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editorial

Experts, truth and scepticism

We scientists have a dilemma. We are experts in our area of research, but our job demands that we constantly remain sceptical of our latest results even when we deeply believe we have unfolded new layers of truth. This is the world of science and, for the most part, we accept its contradictions. For those on the outside, however, this creates a problem of whom to believe. When a scientist is called to take the stand in a trial, (s)he might be presented as an expert witness. The same thing happens in TV programmes. An expert, in most walks of life, is somebody who knows what (s)he is talking about. The wine expert can distinguish a Sauvignon Blanc from a Chardonnay, the antique expert can tell if a Louis XVI chair is real or a fake and the football expert can explain the significance of playing a defensive midfielder instead of another attacker. But clever lawyers or TV producers often counterbalance one scientific expert with another, each of whom will most probably give a different opinion on the topic at hand.

The important word here is 'opinion'. Whereas wine experts would agree on the type of grape, they could and should have different opinions on the merits of a New Zealand versus Chilean Sauvignon Blanc. But science is rooted in truth, not opinion. When we publish our results, we support them with experiments to reach an inescapable conclusion: the structure of the protein domain, the phenotype of the knockout mouse and the array of transcripts detected in a microarray study should be immutable with time. When others repeat the experiments, they should obtain the same results.

But sometimes the outcome is slightly different. Does this not question the truth of the original report? Or does it just mean that a small variation in the experiment gives rise to a different result? Most frequently, such variations occur when the confident extrapolations arising from the original data do not fully reflect reality and a slightly different approach shows this weakness. Like an unstable tower of building blocks, this new 'fact-brick' makes the whole construction topple. The changing meaning of data is not a catastrophe for science, but rather a normal process.

Somewhere between truth and opinion lies interpretation. The individual data from our experiments may well be rock solid, but we can still put them into inappropriate combinations to present a story that is coherent but incorrect. Eventually, additional experiments from others undermine this story, and we all learn something new from the process—perhaps even some humility. Driven by our efforts to understand life, we often have to start again from scratch when a new experiment shows our whole interpretation to be invalid. In fact, we are taught to be sceptical about seemingly obvious results, and not just to avoid embarrassment if we are later proved to be wrong. We always challenge our students and ask them to perform more controls. We behave as if the truth uncovered in an experiment might be a mirage.

To the outsider, however, this looks as if science were indecisive, its results tentative, scientific experts unreliable and the facts fragile. If so, it follows that all opinions are equally valid. But there is a major difference between an opinion based on facts and an opinion based on bias. Both may be right or wrong, but perversely, an opinion based on bias is less likely to change than an opinion based on facts. Bias tends to be immune to sceptical re-examination, whereas scientific opinions are open to challenge and change. What is even worse, from an outside observer's point of view, is that two scientific experts may hold different interpretations of events based on the same data. It happens all the time at scientific meetings. But we do not shout down a colleague who makes a statement with which we disagree. We ask questions to probe some aspect of it and suggest further discussions over coffee. We usually do not try overtly to undermine a different perspective, for the very good reason that we know that more experiments are always needed to support our proposed model. And when new data point to a new understanding, we quickly integrate that into our work and get on with the research.

Because scientists rely on complex combinations of experimental data, their interpretation and understanding of events may change. But some people outside the laboratory world therefore present science as a social construct in which consensus defines the interpretation of contradictory facts. As social moods are, by definition, ephemeral, it follows that scientific edifices are too. As such, no scientist's opinion is a real truth and no scientist is an expert. But this is a very damaging view. Freed from scientific input, bias rules with a certainty that is ultimately viewed as expert and that is invulnerable to sceptical assessment. Propaganda-driven mixes of select scientific data sometimes cleverly omit challenging discordant results. Those who undermine research in this manner cynically use scientific components for their own purposes. No wonder the public are confused. Too often, the certainty of the convinced wins over the uncertainty of the scientist's probability-laced statements. But we scientists should not change our behaviour. Our truths must be open to sceptical analyses. Our opinions must be clearly separated from the facts from which they are derived. But, most importantly, we need to work with the public and the media to explain that an expert is not infallible, a truth may be revised and scepticism—even if destructive—can be healthy.

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