

Communicating uncertainty

How to SAY
"I am not sure"

One thing is certain: nothing is. Science is an iterative approach of getting closer to “the truth” but without any hope of ever reaching it. It’s about degrees of confidence and the perpetual refinement of our current understanding. Also, measurements are imprecise, samples are biased and models are oversimplified. You’ll have to decide how much of these uncertainties to disclose.

First, know what you don’t know. Establishing facts (“It is the skeleton of a Caucasian female child”) is always probabilistic; and quantities (“The Earth will warm up by 2.5°C”) are determined only within margins of error. This aleatory uncertainty can usually be estimated.

On the contrary, it is very hard to quantify *epistemic* uncertainty: the fact that models have gaps, that theories are disputed, that experts disagree. This does not prevent us from being transparent about existing debates and divergent opinions.

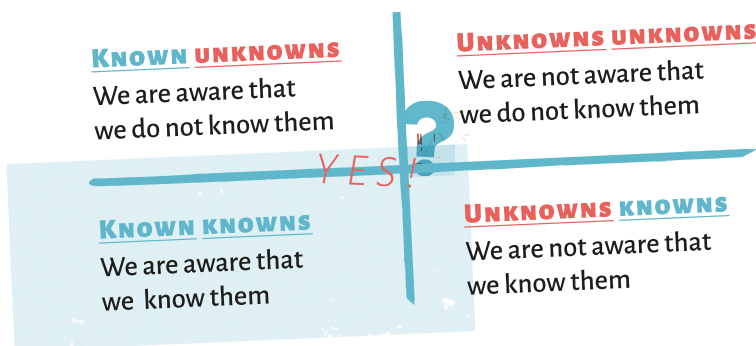
For aleatory uncertainty, you can provide the whole *probability distribution* or just its *mean and standard deviation*. Research suggests that some representations (*violin plots*) are better understood than others (*error bars in bar charts*)^[30]. It is best to state the range of values (95% confidence interval or minimum and maximum values, etc.), but a range, even if unexplained, is better than nothing. When comparing different options (medical treatments, educational approaches or economic interventions), try to visually communicate the strength of evidence and effect size, to avoid the fallacy that all insights carry the same weight.

Studies indicate that numerical values of probability are usually better understood – even by people with *low* numeracy – than verbal descriptions (“approximately”, “likely”, etc.). The latter are interpreted differently by different people – or even by the same person – depending on the context.

The IPCC has defined a glossary in which “very likely” means probabilities above 90 per cent, but readers tend to underestimate the term at 65 to 75 per cent^[31]. The use of qualifiers blurs the intended communication of uncertainty, but – again – this is better than reinforcing, by omission, a dreamed-up certainty.

Does transparency about uncertainty increase trust in your message or does it encourage unfair dismissal of expertise? Current research, alas, presents diverging answers. It seems, however, that communicating aleatory uncertainty promotes trust and quality in decision-making^[30]. Honestly addressing the struggle for certainty is a strength of the scientific method. In science communication, it is usually perceived as good practice.

There is a lot of uncertainty about the best way to communicate uncertainty, and you have to deal with that uncertainty – just like your audience does when you explain scientific knowledge. Now, some things are fairly certain, and you might state with confidence that “The Earth is not flat, climate change is real, and I have read this chapter”.



The famous Donald Rumfeldt’s matrix of (un)knowns.

Recommended reads:

- van der Bles *et al.* (2019), *Communicating uncertainty about facts, numbers and science*, Royal Society Open Science 6: 181870. <https://doi.org/10.1098/rsos.181870>
- Dharmi M.K. & Mandel D.R. (2022), *Communicating Uncertainty Using Words and Numbers*, Trends in Cognitive Sciences 26: 514. <https://doi.org/10.1016/j.tics.2022.03.002>
- Institute of Medicine (2013), *Environmental Decisions in the Face of Uncertainty*. Washington, DC: The National Academies Press., chapter 6. <https://doi.org/10.17226/12568>