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Playing Dumb on Climate Change

By NAOMI ORESKES JAN. 3, 2015

Photo

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CAMBRIDGE, Mass. — SCIENTISTS have often been accused of exaggerating the threat of climate change, but it's becoming increasingly clear that they ought to be more emphatic about the risk. The year just concluded is about to be declared the hottest one on record, and across the globe climate change is happening faster than scientists predicted.

Science is conservative, and new claims of knowledge are greeted with high degrees of skepticism. When Copernicus said the Earth orbited the sun, when Wegener said the continents drifted, and when Darwin said species evolved by natural selection, the burden of proof was on them to show that it was so. In the 18th and 19th centuries, this conservatism generally took the form of a demand for a large amount of evidence; in the 20th century, it took on the form of a demand for statistical significance.

We've all heard the slogan "correlation is not causation," but that's a misleading way to think about the issue. It would be better to say that correlation is not necessarily causation, because we need to rule out the possibility that we are just observing a coincidence. Typically, scientists apply a 95 percent confidence limit, meaning that they will accept a causal claim only if they can show that the odds of the relationship's occurring by chance are no more than one in 20. But it also means that if there's more than even a scant 5 percent possibility that an event occurred by chance, scientists will reject the causal claim. It's like not gambling in Las Vegas even though you had a nearly 95 percent chance of winning.

Where does this severe standard come from? The 95 percent confidence level is generally credited to the British statistician R. A. Fisher, who was interested in the problem of how to be sure an observed effect of an experiment was not just the result of chance. While there have been enormous arguments among statisticians about what a 95 percent confidence level really means, working scientists routinely use it.

But the 95 percent level has no actual basis in nature. It is a convention, a value judgment. The value it reflects is one that says that the worst mistake a scientist can make is to think an effect is real when it is not. This is the familiar "Type 1 error." You can think of it as being gullible, fooling yourself, or having undue faith in your own ideas. To avoid it, scientists place the burden of proof on the person making an affirmative claim. But this means that science is prone to "Type 2 errors": being too conservative and missing causes and effects that are really there.

Is a Type 1 error worse than a Type 2? It depends on your point of view, and on the risks inherent in getting the answer wrong. The fear of the Type 1 error asks us to play dumb; in effect, to start from scratch and act as if we know nothing. That makes sense when we really don't know what's going on, as in the early stages of a scientific investigation. It also makes sense in a court of law, where we presume innocence to protect ourselves from government tyranny and overzealous prosecutors — but there are no doubt prosecutors who would argue for a lower standard to protect society from crime.

When applied to evaluating environmental hazards, the fear of gullibility can lead us to understate threats. It places the burden of proof on the victim rather than, for example, on the manufacturer of a harmful product. The consequence is that we may fail to protect people who are really getting hurt.

And what if we aren't dumb? What if we have evidence to support a cause-and-effect relationship? Let's say you know how a particular chemical is harmful; for example, that it has been shown to interfere with cell function in laboratory mice. Then it might be reasonable to accept a lower statistical threshold when examining effects in people, because you already have reason to believe that the observed effect is not just chance.

This is what the United States government argued in the case of secondhand smoke. Since bystanders inhaled the same chemicals as smokers, and those chemicals were known to be carcinogenic, it stood to reason that secondhand smoke would be carcinogenic, too. That is why the Environmental Protection Agency accepted a (slightly) lower burden of proof: 90 percent instead of 95 percent.

In the case of climate change, we are not dumb at all. We know that carbon dioxide is a greenhouse gas, we know that its concentration in the atmosphere has increased by about 40 percent since the industrial revolution, and we know the mechanism by which it warms the planet.

WHY don't scientists pick the standard that is appropriate to the case at hand, instead of adhering to an absolutist one? The answer can be found in a surprising place: the history of science in relation to religion. The 95 percent confidence limit reflects a long tradition in the history of science that valorizes skepticism as an antidote to religious faith.

Even as scientists consciously rejected religion as a basis of natural knowledge, they held on to certain cultural presumptions about what kind of person had access to reliable knowledge. One of these presumptions involved the value of ascetic practices. Nowadays scientists do not live monastic lives, but they do practice a form of self-denial, denying themselves the right to believe anything that has not passed very high intellectual hurdles.

Moreover, while vigorously denying its relation to religion, modern science retains symbolic vestiges of prophetic tradition, so many scientists bend over backward to avoid these associations. A vast majority of scientists do not speak in public at all, and those who do typically speak in highly guarded, qualified terms. They often refuse to use the language of danger even when danger is precisely what they are talking about.

Years ago, climate scientists offered an increase of 2 degrees Celsius (or 3.6 degrees Fahrenheit) as the "safe" limit or ceiling for the long-term warming of the planet. We are now seeing dangerous effects worldwide, even as we approach a rise of only 1 degree Celsius. The evidence is mounting that scientists have underpredicted the threat. Perhaps this is another reason — along with our polarized politics and the effect of fossil-fuel lobbying — we have underreacted to the reality, now unfolding before our eyes, of dangerous climate change.

Naomi Oreskes is a professor of the history of science at Harvard and the author, with Erik M. Conway, of "The Collapse of Western Civilization: A View From the Future."

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