Confirmatory Bias, the Bayesian Detective and an Inconvenient Truth

David K. Levine on August 14, 2017

Columbo is the ultimate rational detective. He has a suspect firmly in his sights: based on evidence he has collected so far he assigns a probability π the the suspect being guilty - enough to make him deeply suspicious, but not enough to arrest the suspect. Suddenly a witness emerges and tells a very improbable story but one that exonerates the suspect. In probabilistic terms the story has probability 0 of being true if the suspect is guilty and probability ϵ of being true if the suspect is innocent - where ϵ is a small but positive number.

From a Bayesian point of view the matter is amply summed up by another rational detective, Sherlock Holmes, "Once you eliminate the impossible, whatever remains, no matter how improbable, must be the truth." As guilt is impossible and the story merely improbable we must conclude the suspect is innocent. More generally in Bayesian theory evidence that favors a particular idea should never make you more skeptical of that idea. Never-the-less Columbo immediately arrests the suspect. This is what behavoral economists call "confirmatory bias:" faced with new data that contradicts his belief that the suspect is guilty Columbo far from changing his belief as a good Bayesian should instead ignores the data and simply clings even more strongly to his prior belief. It is the height of irrationality.

The point of this essay is we should leave detecting to detectives and not to behavioral economists. The problem is not with the analysis and not with the rationality of Columbo - it is with the model. Indeed: witnesses lie all the time. Suppose that there is some small probability ρ a witness will come forward and tell a lie exonerating the suspect. Let us make the not unreasonable assumption that the witness will do this only if the suspect is guilty - there is not so much reason to lie if the suspect is going to get off anyway. Let S denote the story of the witness, G denote guilt and I denote innocence. Bayesian logic tells us to look at the likelihood ratio

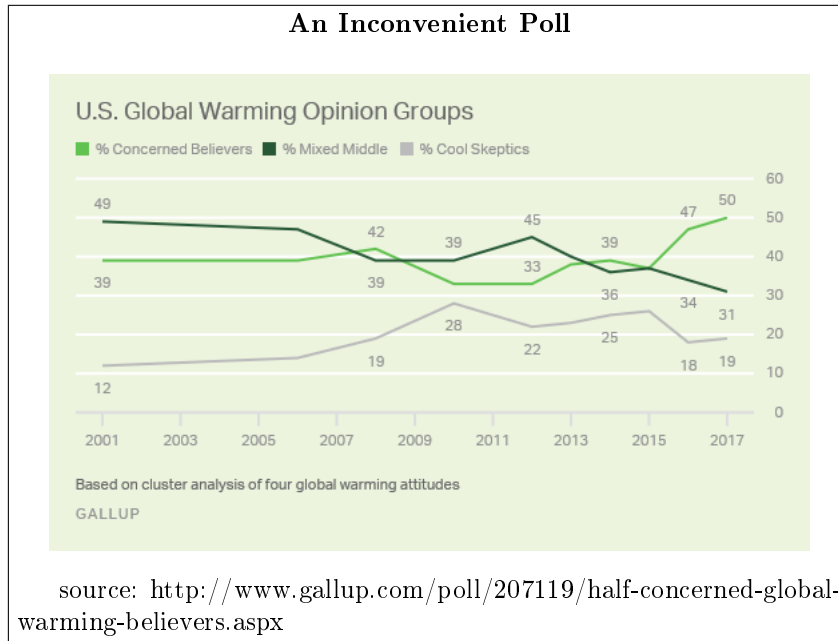$$\frac{\Pr(S|G)}{\Pr(S|I)} = \frac{\rho}{\epsilon}.$$

Then the relative probability of guilt to innocence ($\pi/(1-\pi)$) should be multiplied by this likelihood ratio to determine how the story changes that relative probability. Specifically if this likelihood ratio is bigger than one we should

believe the suspect is more likely to be guilty and if it is less than one we should believe the suspect is less likely to be guilty. If indeed $\rho = 0$ so there are no lying witnesses we should be naive behavioral Bayesians and conclude that the suspect is innocent. If lying witnesses are more likely than crazy stories, that is $\rho > \epsilon$ then we should take the story as evidence against the suspect. Not only is this correct in a Bayesian sense: it is perfectly common sense. It says we should weigh the (lack of) credibility of the witness (ρ) against the plausibility of the story (ϵ). A witness who is very likely to lie (high ρ) and who tells a very implausible story (low ϵ) will convince us the suspect is guilty; a witness who is very unlikely to lie (low ρ) and who tells a very plausible story (high ϵ) should be believed.

You may well wonder: if an implausible lie is going to hurt a suspect who the witness is trying to exonerate - why tell it? The problem is that if the suspect is guilty the truth is even worse. If the witness truthfully related the plausible story of how the suspect committed the crime then the probability of this true story when the suspect is guilty (ρ') is very high and the probability of the story when the suspect is innocent (ϵ') is very low. If, as we might expect, $\rho'/\epsilon' > \rho/\epsilon$ then the lie hurts the suspect less than the truth.

Here is a practical application of the theory. In 2006 a movie "An Inconvenient Truth" starring Al Gore presented evidence that global warming is real, harmful and human caused. From Gallup we see in the graph below that the movie (if it had any impact at all) reduced belief in the truth of its propositions.

An Inconvenient Poll

U.S. Global Warming Opinion Groups

■ % Concerned Believers ■ % Mixed Middle ■ % Cool Skeptics

49
42
39
45
39
47
50
39
39
33
36
34
31
28
22
25
19
18
19
12

2001 2003 2005 2007 2009 2011 2013 2015 2017

60
50
40
30
20
10
0

Based on cluster analysis of four global warming attitudes

GALLUP

source: http://www.gallup.com/poll/207119/half-concerned-global-warming-believers.aspx

According to the theory this would be rational if the witness (Al Gore) lacks credibility and if the story in the documentary is implausible. Al Gore is a politician - which means a dishonest publicity hound - who has no scientific credentials beyond his own false claims about his role in the origin of the internet. So I think we can conclude that ρ is pretty high. With respect to the plausibility of the story: one of the most publicized claims in the documentary is the devastating impact of a 20 foot sea level rise. On the face this seems pretty extreme. More to the point it is not backed by any science: the IPCC estimates[1] for the most extreme scenarios are less than three feet and relatively neutral commentary[2] debunks rather strongly the extreme claims in the Gore movie. So we have to conclude as well that plausibility (ϵ) is low. Hence the Gore movie has the predicted effect: people rationally revise their beliefs to conclude that it is less likely that global warming is real, harmful and human caused.

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[1] https://www.ipcc.ch/pdf/unfccc/cop19/3_gregory13sbsta.pdf
[2] http://scienceline.org/2008/12/ask-rettner-sea-level-rise-al-gore-an-inconvenient-truth/

At least initially the number of believers as well as disbelievers went up
- although the effect on disbelievers appears stronger. There is nothing
inconsistent about this - there can be disagreement about the credi-
bility of Al Gore and about the plausibility of his film. For example,
Democrats may view Al Gore as more credible (low ρ) than Republicans
(high ρ'), so even if both have the same view about the plausibility of his
film the conclusion of a Democrat (ρ/ϵ) may be less than one (meaning
their beliefs move in favor of Gore) while the conclusion of a Republi-
can (ρ'/ϵ) may be greater than one (meaning their beliefs move against
Gore). This also is relevant to the incentive to lie: we have to ask -
which audience is the liar playing to? Is the lie to rally the faithful or
convert the faithless?

To be clear about this: every time memos are leaked in which a scientist is
more interested in progaganda than truth; every time global warming is pro-
moted by someone who hates progress and mankind and so has a different
agenda for wanting to slow global warming - every time - ρ goes up. And every
extreme or misleading claim lowers ϵ. There are those that believe that the way
to truth is to offset the lies of the other side through lies of their own. The
evidence suggests otherwise.