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The Base-Rate-Fallacy Fallacy

When attempting to avoid the base-rate fallacy leads to error

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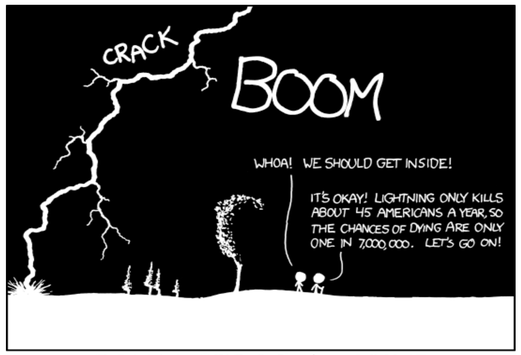
Medical Diagnosis Case*

One in 1,000 people have some disease, D. You have a test for the presence of D with the accuracy described here:

Disease Test Accuracy		Test Result: Positive	Test Result: Negative
Disease D	Present	0.9	0.1
	Absent	0.1	0.9

You randomly select a person to test. The test yields a positive result. How confident should you be that this person has D? Answer: a little less than 1%. According to Tversky and Kahneman, people tend to neglect base rates and focus on the accuracy statistics about the test. This is the **Base-Rate Fallacy.**

*Adapted from Titelbaum (2022) and Royall (1997).



THE ANNUAL DEATH RATE AMONG PEOPLE WHO KNOW THAT STATISTIC IS ONE IN SIX.

Munroe, Randall. *xkcd*, "Conditional Risk." https://xkcd.com/795

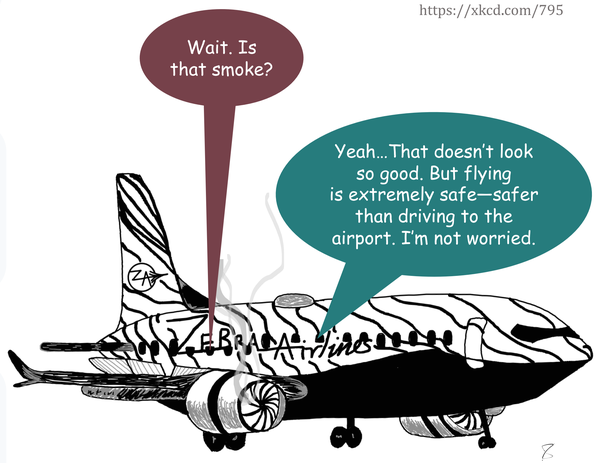
Bayes's Theorem (Odds Form)

$$\frac{\Pr(H|E)}{\Pr(\neg H|E)} = \frac{\text{Base Rate}}{1 - \text{Base Rate}} \times \frac{\Pr(E|H)}{\Pr(E|\neg H)}$$

H: hypothesis of interest
E: some evidence (stated in the form of a proposition)
Base Rate: prevalence of H in the population of interest

Epistemic Base-Rate-Fallacy Fallacy

Occurs when agents neglect evidence from likelihoods due to their focus on a low base rate (i.e., prior probability).



Base-Rate Neglect (& Fixation?)

Neglect

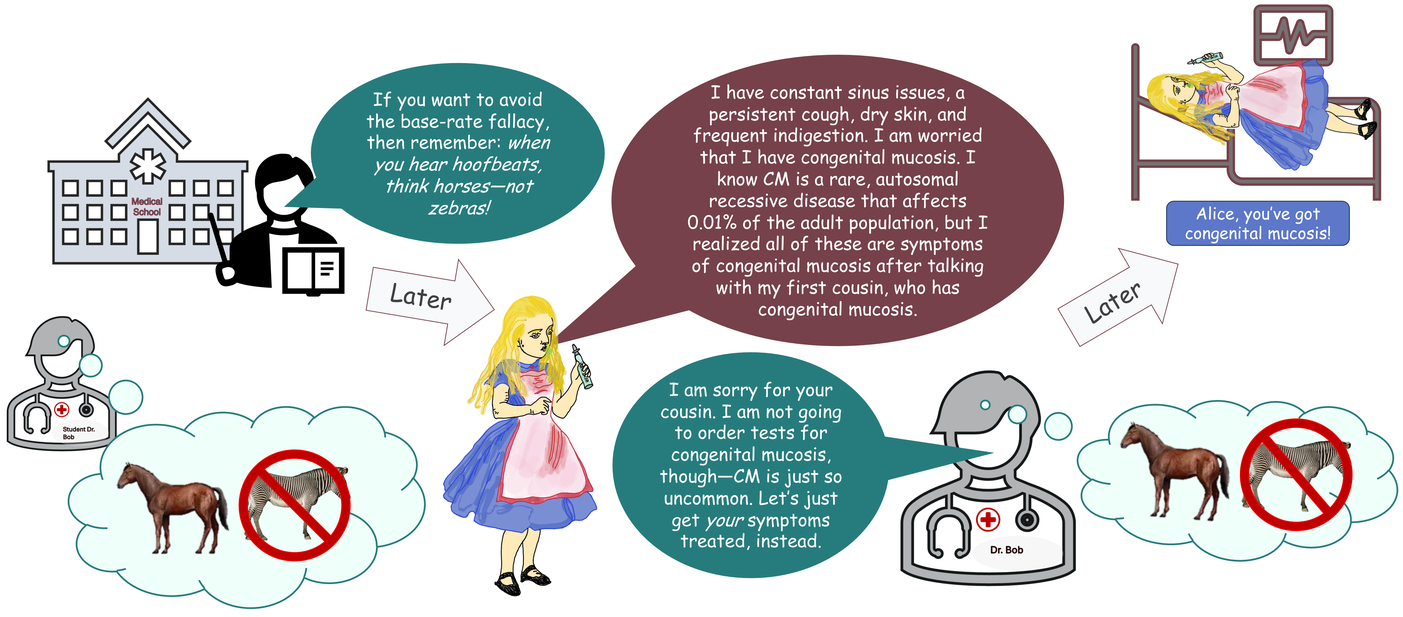
$$\frac{\Pr(H|E)}{\Pr(\neg H|E)} = \frac{\text{Base Rate}}{1 - \text{Base Rate}} \times \frac{\Pr(E|H)}{\Pr(E|\neg H)}$$

Fixation

$$\frac{\Pr(H|E)}{\Pr(\neg H|E)} = \frac{\text{Base Rate}}{1 - \text{Base Rate}} \times \frac{\Pr(E|H)}{\Pr(E|\neg H)}$$

Decision-Theoretic Base-Rate-Fallacy Fallacy

Occurs when agents decide not to seek more evidence solely because of the presence of a low base rate.



What it isn't:

- Inverse fallacy (Koehler, 1996)
- Inverse base-rate effect (Don et al, 2021)
- All cases of conservatism effect (Phillips and Edwards, 1966; Howe et al., 2022)

Competing Explanations:

- Unproblematic Bayesian search
- Failure to use the correct base-rate / failure to update on *all* evidence
- Proper updating without reaching action threshold

Further Questions

- Testing for whether and how often the BRFF occurs: experimental design ideas?
- Are there other competing explanations not considered here?
- Can you think of other cases of the BRFF?

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