This guide contains key points to consider when presenting data. It highlights general best practice to make sure your message is understood, with a focus on presenting and framing uncertainty.

Even the best data can be misread or misinterpreted if presented poorly or without adequate context. This is especially true of data relating to uncertainty. Providing information about uncertainty connected to forecasts allows decision makers to make more informed choices relevant to their specific requirements.

Extra attention to clarity and detail is needed when groups with different expertise and interests are communicating with one another. A certain type of chart might be an everyday form of presentation for an atmospheric scientist, but wholly unfamiliar to a government decision maker or journalist. With increasing public access to specialist communications via the web and open access, it pays to consider a potential readership wider than your peers whenever you disseminate data.

Without an understanding of uncertainty amongst the public and policymakers alike, scientists will struggle to talk about uncertainty in their research and we will all find it hard to separate evidence from opinion.

– Sense About Science

further reading

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Tufte, E. 2001. *The Visual Display of Quantitative Information*, 2nd Edition, Graphics Press

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about

The Robust Assessment and Communication of Environmental Risk (RACER) research team seeks to improve the quantification and communication of uncertainty and risk in natural hazards. We are funded by the Natural Environment Research Council (NERC) under the Probability Uncertainty and Risk in the Environment (PURE) Programme. This leaflet was written as part of an interdisciplinary project at the University of Reading with the Departments of Meteorology, Psychology, and Typography & Graphic Communication.

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presenting data and uncertainty

a quick guide

communication choices

Information can be communicated through words, numbers, diagrams and graphs, each with their own strengths and weaknesses.

Numbers may appear to be unambiguous, but people do not always interpret numerical information as expected – especially probability and percentages. For non-technical audiences, consider re-wording percentage probabilities, e.g. '30%' as a '3 in 10' chance. Exponential notation may not be familiar to non-technical audiences and should be contextualised or avoided where practical, e.g. 0.004 instead of 4×10^{-3}.

Combination and repetition across different representations can strengthen a message. Numbers might show the core data, a graph might show overall relationships, while words give context or elaboration. Consider which representations and combinations are most appropriate for your message and data, the target audience, and the medium of communication.

Vocabulary may be understood differently across groups, e.g. scientists, industry and the public. Clarify potentially ambiguous words such as 'uncertainty' or 'error' where audiences' interpretations may differ.

Frame risk statements to help people make balanced judgements. E.g. people may respond differently to a 40% chance of an event occurring, compared to a 60% chance of it not occurring (ideally, provide both).

CDF and PDF: Cumulative Distribution Function graphs (CDFs) may be misinterpreted as Probability Density Functions (PDFs) if they show line plots that might be possible for either function. All graphs need clear titles, labels, and contextualisation.

labels, context and colour

Clear and consistent labelling and contextualisation lower the risk of misinterpretation. While this seems fundamental, it is often forgotten.

Support interpretation of graphs, charts and tables with clear titles, labelling of axes (with units) and keys. Many readers will not read a document sequentially, so interpretation of material outside the main text should be possible without the reader needing to look between the two. Annotations can provide point-specific explanations.

Explain uncertainty by showing its sources, options for addressing it and the range of possible outcomes. While this may not be applicable in all cases, consider what contextual information is needed by the reader to make sense of or act upon the data.

Colour interpretation may vary across readers. It is essential to provide a key, but not everyone will refer to it.

- 'Inherent' colour meanings may not be interpreted consistently. For example, readers might interpret blue as representing high values in relation to rainfall, but low values in relation to temperature.
- Too many colours can make it difficult to identify and track data series, especially if the colours used are too close in hue to be distinguished easily. Use clearly distinct colours when colour coding variables.

It is difficult to keep track of too many similar colours.

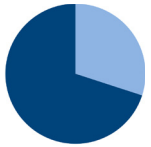
- Be aware that colour blindness reduces the ability to distinguish certain colours (most commonly red and green) and tonal variation. It affects around 7% of the male population.

visual effects and 'chart junk'

A guiding principle should be to keep your presentation clean, simple and informative.

Chart junk (Edward Tufte's term for unnecessary decorative additions) can distract the reader from the data and patterns you want them to observe.

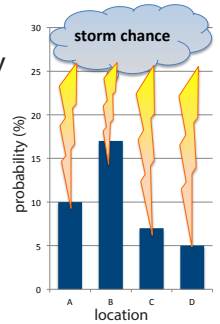
- 3D effects can skew the perception of values shown by bar height or length in histograms and impair perception of angles in pie charts.



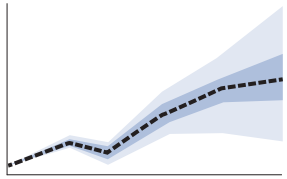
The 3D effect makes the segment angle size difficult to read.

- Illustrations and ornaments added to data presentations may distort or distract attention from your data.

The decorations here distract from accurate reading of the bar heights and might suggest there is more lightning in some locations.



Design and editorial choices can direct the focus of the reader. Consider what you are trying to communicate when showing summary values (e.g. median lines), as readers might fixate on these at the expense of the rest of the data. Whether or not this is desirable will depend on the context.



The median line on this fan chart might be seen as a specific answer in the middle of the uncertainty, potentially distracting attention from the more extreme options.