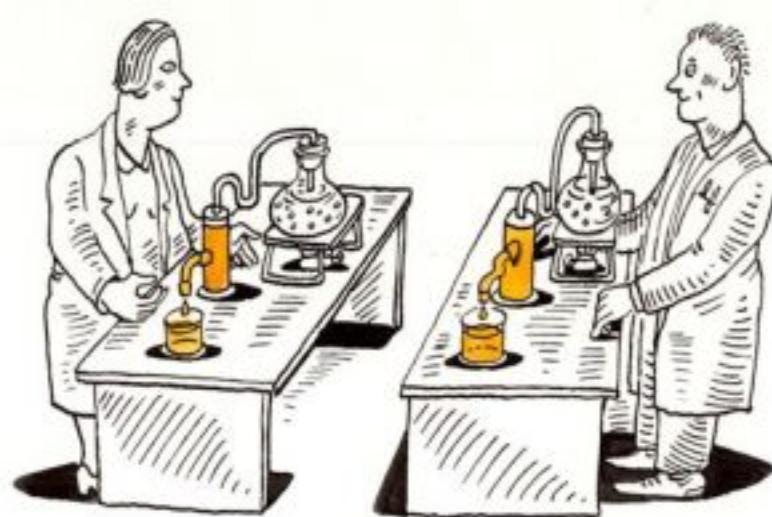
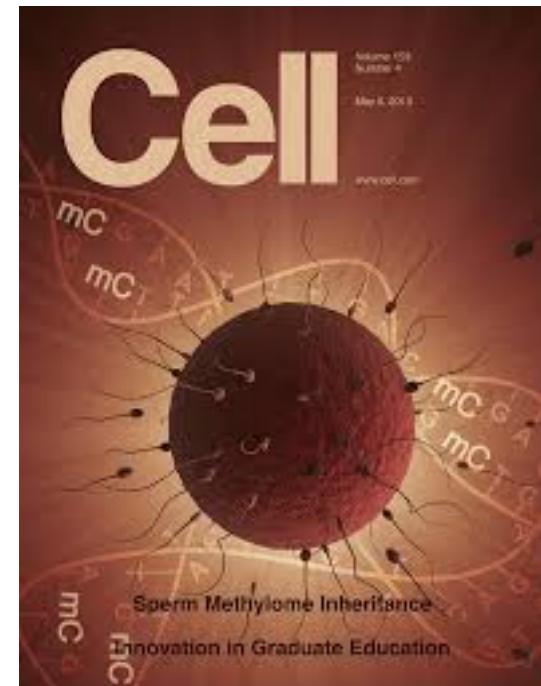
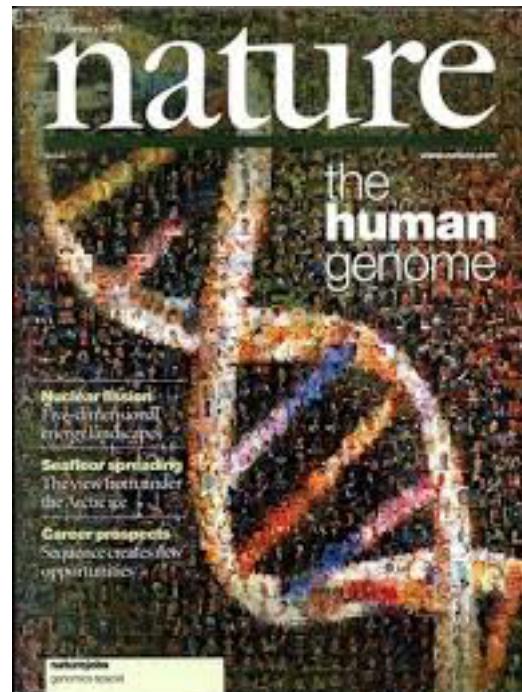


Reproducibility



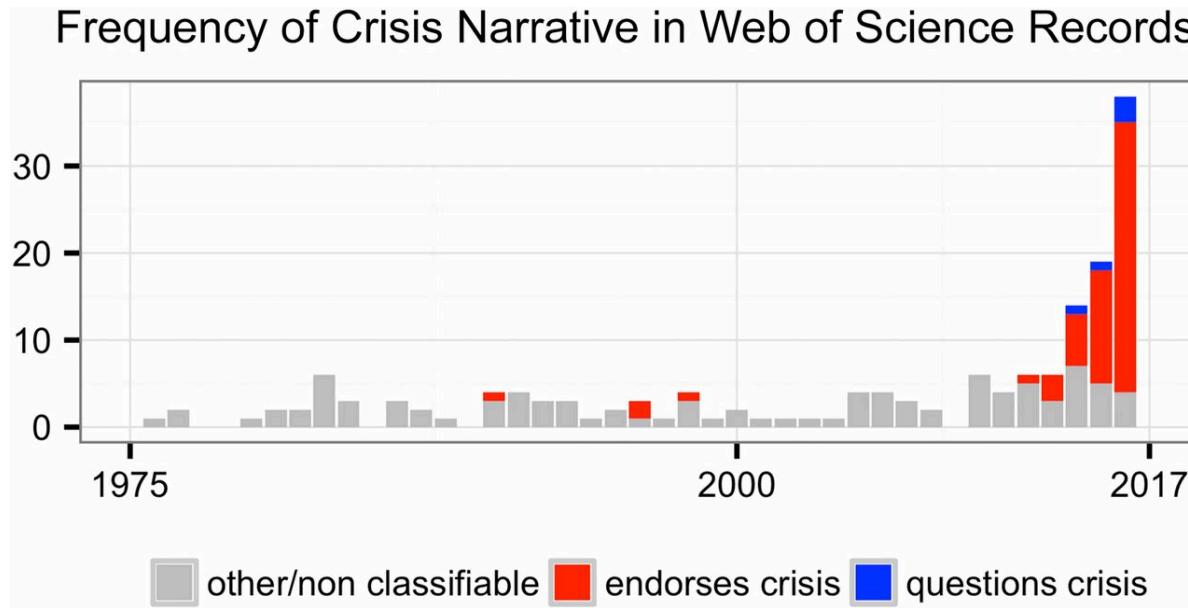
Reproducibility



Reproducibility

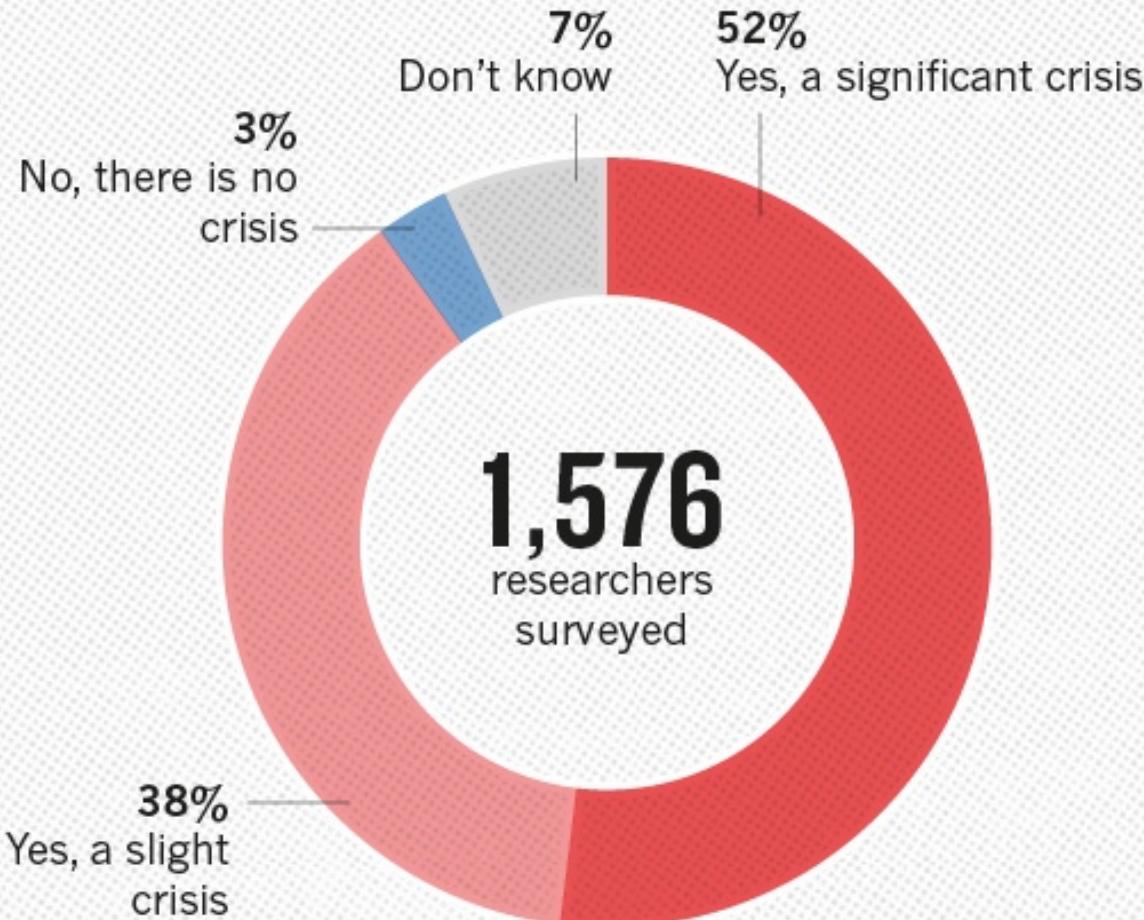
On speaking with many investigators in academia and industry, we found widespread recognition of this issue (Begley and Ellis, 2012).

Reproducibility



Reproducibility

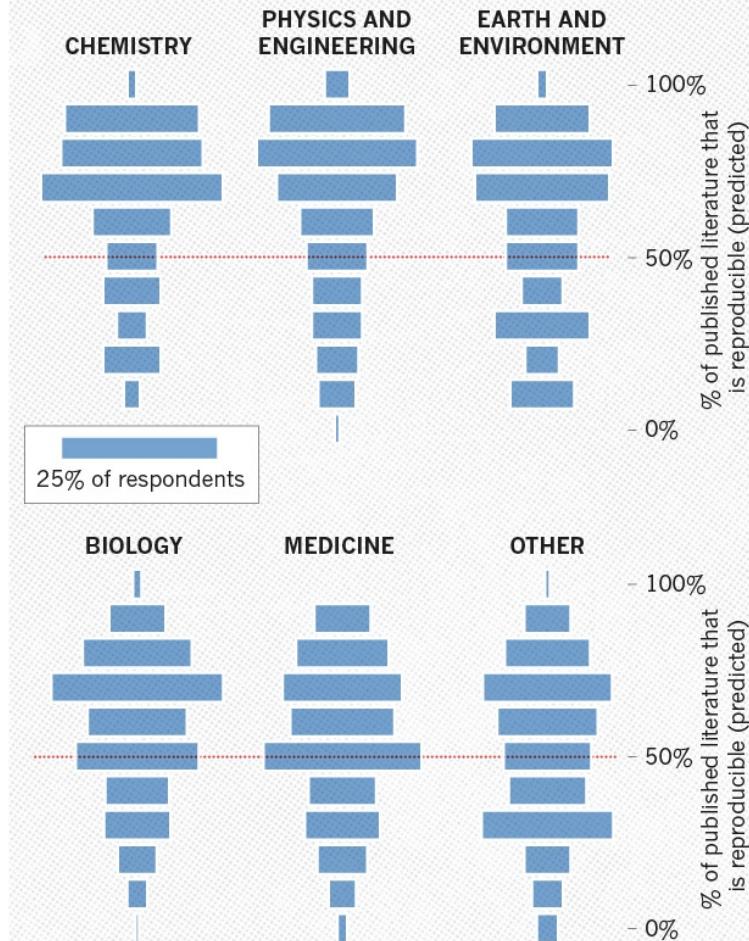
IS THERE A REPRODUCIBILITY CRISIS?



Reproducibility

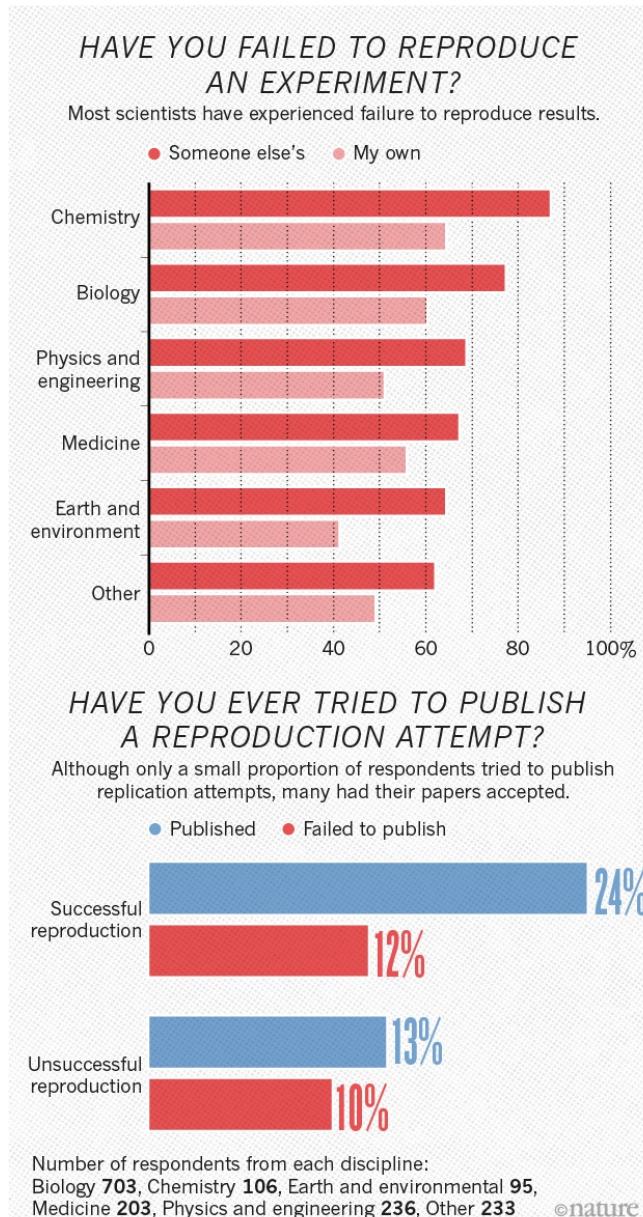
HOW MUCH PUBLISHED WORK IN YOUR FIELD IS REPRODUCIBLE?

Physicists and chemists were most confident in the literature.



Number of respondents from each discipline:
Biology 703, Chemistry 106, Earth and environmental 95,
Medicine 203, Physics and engineering 236, Other 233 ©nature

Reproducibility



Reproducibility

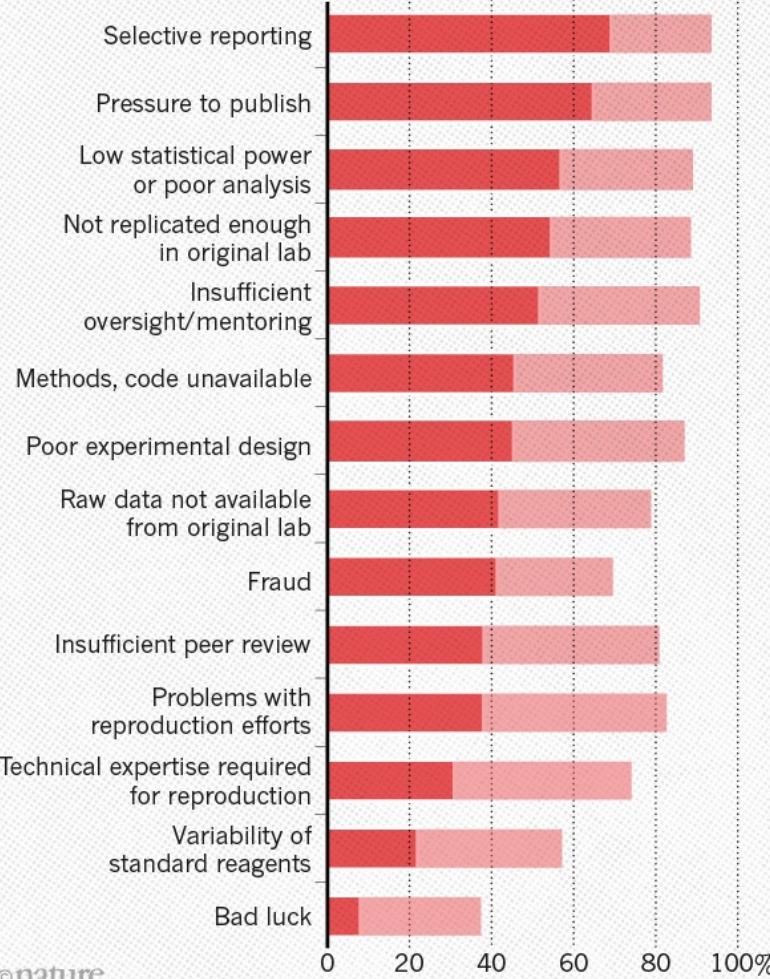
How can irreproducibility be both something everyone knows about, and an emerging crisis?

Reproducibility

WHAT FACTORS CONTRIBUTE TO IRREPRODUCIBLE RESEARCH?

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

- Always/often contribute
- Sometimes contribute



Reproducibility

HOW SCIENTISTS FOOL THEMSELVES — AND HOW THEY CAN STOP

Humans are remarkably good at self-deception. But growing concern about reproducibility is driving many researchers to seek ways to fight their own worst instincts.

COGNITIVE FALLACIES IN RESEARCH



HYPOTHESIS MYOPIA

Collecting evidence to support a hypothesis, not looking for evidence against it, and ignoring other explanations.



TEXAS SHARPSHOOTER

Seizing on random patterns in the data and mistaking them for interesting findings.



ASYMMETRIC ATTENTION

Rigorously checking unexpected results, but giving expected ones a free pass.



JUST-SO STORYTELLING

Finding stories after the fact to rationalize whatever the results turn out to be.

DEBIASING TECHNIQUES



DEVIL'S ADVOCACY

Explicitly consider alternative hypotheses — then test them out head-to-head.



PRE-COMMITMENT

Publicly declare a data collection and analysis plan before starting the study.



TEAM OF RIVALS

Invite your academic adversaries to collaborate with you on a study.



BLIND DATA ANALYSIS

Analyse data that look real but are not exactly what you collected — and then lift the blind.

Reproducibility

A lack of preproducibility

Reproducibility

Karl Popper – Science may best be described as the art of systematic oversimplification – the art of discerning what we may **with advantage** omit.

Results that generalize to...

...all universes are math

...our universe belong to physics

...all life on earth underpin molecular biology

...all mice are murine biology

Results that hold for a particular mouse in a particular lab in a particular experiment are arguably not science.

Reproducibility

Communicating a scientific result requires enumerating, recording and reporting those things that cannot with advantage be omitted

Reproducibility

Communicating a scientific result requires enumerating, recording and reporting those things that cannot with advantage be omitted.

Example: Methods last week on cooking.

Omit day of the week?

Amount of butter?

Type of oven?

Brand of eggs?

Temperature?