Can we trust the experts?

April 1, 2024, Mather House, CWRU

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77 peer-reviewed publications
Frequent NIH grant reviewer

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Declarations:
-NIH (PI) and CDC (co-I) funding
-Venatorx Pharmaceuticals unspent research grant milestone
-Co-founder and President of the nonprofit Knowledge Advances Inc; released the free educational app **'Advance: Life training'**

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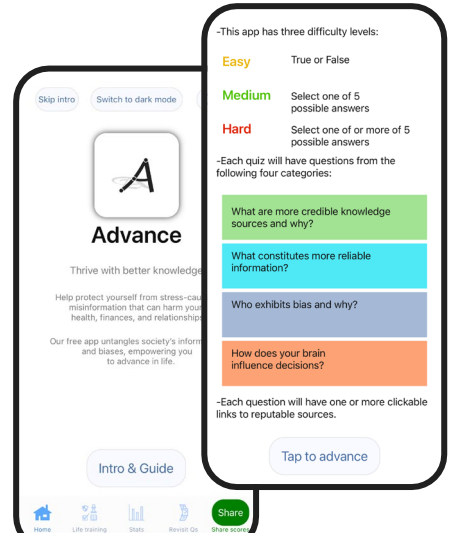
GET IT ON Google Play



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Today's take home message on "Can we trust the experts?"

Increase your odds of finding sources and information with higher reliability (experts play a crucial part in this).

How? … this lecture

Navigating the current information ecosystem is not easy

- Trust in science, journalism, and institutions is currently quite low
- “Fake media”, “Big lie”, post-truth society
- Social media, misinformation, disinformation, fear mongering
- Artificial intelligence, deep fakes
- Experts, politicians, pundits/talk show hosts
- FactCheck, PolitiFact, Science Feedback
- CDC, FDA, NIH
- NYT, WSJ, etc.

Let’s start from the basics to improve one’s chances to recognize both sources and facts that are more reliable.

Facts are important, sometimes fatally so

Which **mushroom** or **fish** is toxic for consumption?

or

or

Knowing the facts can keep you alive!

https://en.wikipedia.org/wiki/Lophius
https://en.wikipedia.org/wiki/Mushroom_poisoning
https://en.wikipedia.org/wiki/Fugu
https://healing-mushrooms.net/Boletus-edulis

Facts are essential; they should be considered a basic human need like food, water, and shelter

Recognizing the importance of reliable facts, humankind, over millennia, has developed **four** main professions or processes dedicated to generating facts (i.e., job specialization):

1. **Science**
2. **Journalism**
3. **The judicial system**
4. **Intelligence agencies (e.g., CIA and FBI)**

Professionals in these four categories are **experts** at gathering facts: they have the training, the sources, resources, the methods, etc. …. but they are not flawless which is what other competing sources of information take advantage of via cherry picking such instances to decrease trust in those four professions.

These fact-generating professions or processes have been refined over centuries to improve factual accuracy

	Education	Ethics & Standards	Evidence	Reputation to uphold	Consequences of errors or fraud
1. Science	✓	✓	✓	✓	✓
2. Journalism	✓	✓	✓	✓	✓
3. The judicial system	✓	✓	✓	✓	✓
4. Intelligence agencies	I assume they all receive checkmarks but due to their secretive nature, I will just not discuss it here				

https://ori.hhs.gov/content/case_summary

Retraction Watch

Tracking retractions as a window into the scientific process

https://retractionwatch.com/

https://www.npr.org/2023/07/19/1188828810/stanford-university-president-resigns

Associated Press reporter fired over erroneous story on Russian attack

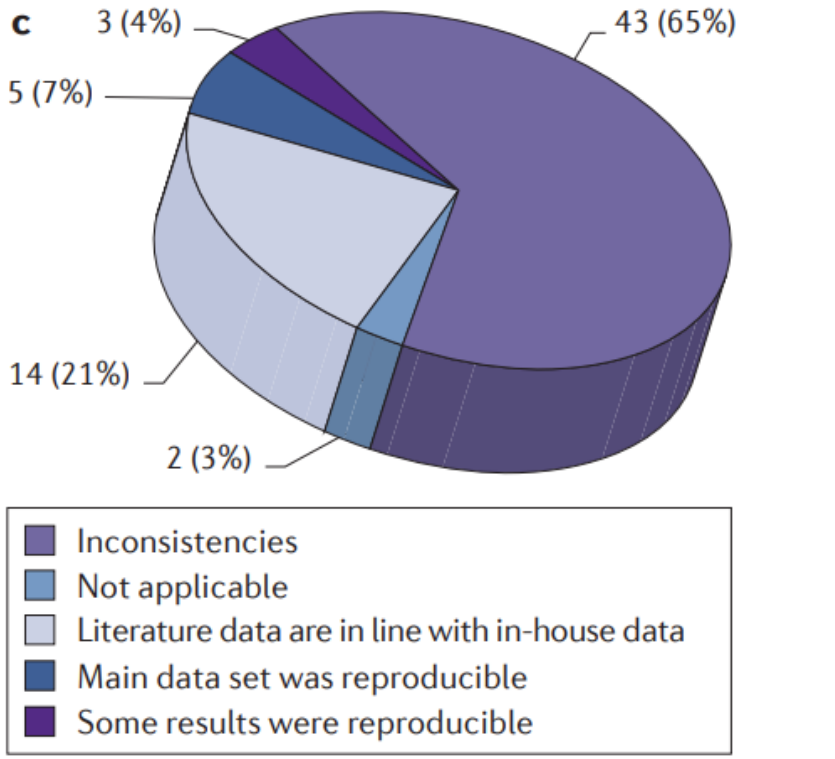
https://www.washingtonpost.com/media/2022/11/21/james-laporta-associated-press-poland-russia-missile/

Despite their refinements, none of these four main fact-generating professions or processes are flawless

	Examples of errors or flaws
1. Science	**Andrew Wakefield's Study on MMR Vaccine and Autism (1998)** https://en.wikipedia.org/wiki/Andrew_Wakefield **Cold Fusion Claims by Pons and Fleischmann (1989)** https://en.wikipedia.org/wiki/Cold_fusion
2. Journalism	**Stephen Glass Fabrications (1998)** https://en.wikipedia.org/wiki/Stephen_Glass **NBC's "Dateline" GM Truck Scandal (1992)** https://www.latimes.com/archives/la-xpm-1993-02-10-mn-1335-story.html
3. The judicial system	**Innocence Project that helped overturn over 300 convictions** https://en.wikipedia.org/wiki/Innocence_Project **List of wrongful convictions in the US (Wikipedia)** https://en.wikipedia.org/wiki/List_of_wrongful_convictions_in_the_United_States
4. Intelligence agencies	**Weapons of mass destruction in Iraq (2002)** https://www.businessinsider.com/heres-the-full-version-of-the-cias-2002-intelligence-assessment-on-wmd-in-iraq-2015-3

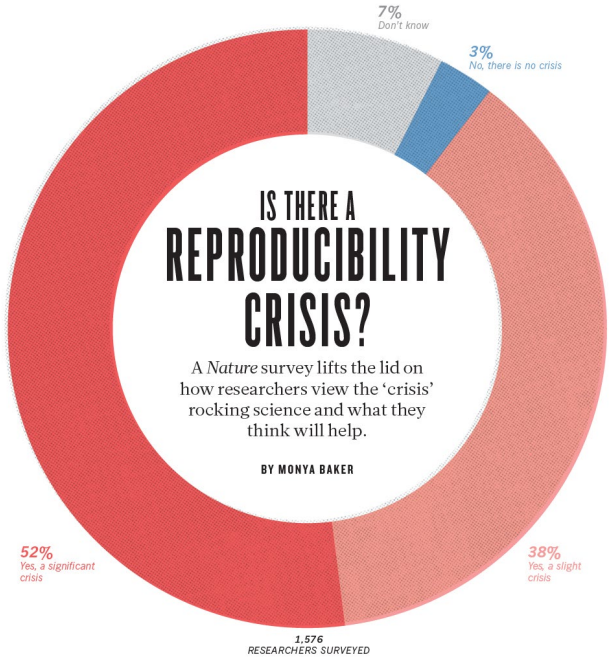
Science is not always flawless: Reports about a replication crisis in science since 2011

Scientists at Bayer had trouble reproducing other published findings



NATURE REVIEWS | DRUG DISCOVERY 2011 10(9):712

https://pubmed.ncbi.nlm.nih.gov/21892149/



More than 70% of researchers have tried and failed to reproduce another scientist's experiments, and more than half have failed to reproduce their own experiments. Those are some of the telling figures that emerged from *Nature*'s survey of 1,576 researchers who took a brief online questionnaire on reproducibility in research.

452 | NATURE | VOL 533 | 26 MAY 2016

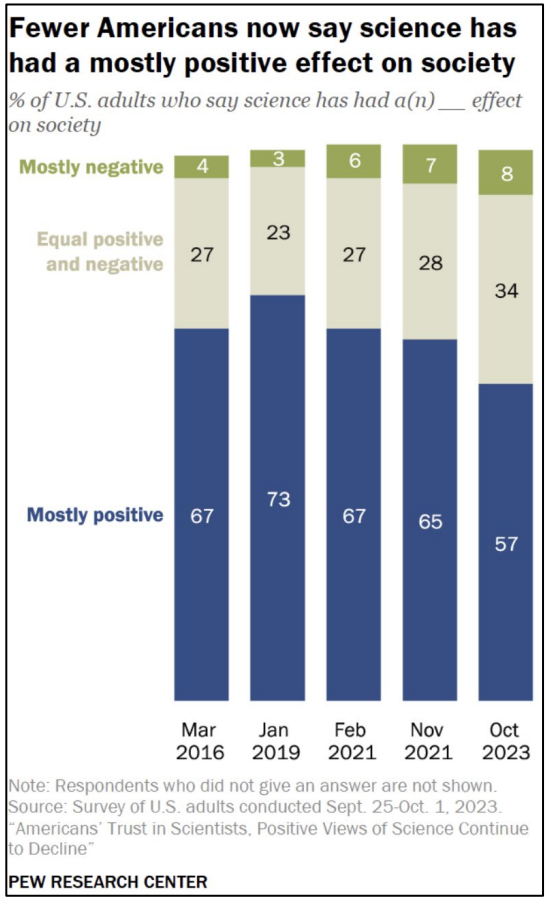
https://www.nature.com/articles/533452a

This awareness had led to some structural improvements (need to submit raw data, rigor questionnaire in Nature, meta-analysis, etc.); see here for more info: https://www.nature.com/articles/s44271-023-00003-2

Despite the low trust in science, the retraction rate for biomedical science articles is very small (only ~0.04 %)

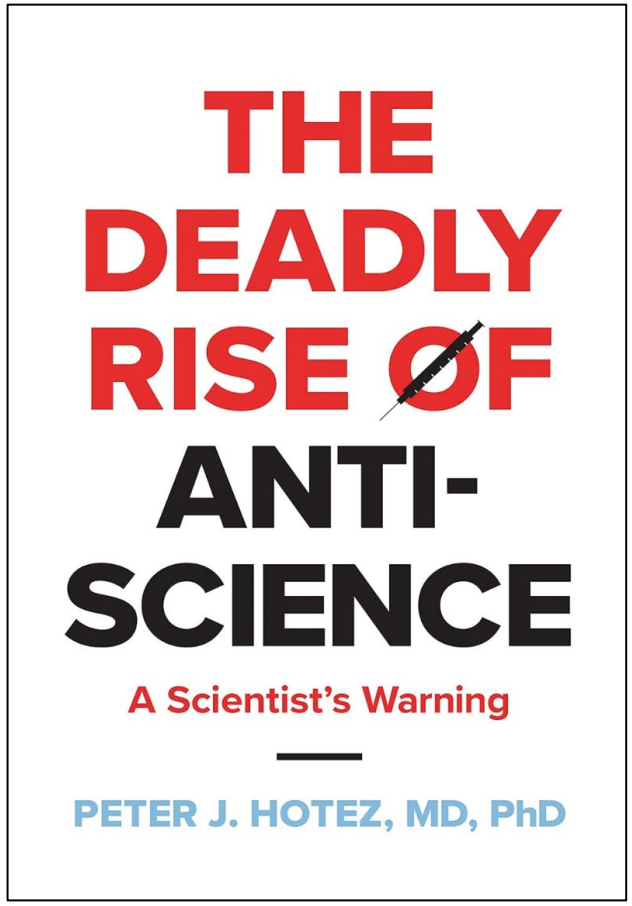
https://ncbi.nlm.nih.gov/pmc/articles/PMC10485848/

These error, fraud, replication issues have contributed to decreased trust in science



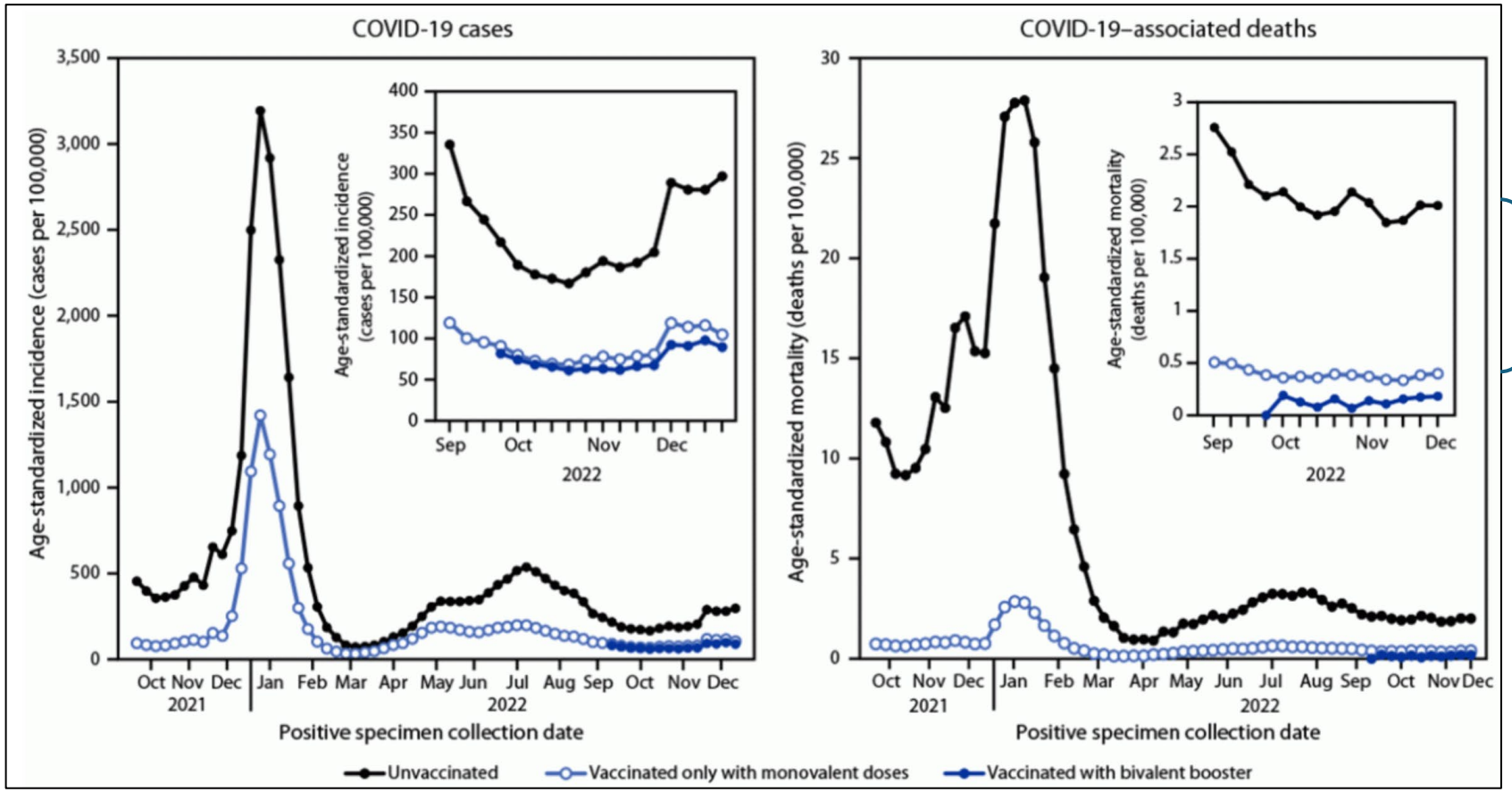
https://www.pewresearch.org/science/2023/11/14/americans-trust-in-scientists-positive-views-of-science-continue-to-decline/

https://www.science.org/doi/epdf/10.1126/science.ado3040



Decreased trust in science can have deadly consequences

Vaccine hesitancy costs lives:



4X

8X increase in deaths

Morbidity and Mortality Weekly / February 10, 2023 / 72(6);145–152
https://www.cdc.gov/mmwr/volumes/72/wr/pdfs/mm7206-h.pdf

Trust in journalism is also decreasing

Although reputable journalists at reputable newspapers will make every effort to ensure their articles are factually accurate, they can have biases in other aspects:

1. Choice of which news to cover for increased clicks or views
2. Choice of covering only the latest news because of ‘news’ bias (vulnerable to exploitation by politicians who strategically make daily outrageous statements to stay in the news)
3. Non-neutral language

But it is not just the four main fact-generating professions or processes that want your attention

1. ***Science***
2. ***Journalism***
3. ***The judicial system***
4. ***Intelligence agencies***
5. **Politicians**
6. **Talk show hosts**
7. **Pundits**
8. **People or entities on social media**
9. **Product advertisements**
10. **Internet and dark web**

Frequently contradict each other

Potential Serious Consequences:

- Emergence of a post-truth society
- Deepening divisions within society due to accepting opposing facts

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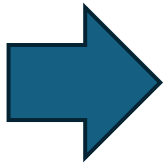
Acceptance of contradictory facts is one of society's **biggest problems** often contributing to other global problems such as climate change denial and vaccine hesitancy.

To help overcome this, I hope to encourage discussion with this talk and I have co-founded the nonprofit Knowledge Advances Inc. that developed the educational app '**Advance: Life training**'. This app helps users navigate the information ecosystem.

How to navigate the information ecosystem?

Since none of these four main fact-generating professions or processes are flawless and there are ample other sources of information:



One should recognize the ones with higher reliability to increase your odds of having factually correct information.

How? First, one needs to understand how humankind has refined the four primary fact-generating professions or processes to enhance reliability, given the critical importance of factual correctness.

Comparing the Rigor of Scientific Publishing with Social Media

Social media comments are not checked

1. Type paragraph and click post

Science is rigorously vetted

1. Transform scientific ideas into a grant application to obtain experimental evidence and necessary funding.
2. Include data, rigor of data, and in-text citations to references in grant.
3. Complete a conflict of interest declaration at your institution.
4. Institutional approval to submit your grant proposal for review.
5. A study section reviews and scores the grants with the top ~10-20% receiving funding.
6. Declare all additional support to the funding agency to prevent budget overlap before receiving funds.
7. Conduct research and analyze data to establish statistical significance, justifying manuscript preparation for publication.
8. Externally validate data before manuscript submission (some fields).
9. Include data, rigor of data, and in-text citations to references in manuscript.
10. Ensure all co-authors agree on the final draft of the manuscript.
11. Report any conflicts of interest for each author.
12. Submit the manuscript and data to journal for peer review.
13. The journal editor decides to send the manuscript for review or to reject it.
14. 2-5 peer reviewers evaluate the manuscript.
15. The editor may reject, ask for revisions, or accept the manuscript for publication (some journals accept only the top 10%).
16. Once accepted, undergo journal copy-editing.
17. After publication, the scientific community builds upon the results. Corrections or retractions may occur if replication fails.
18. If others can replicate findings: **acceptance by the scientific community, the final but most important step**.

The Wakefield MMR vaccine autism link study failed these scientific rigor steps

- Some of his patients (children) were not randomly selected as they were already known to have pre-existing developmental concerns.
- Dr. Wakefield had an undisclosed conflict of interest (he was funded by personal injury lawyers who were representing people suing MMR vaccine makers).
- Results could not be replicated by others. Manuscript was retracted.

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2831678/
- https://www.cdc.gov/vaccinesafety/concerns/autism.html
- https://www.vox.com/2015/2/2/7965885/vaccine-autism-link-false-evidence-wakefield
- https://bigthink.com/guest-thinkers/autismvaccine-doc-andrew-wakefield-gets-the-boot/
- https://www.chop.edu/centers-programs/vaccine-education-center/vaccines-and-other-conditions/vaccines-autism
- https://en.wikipedia.org/wiki/Andrew_Wakefield

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Self-correction in science via interconnectedness

Example: Steps involved in the drug discovery process

1. Disease identified in patients
2. Disease target discovery and validation (genetic studies)
3. Protein expression, purification, and activity assay of drug target
4. In vitro screening for inhibitors of drug target based on assay (lead identification)
5. Characterization of inhibitors using protein crystallography and biophysical studies
6. Medicinal chemistry to improving affinity of inhibitor, cell-based assays, and toxicology studies (lead optimization)
7. Mouse studies probing efficacy of optimized inhibitor
8. Improving Pharmacokinetics (PK) and pharmacodynamics (PD) of inhibitor via medicinal chemistry
9. Testing inhibitor efficacy in non-rodent translational animal disease model (e.g., non-human primates)
10. Formulation development and clinical trial in humans

Science continuously builds on the published results of others. This often involves **replicating** the step before the new planned study. These different steps are often done in different labs (as they have different expertise) promoting independent replication. If results in one of the steps are not valid as it could not be replicated by others, that line of scientific inquiry ends there. Scientific reliability in general is strong as so many medicines have completed this interdependent process. Scientific validation continues after a drug is approved leading to some approvals being revoked.

What enhances or constitutes evidence/findings of higher reliability

More reliable → **Less reliable**

Science:

-Scientific consensus
-Meta-analysis
-Systematic review

>

Single scientific study with orthogonal experiments

>

Single Experiment

Judicial system:

-Testimony under oath
-Evidence gathered during discovery phase
-Judgement by jury/judge

>

Accusations

All sources:
(incl. journalism)

-No conflict of interest
-Expertise in subject
-Transparent evidence
-Not anonymous

>

-Conflict of interest
-No expertise in subject
-No transparent evidence
-Anonymous

Recognizing these factors has the potential to **unite people** around shared, more reliable facts, potentially **reducing societal divisions**.

Factors Enhancing Factual Reliability	Tot=
Transparent Authorship: Are the authors or sources of the information clearly identified, ensuring accountability and credibility, or anonymous?	
Expertise and Credentials: Is the person or entity an expert in the subject matter (via experience, profession, and/or education)?	
Use of Evidence: Does the source substantiate their claims with reliable data and its rigor (such as figures or tables), citations, or authoritative sources? This includes statements made under oath, evidence presented during judicial proceedings, and judicial findings by judges or juries.	
Professional Ethics, Standards: Is the person or entity part of a profession bound by ethics and standards for factual correctness? (such as science/medicine, journalism, and the judicial system).	
Organizational Reputation: Is the person or entity part of an organization which has a reputation to uphold for factual correctness?	
Reputation Author: Does the person or entity itself have a reputation to uphold for factual correctness?	
Accountability: Does the person or entity face professional consequences for disseminating incorrect information, including issuing corrections or retractions, or risk losing their job, funding, accreditation, or license?	
Editorial Oversight: Is the information subject to **prior editorial review** and/or **independent peer evaluation** to enhance accuracy and rigor?	
Verification, Replication, and Consensus: Have the claims been independently verified or replicated and align with established findings, supported by expert consensus. Or does it contradict the expert consensus?	
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Methodological and Data Transparency: Are the methods, sources, and data used in generating the information clearly stated and available for scrutiny **before**, **during**, and/or **after** the peer or editorial review?	
Commitment to Fact-Finding Under Risk: Does the individual show a dedication to factual accuracy by accepting dangers such as chemical or biological hazards in laboratory environments, or physical threats or death in conflict zones for journalists?	
History of Accuracy: Does the person or entity have a track record of accuracy in their statements or publications, avoiding baseless accusations?	
Neutral Language and Depth in Publishing: Does the platform mandate the use of neutral language, steering clear of sensationalism and fear-mongering, while accommodating the lengthy, nuanced analysis essential for thoroughly exploring complex topics?	

Factors Enhancing Factual Reliability: Structural biologist scientist	Tot=18
Transparent Authorship: Are the authors or sources of the information clearly identified, ensuring accountability and credibility, or anonymous?	
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Factors Enhancing Factual Reliability: Someone on the dark web or anonymous on social media	Tot=0
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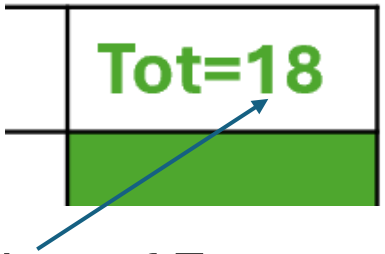

The higher the number of **Factors Enhancing Factual Reliability**, the greater the likelihood that the information is not only factually correct but also presents a comprehensive and accurate portrayal of the subject matter.

Feel free to complete this evaluation exercise by yourself for:

- *Journalists employed by reputable newspapers (one of the four fact-generating professions so the **Total** will be quite high)*
- *Other people you might be listening to for information (talk show hosts, prominent people on social media, etc.)*

Today's take home message on "Can we trust the experts?"

Increase your odds of finding sources and information with higher reliability (experts play a crucial part in this).

How? :

The main **four** main professions or processes dedicated to generating facts humankind has developed and refined:

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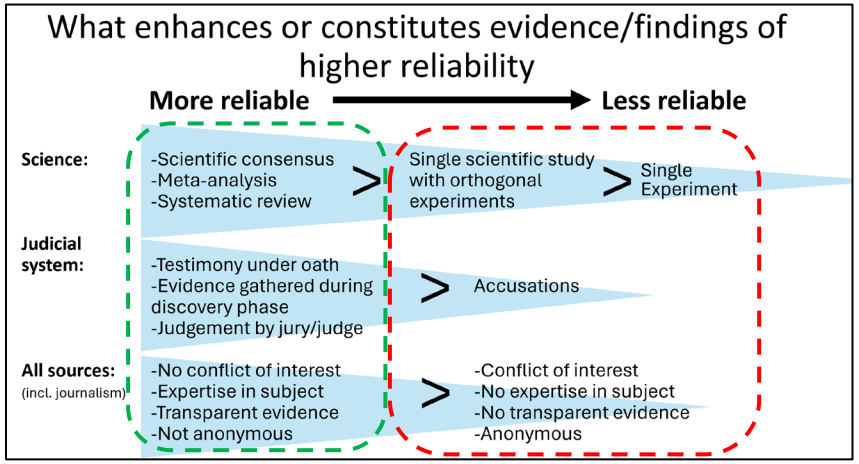


But these four are not flawless which is what other competing information source take advantage of via cherry picking such instances to decrease trust in those four professions/processes.

But the information ecosystem is much more complex than this:

1. What are more credible knowledge sources and why?

We covered that today

2. What constitutes more reliable information?

We covered this a bit today

3. Who exhibits bias and why?

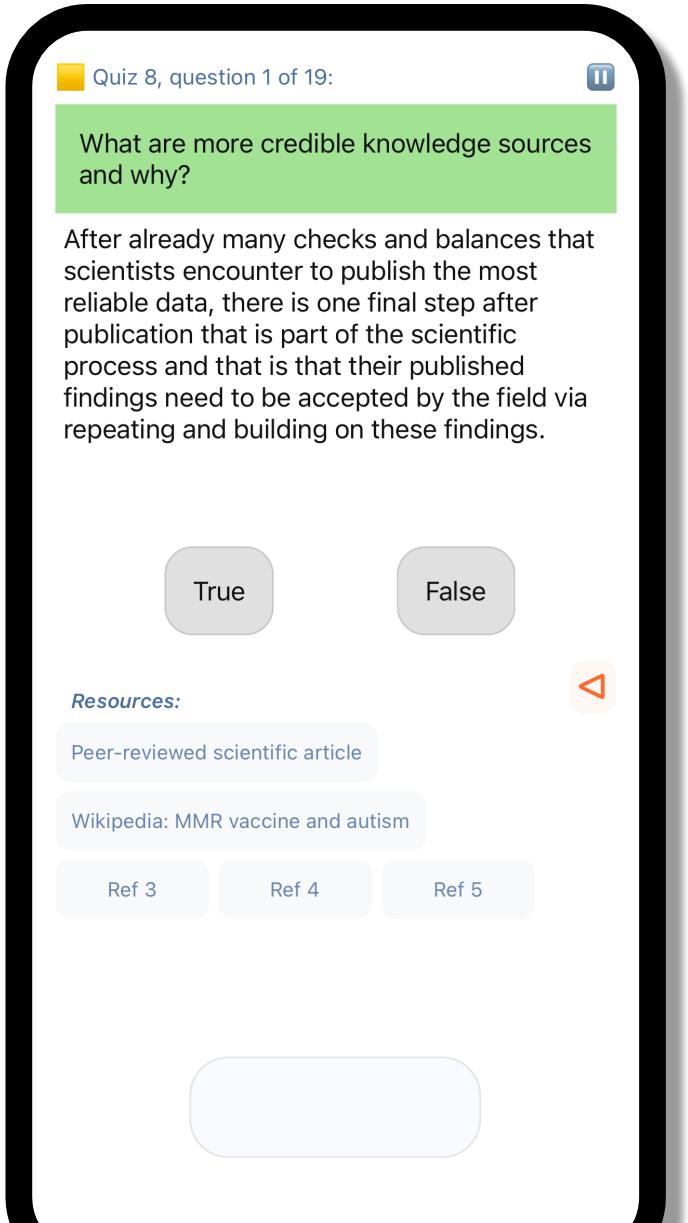
4. How does your brain influence decisions?

To help people better understand this information ecosystem to help tackle one of society's biggest problems, I co-founded the nonprofit Knowledge Advances Inc. and developed the free app '**Advance: Life training**'.

https://knowledgeadvances.org/

Download on the App Store

GET IT ON Google Play



Most of what I covered today can also be learned via the free app '**Advance: Life training**'

Advance: Life training

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Vivien Yee and Focco van den Akker

https://knowledgeadvances.org/