Designing persuasive tables and charts

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Bad data graphics can be expensive, if not fatal. The 1986 space shuttle Challenger tragedy in which seven astronauts died was caused, in part, by bad data graphics. By bad, we mean visuals that did not communicate the intended message. Because NASA officials did not understand vital information, the launch decision was ill-informed and the outcome catastrophic. The question we address is what leads experienced engineers to commit such a grave error? The answers are relevant for anyone in the business of communicating technical information for making decisions that have important outcomes. In dramatic situations, badly communicated technical information can cost lives. More routinely, it degrades decision making and lowers performance.

We will come back to the Challenger tragedy but let us begin by saying that incommunicative data graphics are surprisingly common. We have come across innumerable examples in the past five years. This is puzzling, given that tables and graphs only summarise basic data.

Technical publications usually avoid the more grotesque graphic mistakes of the popular press, yet, as the Challenger story suggests, engineers and scientists are not immune. Technical communicators face at least four problems. Firstly, the principles of data graphics are rarely taught or even talked about among professionals, forcing most technical communicators to work out solutions for themselves. Secondly, the evidence base for presenting data graphics is sadly small and diverse. Finding reliable advice is not easy. Thirdly, clients, colleagues and others frequently misunderstand what makes a good graphic: myths and misunderstandings abound. Finally, designing readable data graphics is time consuming and this is often not appreciated by others.

This article is based on good practice recommendations by experts (see bibliography). Our own objective is to encourage data to be readable and designed for the convenience of the intended audience. In this article 'data graphics' encompasses tables and graphs, while 'graph' is shorthand for bar, line and pie charts. We develop our argument and offer advice under two headings: popular misconceptions and neglect of wording.

Popular misconceptions

Unsupported ideas and faulty logic about data graphics are now part of public consciousness. The public has remarkably low expectations of numeric information: obscure and indecipherable tables or graphs seemingly never surprise them. Too many numerate professionals feed this confusion, either intentionally or negligently. Accountants, for instance, sometimes present basic financial figures in unnecessarily complex and discouraging ways. Such poor communication borders on incompetence. To create lucid, intelligible data graphics, we suggest the following techniques:

Reduce the amount of data. Designing useful data graphics requires decision-making, judging what data is relevant, and what can be ignored. Too much data swamps, confuses and misleads. Think of the needs of your readers. Provide selective, edited demonstration tables – focusing on a specific point – rather than comprehensive tables. Similarly, graphs should focus on an explicit story.

Present refined thought. Persuasive data graphics are the product of time and thought. Serious communicators need time to analyse the data and design it appropriately for the intended audience. A resulting table or graph may look simple (like Figure 1) but is the result of knowledge, experience and commitment to communicating with others.

Don't overestimate graphs. Graphs are fundamentally simple. Bar graphs show that one thing is larger than another, lines show changes over time and pies show the parts of a whole. Graphs that look complex almost always do so because of over-elaborate presentation, not intellectual rigour. The fact is that graphs cannot explain complex messages and complex graphs do not communicate effectively. Compare the simplicity and persuasiveness of Figure, 1 with the vague, indecisiveness of Figure 2.

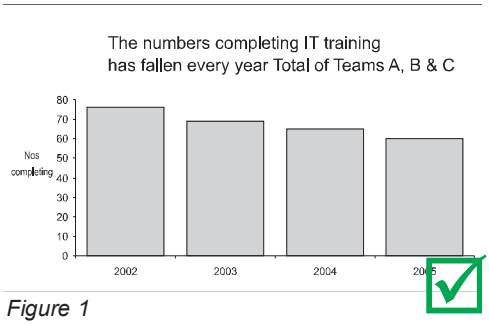

Figure 1

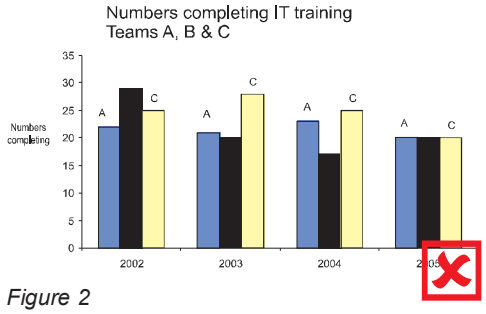

Figure 2

Use a table. Saying the public prefers graphs to tables is like saying someone prefers a hammer to a saw. Both are useful tools but they do different jobs. Graphs excel at a single storyline, at high contrasts and broad trends; they are less good at detail. Tables are more versatile and can present complex stories. Additionally tables hold detail conveniently and, when well designed, are easy to read. Yet communicators are sometimes pressurised into using graphs when a table is appropriate. People who are interested in your subject will be interested in relevant, readable data, however it is presented.

Remove debris. Gratuitous decoration (such as labels, gridlines, shading, borders, tick marks and embolding) detracts from the message. Emphasise the data, not the decoration. To make your tables and graphs authoritative, keep them simple, small and stripped of clutter. Look at *The Economist*: it serves a highly numerate, serious readership and illustrates articles with small, succinct data graphics with scarcely a gridline or data label in sight.

Steer clear of pie charts and 3D graphs. The public may like pie charts but they force readers into the mental juggling of comparing triangles arranged in a circle. Most of us think linearly and a simple bar chart presents this data more conveniently. Equally, 3D graphs may be popular but they tend to distort data – readers do not know from which point of the image they should measure. Avoid them.

Designing tables and charts

Neglect of wording. A Picasso or da Vinci may speak for itself but data graphics need words. Inadequate, obscure or unreadable wording is a frequent cause of tables and graphs being incomprehensible. Neglect the surrounding text in a graph and readers will walk away befuddled or, worse, confident in their misinterpretation. Here is some advice:

Make graphics self-explanatory. Readers should not have to refer to the text to understand what the data graphic is about. Obscure abbreviations, jargon and inadequate labelling are common (even in technical journals) and off putting to readers. Keep lettering horizontal and large enough to read. Label all axes.

Use the title to reinforce a graph's message. The best graph titles introduce, summarise and reinforce their message, as in Figure 1: 'The number completing IT training has fallen'. If you can't summarise your graph in a short sentence or phrase, it's probably because the content is too complex to be a successful graph. Look at Figure 2: it cannot be captured in a single phrase because it has no single story to tell. It is not a good graph – it does not communicate with ease.

Avoid key legends. Keys or legends on graphs demand that readers look at two things at once. Label bars, lines and pie slices directly for the convenience of readers.

Conclusion

So, what went wrong with the Challenger? The evening before take-off, engineers involved in the design of the Challenger tried to alert NASA officials that the unseasonably cold weather might damage some of the parts. To persuade NASA to delay the launch, the engineers drew up 13 visuals. NASA remained unconvinced, the rocket was launched and exploded after only 73 seconds. A full analysis can be read in Edward Tufte's in *Visual Explanations*. He shows that the tragedy arose because of the engineers' failure to communicate with decision makers. In particular, a combination of poor selection of data and poor presentation of data fatally reduced the persuasiveness of their warning. The engineers failed to think through what information would persuade their audience and how to present it effectively.

Thankfully, few poorly presented table or graphs contribute to deaths but many lead to confusion, time wasting and poor decision-making. To persuade your audience, invest time in learning to become proficient in expressing numeric ideas as simply as possible. Select and reduce data, showing only what is relevant for readers. Choose an appropriate, effective display. Strip tables and graphs of clutter and ensure the text is coherent and readable. Above all, make a personal commitment to presenting the data for the convenience of the reader.

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References:
Bigwood, S and Spore, M (2003) *Presenting numbers, tables, and charts* Oxford University Press
British Standard 7581: *The presentation of tables and charts 1992*
Ehrenberg, A S C (1986) *A Primer in Data Reduction*, John Wiley & Son
Tufte, E R (1993) *The Visual Display of Quantitative Information* The Graphics Press (USA)
Tufte, E R (1997) *Visual Explanations* The Graphics Press (USA)

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