How to Spot a Non-Expert: Tell-Tale Signs of Pseudoscience

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Plan of presentation

- What is science?
- Pseudoscience (in psychology and elsewhere)
- Lilienfeld's features of pseudoscience
- French's Quick Tips for spotting a (potential) pseudoscientist
- The psychology of pseudoscientific belief
- Ray Hyman's "proper criticism"
- Cook & Lewandowsky's *Debunking Handbook*

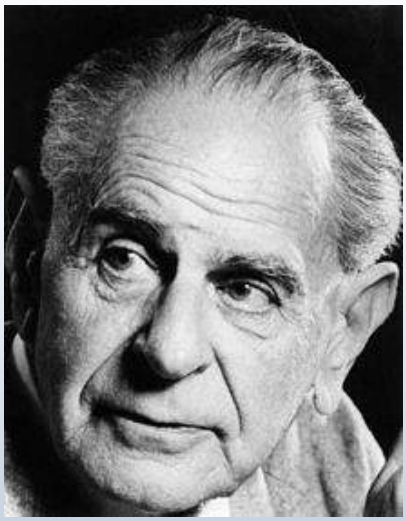
Sir Francis Bacon (1561-1626)

Science as induction

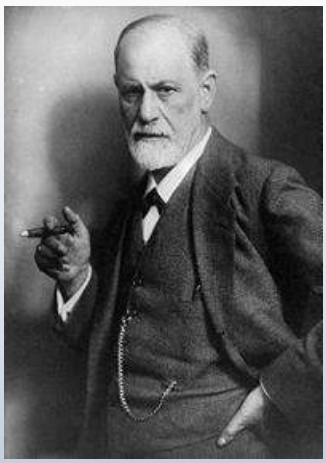
Sir Karl Popper (1902-1994)

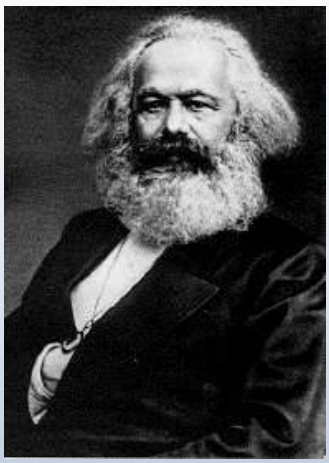
Problems with induction

Proposed falsification as main criterion



Problem Cases





Falsification

- Problems with falsification as defining feature of science
  - At best, prescriptive not descriptive
  - Hypothesis should not be abandoned following first apparent falsification
- But falsification still useful indicator if either
  - Hypothesis non-falsifiable in principle; or
  - Over-reliance on ad hoc excuses to avoid falsification
- No universally agreed definition or set of criteria to differentiate science from non-science

Salient characteristics of a scientific theory

- Reproducible. Makes predictions that can be tested by any observer, with trials extending indefinitely into the future.
- Falsifiable and testable.
- Consistent. Generates no obvious logical contradictions, [...] being consistent with observation.
- Pertinent. Describes and explains observed phenomena.

Salient characteristics of a scientific theory

- Correctable and dynamic. Subject to modification as new observations are made.
- Integrative, robust, and corrigible. Subsumes previous theories as approximations, and allows possible subsumption by future theories.
- Parsimonious. Economical in the number of assumptions and hypothetical entities.
- Provisional or tentative. Does not assert the absolute certainty of the theory.

The 10 Commandments

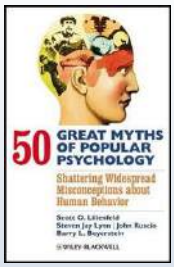
- Scott Lilienfeld (2005). The 10 commandments of helping students distinguish science from pseudoscience in psychology. *APS Observer,* 18, 39-40 & 49-51.
- Pseudoscience - claims and methods that are falsely presented as science
- Benefits of teaching about pseudoscience
  - Helps students to understand true nature of science
  - Painlessly provides critical thinking skills
- "inscribe these commandments on impressive stone tablets to be mounted outside of all psychology departments"

Dubious claims (partial list)

- "dubious claims on the fringes of scientific knowledge"
- "extrasensory perception, psychokinesis, channelling, out-of-body experiences, subliminal persuasion, astrology, biorhythms, 'truth serum,' the lunar lunacy effect, hypnotic age regression, multiple personality disorder, alien abduction reports, handwriting analysis, rebirthing therapy, and untested herbal remedies for depression"

Great Myths of Popular Psychology

Lilienfeld, S. O., et al. (2010). *50 Great Myths of Popular Psychology.* Chichester: Wiley



- We only use 10% of our brains.
- Expressing anger is usually better than holding it in.
- Opposites attract in interpersonal relationships.
- High self-esteem is necessary for psychological health.
- People with schizophrenia have more than one personality.

First Commandment

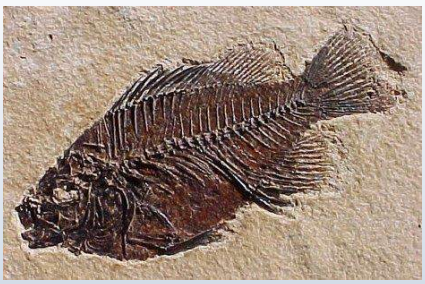
- *Thou shalt delineate the features that distinguish science from pseudoscience.*
  - A tendency to invoke hypotheses, which can be thought of as "escape hatches" or loopholes, as a means of immunising claims from falsification
  - An absence of self-correction and an accompanying intellectual stagnation
  - An emphasis on confirmation rather than refutation
  - A tendency to place the burden of proof on sceptics, not proponents, of claims
  - Excessive reliance on anecdotal and testimonial evidence to substantiate claims

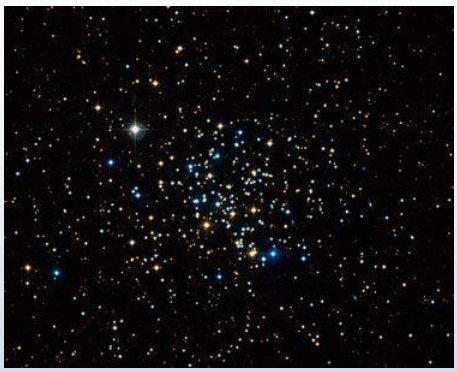
First Commandment

- *Thou shalt delineate the features that distinguish science from pseudoscience.*
  - Evasion of the scrutiny afforded by peer review
  - Absence of "connectivity" [...], that is, a failure to build on existing scientific knowledge
  - Use of impressive-sounding jargon whose primary purpose is to lend claims a façade of scientific respectability
  - An absence of boundary conditions [...], that is, a failure to specify the settings under which claims do not hold

Ad hoc hypotheses

- Young Earth Creationism

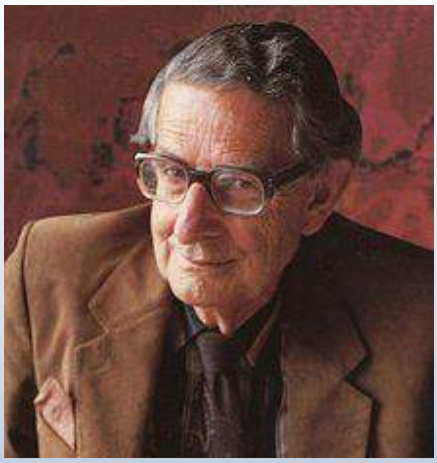




- Occam's Razor: "*Pluralitas non est ponenda sine neccesitate*" or "plurality should not be posited without necessity."

Absence of Self-Correction

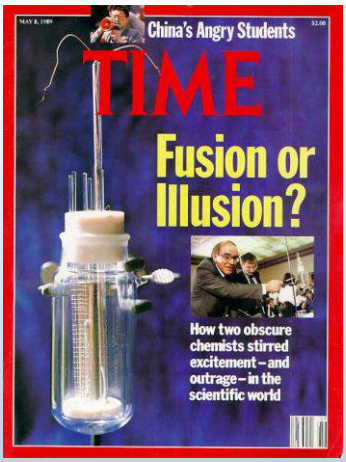
Emphasis on Confirmation



Burden of Proof

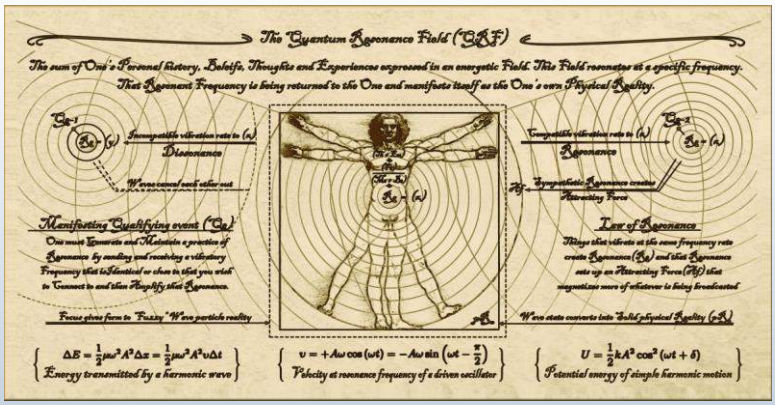
Anecdotal Evidence

Evasion of Peer Review

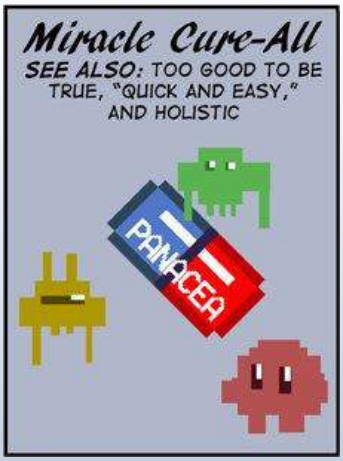


Absence of Connectivity

Impressive Jargon



Absence of Boundary Conditions

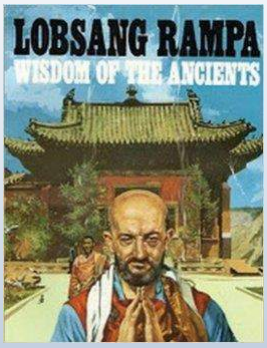


Chris French's Top Tips

- *Excessive reliance on anecdotal and testimonial evidence to substantiate claims.*
- *Use of impressive-sounding jargon whose primary purpose is to lend claims a façade of scientific respectability*

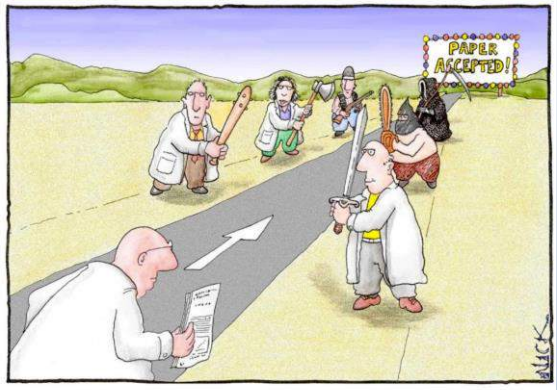
Chris French's Top Tips

- *An absence of self-correction and an accompanying intellectual stagnation*



Chris French's Top Tips

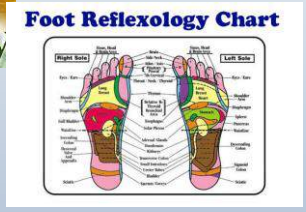
- *Evasion of the scrutiny afforded by peer review*



Most scientists regarded the new streamlined peer-review process as "quite an improvement."

Chris French's Top Tips

- *Claims that their theory or application of their theory has extremely wide applicability*



Chris French's Top Tips

- *No evidence of proper training in the field in question*


The Name of the University

hereby confers upon

Your Name

the degree of

Your Degree and Major

together with all the rights, privileges and honors appertaining thereto in consideration of the satisfactory completion of the course prescribed in

Your College

In Testimony Whereof, the seal of the University and the signatures as authorised by the Board of Trustees are hereunto affixed.

Given at your City on the twelfth day of December in the year of our Lord nineteen hundred ninety-eight.

President of the University

Secretary of the Board of Trustees

Chris French's Top Tips

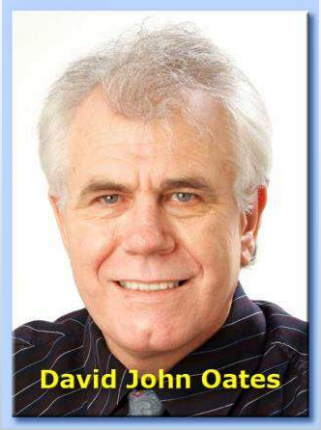
- *Properly qualified scientists issuing pronouncements outside their area of expertise.*
- Astrophysicist Fred Hoyle stated that a living cell was as likely to form from evolution as a Boeing 747 emerging after a tornado spinning through a junkyard

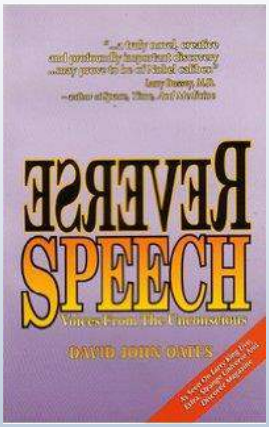
Chris French's Top Tips

- *Properly qualified scientists issuing pronouncements outside their area of expertise.*
- Physicist Brian Josephson awarded a Nobel prize for work on superconductivity.
- Claims quantum mechanics can explain telepathy

Chris French's Top Tips

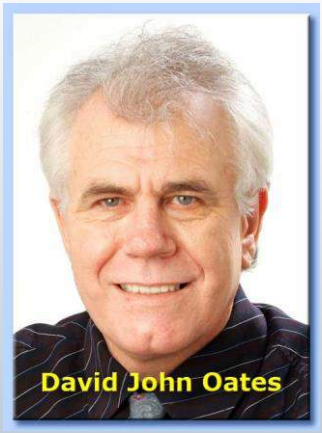
- *Self-interest served if claims accepted*

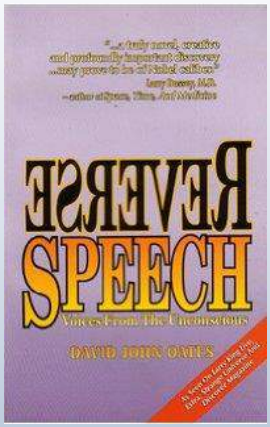




Chris French's Top Tips

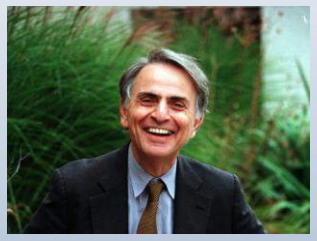
- *Endorsement from other pseudoscientists*





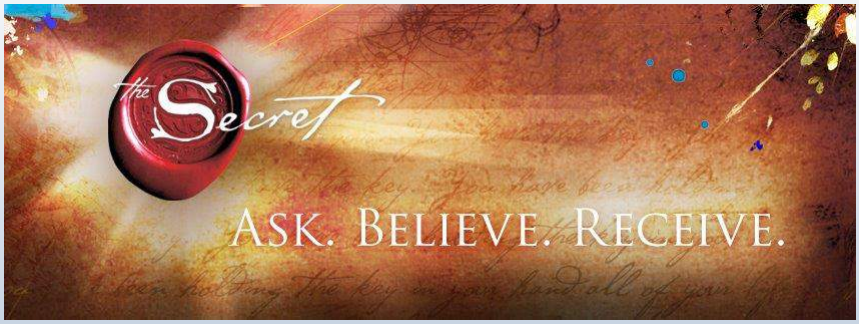
Chris French's Top Tips

- *Likening self to Galileo*
- *Carl Sagan:* "… the fact that some geniuses were laughed at does not imply that all who are laughed at are geniuses. They laughed at Columbus, they laughed at Fulton, they laughed at the Wright Brothers. But they also laughed at Bozo the Clown."



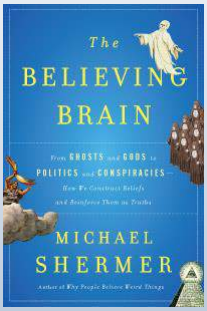
Chris French's Top Tips

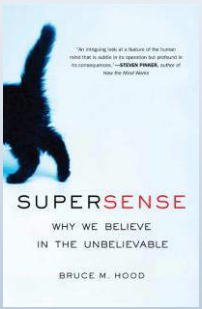
- *Claims that appear simply too good to be true*

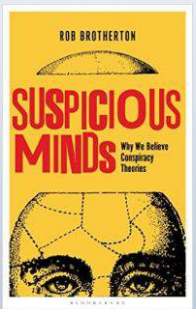


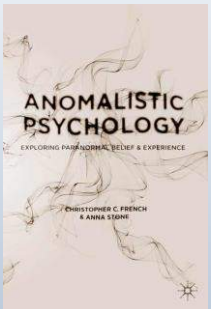
The Psychology of Pseudoscientific Beliefs

- Some pseudoscientific beliefs (e.g., paranormal beliefs, belief in CAM, belief in conspiracy theories) have received much more attention than others (e.g, neuromythology, historical revisionism)









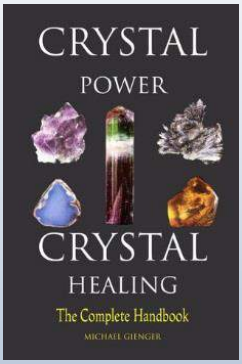
Some themes

- Social
- Experiential
- Cognitive
- Emotional/motivational

Social Factors

Experiential Factors

- With respect to CAM
  - Placebo effect
  - Natural variability in the course of illnesses
  - Body's own recuperative powers
- *Post hoc ergo propter hoc*
- After this therefore because of this



Cognitive Factors

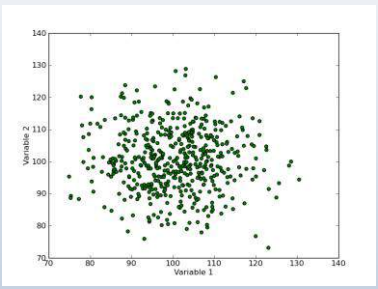
- Illusory correlations
- A causes B?

Illusory Correlations

	A	Not-A
B	a	b
Not-B	c	d

Illusory Correlations

	A	Not-A
B	a	b
Not-B	c	d



Cognitive factors

- Kahneman's (e.g. 2002) two-system model

SYSTEM 1

Intuition

Automatic•
Fast•
Approximate•
Parallel•
Effortless•
Heuristic-based•
Slow-learning•
Emotional•

SYSTEM 2

Reason

•Controlled
•Slow
•Precise
•Serial
•Effortful
•Rule-based
•Flexible
•Neutral

A tiger in the bushes?

Evolutionary Perspective

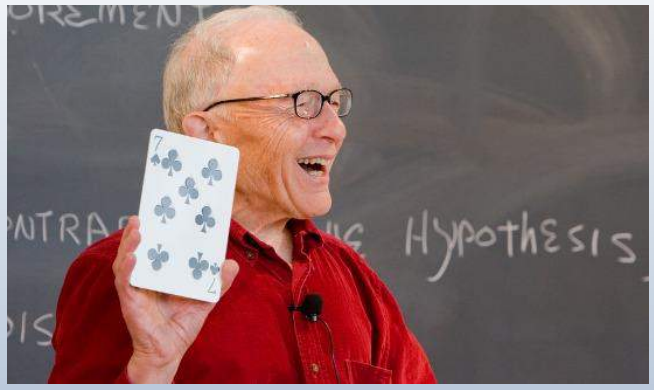
- Our brains have evolved with a bias towards Type 1 error – mistakenly seeing order in chaos…
- … as opposed to Type 2 error – mistakenly seeing chaos in order

Confirmation Bias

- Pseudoscientific claims appeal to our desire to
  - get rich quick
  - tap into psychic abilities
  - stay healthy
  - be convinced that death is not the end
  - gain access to hidden knowledge

Practical Advice

- Ray Hyman's "proper criticism"
- http://www.csicop.org/si/show/proper_criticism/

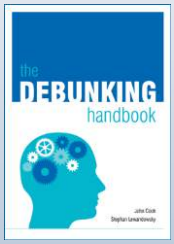


Proper Criticism

- Be prepared
- Clarify your objectives
- Do your homework
- Do not go beyond your level of competence
- Let the facts speak for themselves
- Be precise
- Use the principle of charity
- Avoid loaded words and sensationalism

The Debunking Handbook

- By John Cook and Stephan Lewandowsky
- Available for free download (in English, Dutch, and other languages from:
- http://www.skepticalscience.com/Debunking-Handbook-now-freely-available-download.html



Information Deficit Model

NGOs, like most scientists, often cling to the "deficit" model:

that simply providing information will lead to societal change. This is clearly not the case.

Familiarity Backfire Effect

- Simply mentioning a myth may make it more familiar and thus *more* likely to be accepted
- Skurnick et al. (2005) showed people a flyer that debunked common myths about flu vaccines
- If questioned immediately after reading the flyer, people were able to successfully identify the myths as myths
- However, even after a mere 30 minutes some people scored worse having read the flyer.

Advice

- Ideally one should debunk the myth without actually mentioning it at all
- Just present the facts that counter the myth not the myth itself
- Avoid headlines like: **Can therapists recover repressed memories of childhood sexual abuse?**
- Use instead: **Therapy can produce false memories of childhood sexual abuse**

Overkill Backfire Effect

- Science communicators sometimes make their message too complex to be easily understood
- A simply myth is often more cognitively attractive than a complex correction
- Three counterarguments are more memorable than twelve
- Advice: KISS!
- Keep It Simple, Stupid!

Worldview Backfire Effect

- Confirmation bias leads to resistance to accepting debunking if claim is in line with strongly held worldview
- McHoskey (1995) had volunteers read same fact sheet about JFK assassination
- Led to polarisation of views, each side (lone gun man vs. conspiracy) seeing the text as supporting their position
- Stronger polarisation for those with stronger pre-existing beliefs

Advice

- You won't convince the True Believer, so concentrate your efforts on those who are less strongly committed to the faulty belief
- Think about how you frame the issue
  - E.g., if talking to conservatives, refer to "carbon offset" rather than "green tax"

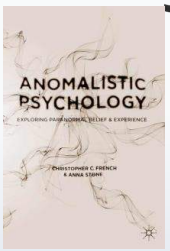
Fill the Gap!

- The myth explained something to the believer
- If you take it away, you leave an explanatory gap
- Fill it with an alternative explanation
  - Mock jurors much more likely to acquit if alternative suspect put forward in murder trials rather than just establishing the innocence of defendant
- Explain why the myth is wrong
  - Point out rhetorical devices used to present it
    - Cherry picking data, fake experts, unfalsifiable conspiracy theories
  - What did the misinformer have to gain?

The Need for Critical Thinking

Belief in Conspiracies

Thank you for listening!



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