.3	2.7	2.9	13.3
42	Germany	1946-2009	3.9	0.9	n.a.	n.a.	3.2
43	France	1949-2009	4.9	2.7	3.0	n.a.	5.2
44	Finland	1946-2009	3.8	2.4	5.5	n.a.	7.0
45	Denmark	1950-2009	3.5	1.7	2.4	n.a.	5.6
46	Canada	1951-2009	1.9	3.6	4.1	n.a.	2.2
47	Belgium	1947-2009	n.a.	4.2	3.1	2.6	n.a.
48	Austria	1948-2009	5.2	3.3	-3.8	n.a.	5.7
49	Australia	1951-2009	3.2	4.9	4.0	n.a.	5.9
50							
51			4.1	2.8	2.8	=AVERAGE(L30:L44)	

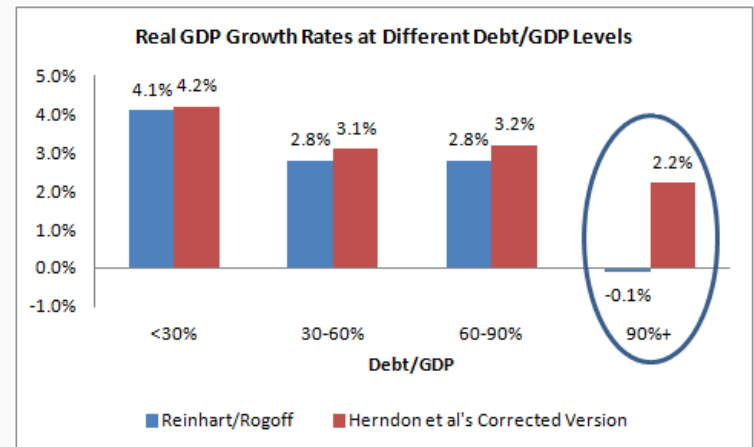


Chart: Jared Bernstein

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The war over supercooled water

DOI:10.1063/PT.6.1.20180822a

22 Aug 2018 in [Research & Technology](#)

The war over supercooled water

How a hidden coding error fueled a seven-year dispute between two of condensed matter's top theorists.

Ashley G. Smart

11
COMMENTS

< PREV NEXT >



Two different chemists ran simulations to see what happens when water is supercooled to around -40°C , where it will spontaneously freeze even if it is free of impurities.

Source: A. G. Smart, "The war over supercooled water," *Physics Today*, (2018)

<https://physicstoday.scitation.org/doi/10.1063/PT.6.1.20180822a/full/>

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Over the next seven years, the perplexing discrepancy would ignite a bitter conflict, with junior scientists caught in the crossfire. At stake were not only the reputations of the two groups but also a peculiar theory that sought to explain some of water's deepest and most enduring mysteries. Earlier this year, the dispute was finally settled. And as it turns out, the entire ordeal was the result of botched code.

Source: A. G. Smart, "The war over supercooled water," Physics Today, (2018)

<https://physicstoday.scitation.org/doi/10.1063/PT.6.1.20180822a/full/>

Credits

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Acknowledgments

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