

When are We Convinced?

💡 Does **smoking** cause cancer?

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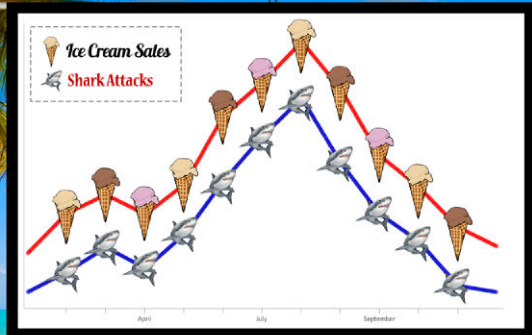
💡 Does **smoking** cause cancer?

💡 Does **cell phone use** cause cancer?

- analyze a single issue from multiple perspectives [GLO 2]
- contested assumptions and intellectual debates across the globe [GLO 1]

Such tests can, and should, remind us of the effects that the play of chance can create... Beyond that they contribute nothing to the proof of our hypothesis. [Bradford Hill]

Correlation is not Causation



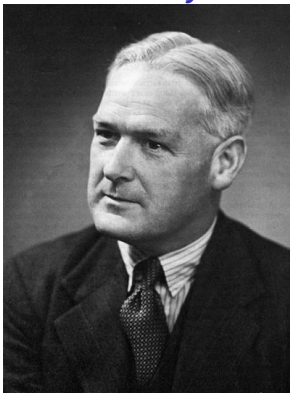
WARNING!

Restricting the number of ice creams sold reduces the likelihood of shark attack.

<http://onlineinsider.tumblr.com/post/7351752849/correlation-is-not-causation>
http://news.bbc.co.uk/2/hi/uk_news/magazine/7592579.stm



Reasonable Certainty without Proof?



Austin Bradford Hill (1897-1991)

1965 formalised methodology for clinical trials via 9 criteria

Bradford Hill Criteria/ Hill's criteria for causation

“The Environment and Disease: Association or Causation?”

Proceedings of the Royal Society of Medicine, 58, 295–30

Strength, Consistency and Biological Gradient

Strength of the association, including diverse studies. Does increased exposure result in a greater response?

The death rate from cancer of the lung in cigarette smokers is nine to ten times the rate in non-smokers and the rate in heavy cigarette smokers is twenty to thirty times [Bradford Hill]

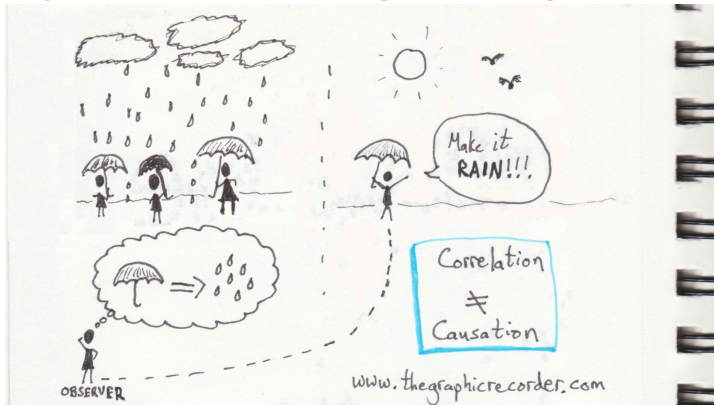
the Advisory Committee to the Surgeon General... found the association of smoking with cancer of the lung in 29 retrospective and 7 prospective inquiries... The lesson here is that broadly the same answer has been reached in quite a wide variety of situations and techniques [Bradford Hill]

the death rate from cancer of the lung rises linearly with the number of cigarettes smoked daily [Bradford Hill]

Specificity and Temporality

Other likely explanations? Does the effect occur afterward?

investigations ... have been criticized ... But... If other causes of death are raised 10, 20 or even 50% in smokers whereas cancer of the lung is raised 900–1000% we have specificity... in the magnitude of the association [Bradford Hill]



Plausibility, Coherence and Analogy

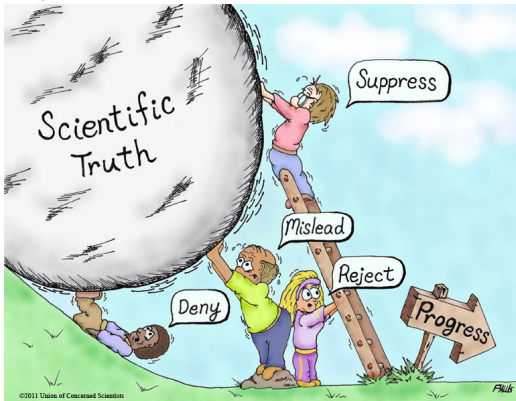
Make sense? Conflict with current knowledge? Or tie-in with similar associations?

[Bradford Hill] *association with cigarette smoking [is] coherent with the temporal rise that has taken place... over the last generation and with the sex difference in mortality...*

[Bradford Hill] *With the effects of thalidomide and rubella before us we would surely be ready to accept slighter but similar evidence*

Experiments

[Bradford Hill] *Occasionally it is possible to appeal to experimental, or semi-experimental, evidence. For example, because of an observed association, some preventative action is taken... Here the strongest support for the causation hypothesis may be revealed.*

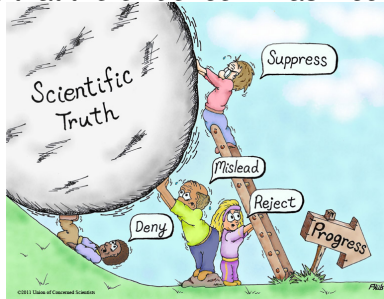


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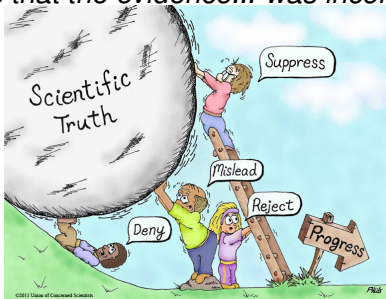
PAUL



In 1994, heads of the major U.S. tobacco companies testified before Congress that the evidence... was inconclusive...

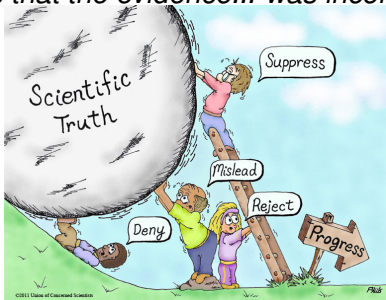


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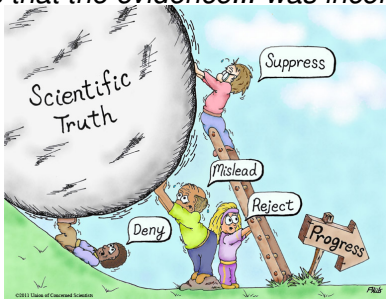
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Less than 1 month after... a box containing confidential documents... [with] evidence that the tobacco industry had for decades known and accepted the fact that cigarettes caused premature death... [and worse they]

In 1994, heads of the major U.S. tobacco companies testified before Congress that the evidence... was inconclusive...



*Less than 1 month after... a box containing confidential documents... [with] evidence that the tobacco industry had for decades known and accepted the fact that cigarettes caused premature death... [and worse they] helped manufacture the smoking controversy by funding scientific research that was intended to obfuscate and prolong the debate about smoking and health. ["The cigarette controversy" by Cummings KM, A Brown & R. O'Connor. *Cancer Epidemiol Biomarkers Prev.* 2007 Jun 16(6):1070–6]*