When Bad Theories Happen to Good Scientists

Matt Ridley | Part 1 of 3 | Wall Street Journal | July 20, 2012

John S. Dykes

There's a myth out there that has gained the status of a cliché: that scientists love proving themselves wrong, that the first thing they do after constructing a hypothesis is to try to falsify it. Professors tell students that this is the essence of science.

Yet most scientists behave very differently in practice. They not only become strongly attached to their own theories; they perpetually look for evidence that supports rather than challenges their theories. Like defense attorneys building a case, they collect confirming evidence.

In this they're only human. In all walks of life we look for evidence to support our beliefs, rather than to counter them. This pervasive phenomenon is known to psychologists as "confirmation bias." It is what keeps all sorts of charlatans in business, from religious cults to get-rich-quick schemes. As the philosopher/scientist Francis Bacon noted in 1620: "And such is the way of all superstition, whether in astrology, dreams, omens, divine judgments, or the like; wherein men, having a delight in such vanities, mark the events where they are fulfilled, but where they fail, though this happen much oftener, neglect and pass them by."

Just as hypochondriacs and depressives gather ample evidence that they're ill or ill-fated, ignoring that which implies they are well or fortunate, so physicians managed to stick with ineffective measures such as bleeding, cupping and purging for centuries because the natural recovery of the body in most cases provided ample false confirmation of the efficacy of false cures. Homeopathy relies on the same phenomenon to this day.

Moreover, though we tell students in school that, as Karl Popper argued, science works by falsifying hypotheses, we teach them the very opposite—to build a case by accumulating evidence in support of an argument.

The phrase "confirmation bias" itself was coined by a British psychologist named Peter Wason in 1960. His classic demonstration of why it was problematic was to give people the triplet of numbers "2-4-6" and ask them to propose other triplets to test what rule the first triplet followed. Most people propose a series of even numbers, such as "8-10-12" and on being told that yes, these numbers also obey the rule, quickly conclude that the rule is "ascending even numbers." In fact, the rule was simply "ascending numbers." Proposing odd numbers would have been more illuminating.

An example of how such reasoning can lead scientists astray was published last year. An experiment had seemed to confirm the Sapir-Whorf hypothesis that language influences perception. It found that people reacted faster when discriminating a green from a blue patch than when discriminating two green patches (of equal dissimilarity) or two blue patches, but that they did so only if the patch was seen by the right visual field, which feeds the brain's left hemisphere, where language resides.

Despite several confirmations by other teams, the result is now known to be a fluke, following a comprehensive series of experiments by Angela Brown, Delwin Lindsey and Kevin Guckes of Ohio State University. Knowing the word for a color difference makes it no quicker to spot.

One of the alarming things about confirmation bias is that it seems to get worse with greater expertise. Lawyers and doctors (but not weather forecasters who get regularly mugged by reality) become more confident in their judgment as they become more senior, requiring less positive evidence to support their views than they need negative evidence to drop them.

The origin of our tendency to confirmation bias is fairly obvious. Our brains were not built to find the truth but to make pragmatic judgments, check them cheaply and win arguments, whether we are in the right or in the wrong.

How Bias Heats Up the Warming Debate

Matt Ridley | Part 2 of 3 | Wall Street Journal | July 27, 2012

Christopher Neal

If, as I argued last week, scientists are just as prone as everybody else to confirmation bias—the tendency to look for evidence to support rather than to test your own ideas—then how is it that science, unlike cults and superstitions, *does* change its mind and find new things?

The answer was spelled out by the psychologist Raymond Nickerson of Tufts University in a 1998 paper: "It is not so much the critical attitude that individual scientists have taken with respect to their own ideas that has given science the success it has enjoyed…but more the fact that individual scientists have been highly motivated to demonstrate that hypotheses that are held by some other scientist(s) are false."

Most scientists do not try to disprove their ideas; rivals do it for them. Only when those rivals fail is the theory bombproof. The physicist Robert Millikan (who showed minor confirmation bias in his own work on the charge of the electron by omitting outlying observations that did not fit his hypothesis) devoted more than 10 years to trying to disprove Einstein's theory that light consists of particles (photons). His failure convinced almost everybody but himself that Einstein was right.

The solution to confirmation bias in science, then, is not to try to teach it out of people; it is a deeply ingrained tendency of human nature. Dr. Nickerson noted that science is replete not only with examples of great scientists tenaciously persisting with theories "long after the evidence against them had become sufficiently strong to persuade others without the same vested interests to discard them" but also with brilliant people who remained wedded to their pet hates. Galileo rejected Kepler's lunar explanation of tides; Huygens objected to Newton's concept of gravity; Humphrey Davy detested John Dalton's atomic theory; Einstein denied quantum theory.

No, the reason that science progresses despite confirmation bias is partly that it makes testable predictions, but even more that it prevents monopoly. By dispersing its incentives among many different centers, it lets scientists check each other's prejudices. When a discipline defers to a single authority and demands adherence to a set of beliefs, then it becomes a cult.

A recent example is the case of malaria and climate. In the early days of global-warming research, scientists argued that warming would worsen malaria by increasing the range of mosquitoes. "Malaria and dengue fever are two of the mosquito-borne diseases most likely to spread dramatically as global temperatures head upward," said the Harvard Medical School's Paul Epstein in Scientific American in 2000, in a warning typical of many.

Carried away by confirmation bias, scientists modeled the future worsening of malaria, and the Intergovernmental Panel on Climate Change accepted this as a given. When Paul Reiter, an expert on insect-borne diseases at the Pasteur Institute, begged to differ—pointing out that malaria's range was shrinking and was limited by factors other than temperature—he had an uphill struggle. "After much effort and many fruitless discussions," he said, "I… resigned from the IPCC project [but] found that my name was still listed. I requested its removal, but was told it would remain because 'I had contributed.' It was only after strong insistence that I succeeded in having it removed."

Yet Dr. Reiter has now been vindicated. In a recent paper, Peter Gething of Oxford University and his colleagues concluded that widespread claims that rising mean temperatures had already worsened malaria mortality were "largely at odds with observed decreasing global trends" and that proposed future effects of rising temperatures are "up to two orders of magnitude smaller than those that can be achieved by the effective scale-up of key control measures."

The IPCC, in other words, learned the hard way the value of letting mavericks and gadflies challenge confirmation bias.

How Bias Heats Up the Warming Debate

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John S. Dykes

Hot summers are invoked as support for climate alarmism; cold winters are dismissed as weather.

I argued last week that the way to combat confirmation bias—the tendency to behave like a defense attorney rather than a judge when assessing a theory in science—is to avoid monopoly. So long as there are competing scientific centers, some will prick the bubbles of theory reinforcement in which other scientists live.

For constructive critics, this is the problem with modern climate science. They don't think it's a conspiracy theory, but a monopoly that clings to one hypothesis (that carbon dioxide will cause dangerous global warming) and brooks less and less dissent. Again and again, climate skeptics are told they should respect the consensus, an admonition wholly against the tradition of science.

Last month saw two media announcements of preliminary new papers on climate. One, by a team led by physicist Richard Muller of the University of California, Berkeley, concluded "the carbon dioxide curve gives a better match than anything else we've tried" for the (modest) 0.8 Celsius-degree rise in global average temperatures over land during the past half-century—less, if ocean is included. He may be right, but such curve-fitting reasoning is an example of confirmation bias. The other, by a team led by the meteorologist Anthony Watts, a skeptical gadfly, confirmed its view that the Muller team's numbers are too high—because "reported 1979-2008 U.S. temperature trends are spuriously doubled" by bad thermometer siting and unjustified "adjustments."

Much published research on the impact of climate change consists of confirmation bias by if-then modeling, but critics also see an increasing confusion between model outputs and observations. For example, in estimating how much warming is expected, the most recent report of the Intergovernmental Panel on Climate Change uses three methods, two based entirely on model simulations.

The late novelist Michael Crichton, in his prescient 2003 lecture criticizing climate research, said: "To an outsider, the most significant innovation in the global-warming controversy is the overt reliance that is being placed on models.... No longer are models judged by how well they reproduce data from the real world—increasingly, models provide the data. As if they were themselves a reality."

It isn't just models, but the interpretation of real data, too. The rise and fall in both temperature and carbon dioxide, evident in Antarctic ice cores, was at first thought to be evidence of carbon dioxide driving climate change. Then it emerged that the temperature had begun rising centuries earlier than carbon dioxide. Rather than abandon the theory, scientists fell back on the notion that the data jibed with the possibility that rising carbon dioxide levels were reinforcing the warming trend in what's called a positive feedback loop. Maybe—but there's still no empirical evidence that this was a significant effect compared with a continuation of whatever first caused the warming.

The reporting of climate in the media is full of confirmation bias. Hot summers (in the U.S.) or wet ones (in the U.K.) are invoked as support for climate alarmism, whereas cold winters are dismissed as weather. Yale University's Dan Kahan and colleagues polled 1,500 Americans and found that, as they learned more about science, both believers and nonbelievers in dangerous climate change "become more skillful in seeking out and making sense of—or if necessary explaining away—empirical evidence relating to their groups' positions on climate change and other issues."

As one practicing scientist wrote anonymously to a blog in 2009: "honestly, if you know anything about my generation, we will do or say whatever it is we think we're supposed to do or say. There is no conspiracy, just a slightly cozy, unthinking myopia. Don't rock the boat."

Bring on the gadflies.