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More Is More, Less Is More, More Is Less: Choosing the Right Amount of Data to Show

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Abstract: How much data should a single figure show? Many researchers default to a 'more is more' approach and show every data series with equal visual weight. While authors may believe that showing everything signals transparency, data visualizations in scientific papers exist to argue a hypothesis or advance an argument, and dense, uniformly styled charts often obscure the very findings they are meant to communicate. This article examines three strategies for deciding how much data to display: 'more is more' (show everything), 'less is more' (show only the key result, at the cost of context), and 'more is less' (show everything but deliberately emphasize what matters). Using a line chart adapted from the chemistry literature, I demonstrate practical techniques such as direct labeling, sequential color palettes, the 'start with gray' approach, and small multiples that can help authors guide readers' attention while preserving the fuller context of their results.

Keywords: Data visualization · Graphs · Scientific communication · Small multiples



Who I am. I am an economist and data visualization specialist whose work focuses on improving how researchers, scientists, analysts, and policymakers communicate data and evidence. My goal is to make complex research more accessible to broader audiences and more useful for decision making. I am the author or co-author of five books on data visualization and research communication – 'Better Presentations', 'Elevate the Debate', 'Better Data Visualizations', 'Data Visualization in Excel', and 'Thoughtful Data' – which provide practical guidance for presenting data and communicating research clearly and responsibly.

What inspires me. I try to find inspiration everywhere. It can be a well-designed subway map, a museum exhibit, a clever warning sign, an album cover design. Almost anything can teach us something about how to take complex information and make it clear without making it simplistic. I'm constantly observing and collecting these everyday moments and asking what principle is at work and whether it applies to how we can more effectively present data and evidence. The best ideas often come from looking beyond one's own field entirely.

What I recommend. For readers who want to go deeper into the ideas in this piece, I'd point to a few resources including the daily email from the FlowingData website that highlights trends and examples in the field. And, naturally, I'd point readers to my own book, 'Better Data Visualizations', where I go into much greater depth on the 'start with gray' technique and small multiples approach discussed in this piece.

1. Introduction

There is a question that sometimes arises in data visualization about the optimum number of data points a creator should include in a graph, chart, or diagram. Many researchers and scientists take an approach of 'more is more' – show all the data. This, it seems people believe, makes the visual more objective and honest: How could an author be accused of hiding relevant information when everything is shown in the visual?

But this approach neglects the fundamental goal of data visualization in the scientific context, which is to further the scientific argument. Figures and tables provide additional evidence to support the authors' argument. Consider, very simply, an argument that the unemployment rate changes with economic output. An author would not write the value of the unemployment rate in every month in the text – no, the graph takes on that role, which enables the author to make the general argument about how the metric ebbs and flows with the economy over time, maybe listing key values.

The 'more is more' strategy is almost contrary to how many people think of what images do – 'a picture is worth a thousand words', it is said. Thus, we could instead apply the more standard 'less is more' mantra to data visualization.

Yet neither summary phrase applies uniformly to data visualization. In some cases, we might want to show 'more'; in others, we might want to show 'less'; and in perhaps the most interesting cases, we might want to show 'less' by actually showing 'more'. (That last one is admittedly cryptic – we'll come to it in a moment.)

Let's take a closer view of all three cases.

Effective design is not only about creating something visually appealing, but about creating something functional.

2. 'More is More'

This is the default approach to data visualization – select all of your data, insert the chart, and hope that the reader will understand everything you are trying to communicate. This might be the researchers' go-to chart because the perception is that showing all of the data demonstrates they are not hiding or obstructing anything in the analysis – the data are all there, so no one could argue the researcher isn't being open and transparent about their findings.

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But this neglects two fundamental aspects of data visualization in chemistry: First, data visualizations are there to support the author's argument and, as such, should be done as clearly as possible (same goes for text!). *Graphs and charts should not be a place for a visual 'brain dump' to demonstrate the author has done the work*; the purpose is to further the argument by clearly demonstrating the findings of the research.

Second, especially in chemistry, researchers typically provide, with published journal articles, a supporting information materials document containing hundreds of pages, results, and figures. This, it seems, should be the place to truly present the 'more is more' visualizations and leave the published journal article free to articulate and communicate your research and argument clearly.

The example in Fig. 1 is a common way many researchers present their findings. All of the data are shown with equal weight and color saturation applied to each line. This graph is based on a visual published in a major chemistry journal that shows heat absorption (in joules per mole per kelvin squared) on the vertical axis and the strength of the magnetic field (in tesla units) on the horizontal axis, with each line denoting a different fixed temperature (in Kelvin). I have masked (*i.e.* made up) the numbers and the labels – the original was not an explicitly poor graph choice or design; I am simply using it as an example to which these three cases can be applied.

From this single image with all eight lines (including the data markers), the reader can probably reach two main conclusions: First, most of the lines spike around 2 or 3 and then decline over the rest of the range, converging at values under 5. Second, something is different about the 0.9 K line, which declines steadily over the range. But to recognize both of those major trends would take the reader some time and to disentangle the specifics of the other lines would be an even greater challenge.

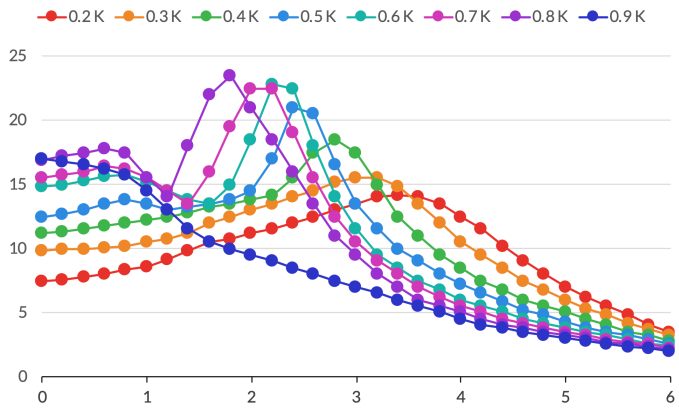


Fig. 1. Line chart with different, similarly saturated colors and a legend.

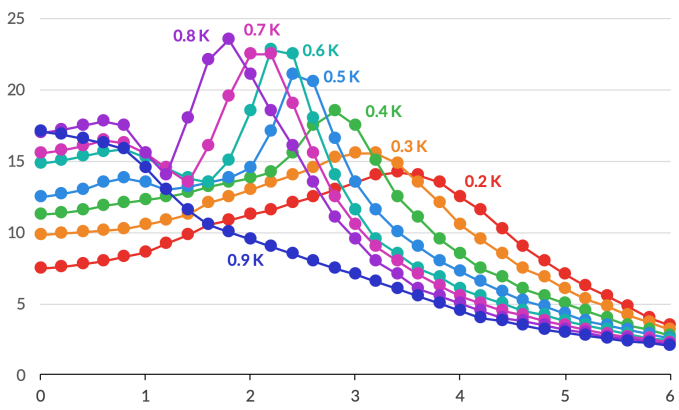


Fig. 2. Line chart with different, similarly saturated colors and direct labels.

You will notice the legend at the top of this graph, which serves as the labels for all of the lines. That legend is separated from the data and forces the reader to bounce back and forth between the data and the labels. In some cases, a better approach is to label the lines on the chart directly (Fig. 2) – sometimes somewhere on the graph and in other cases, maybe right off the edge of the graph. While that's often a better approach, in some cases like this, the result can look a little cluttered. Several factors can help you here including overall size of the chart, text size, color saturation, data pattern, and, of course, the goal of the chart.

The 'start with gray' technique can encourage the creator to consider which labels, compounds, or substructure to highlight.

Another point worth making about this particular chart – again, based on an actual chart but using made-up data – is the color palette. A sequential palette that goes from a light color for low values to a dark color for high values can be more intuitive and easier for readers to understand. Here, however, with eight separate lines, this can be difficult. Fig. 3 shows such a graph with a purple color ramp running from the lightest shade for the 0.2 K line to the darkest for the 0.9 K line. If the goal was to highlight a specific series or set of values, this version might not be especially useful. If, however, the goal was to make a more general point about the overall pattern and convergence of the lines, then perhaps this color palette would actually make sense.

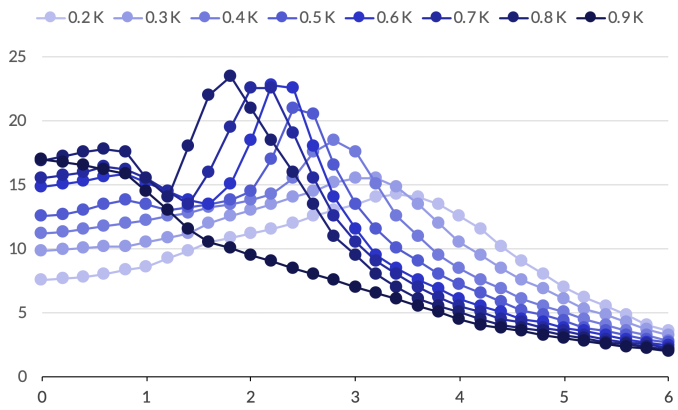


Fig. 3. Line chart with sequential color palette.

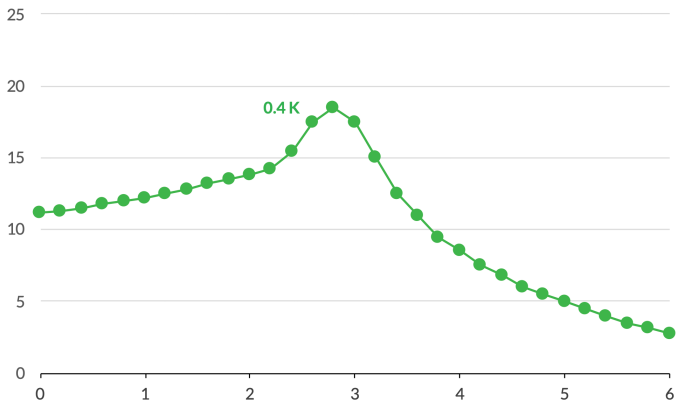


Fig. 4. Line chart with a single line.

3. 'Less is More'

Instead of showing all of the data simultaneously, imagine if the point of the experiment was to argue that the findings of the 0.4 K series were the most important. This argument would not be visible in the 'More is More' approach – the reader would have to dig and squint to find that line, track its progress, and seek to comprehend whether the data being shown match the claims being made by the author.

We thus turn to the 'Less is More' model, which takes the visualization strategy to the other extreme – only showing the key piece of evidence. In this case, Fig. 4 shows only the 0.4 K series. It's easy to read and track the curve, but the reader has no way to judge it against other experiments. The reader can't know if the curve is an outlier or showing something unique in relation to other experiments or findings.

This can be especially important if you are presenting your results to readers (or an audience) who are not familiar with the topic or your data. Is that increase meaningful? Is the decline steeper than we would anticipate? How does it align with what we might otherwise expect? There is no framing, no relation of these data to the whole to give the reader a better sense of the overall patterns.

To be sure, there are times when the 'less is more' approach makes sense; a geographic map or a chemical bond diagram, for example. Or a singular finding that requires its own space – a visual highlight of an important finding or conclusion. In many cases, however, we likely want to give the reader a clear view of the data and its relationship to other relevant data series or experiments.

4. 'More is Less'

This brings us to the final strategy: 'More is Less'. Instead of the 'more is more' approach where every data point is given the same visual weight, the 'more is less' approach still presents all of the data but employs specific strategies to emphasize the values that are key to the argument and important to the reader.

Using our mock data, Fig. 5 shows the same series with each line gray and slightly thinner, except for the 0.4 K series. For that series, the color (and line thickness) remains, with the label placed next to it. (In this case, we could even consider deleting all of the circle data markers on those other series.) If all the details are necessary, they could be included in the supporting information materials document.

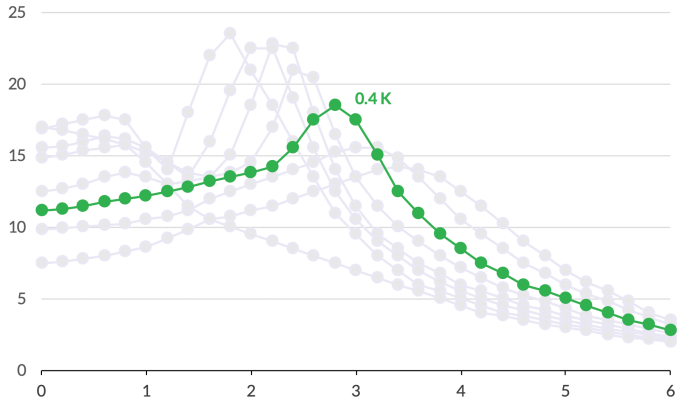


Fig. 5. Using the 'start with gray' technique on a line chart.

This is an approach I call 'starting with gray'. In it, the creator makes every element in the graph the same color (gray) and the same weight.[1] This forces the creator to make specific, purposeful decisions about where they want the reader to focus. After all, if everything in a graph – lines, bars, gridlines, tick marks – is all the same weight and color, the reader won't be able to decipher anything.

We can also clearly see this in standard chemistry papers that illustrate different chemical bonds. What if every label, line, and bond were given the same weight in an initial draft? A reader's attention would likely move all over the figure, focusing on nothing and nowhere. In this case, *the 'start with gray' technique can encourage the creator to consider which labels, compounds, or substructure to highlight.* A simple example is shown in Fig. 6 – the version on the left all in black and the version on the right using orange to highlight and draw attention to that part of the structure.

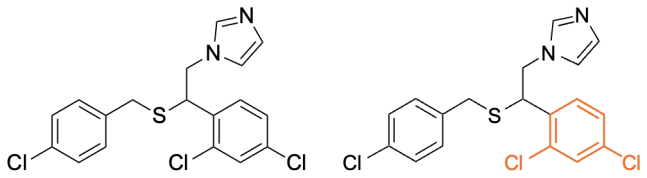


Fig. 6. Chemical substructure of fenticonazole.

Another option that might fall into this 'More is Less' category is what is often called the 'small multiples' technique.[1,2] Instead of showing all of the data in a single graph, the creator breaks the data into multiple charts. The chemistry literature is filled with figures that show several graphs under a single figure umbrella, so this is not an entirely new concept to the field. The small multiples strategy I refer to here is not a collection of different graphs with different data, but a single graph broken into multiple, smaller parts.

Visualizing data is a mix of science and art.

Fig. 7 implements this approach with the same mock data. Here, different series are placed on each of the four graphs – 0.2 K and 0.3 K in the top-left, the focal 0.4 K in the top-right, the collection of four series in the bottom-left, and the 0.9 K series in the bottom-right. The reader can quickly navigate across all four graphs to more clearly see the individual patterns and, because the graphs have the same frame (*i.e.* axis ranges), also understand the related patterns.

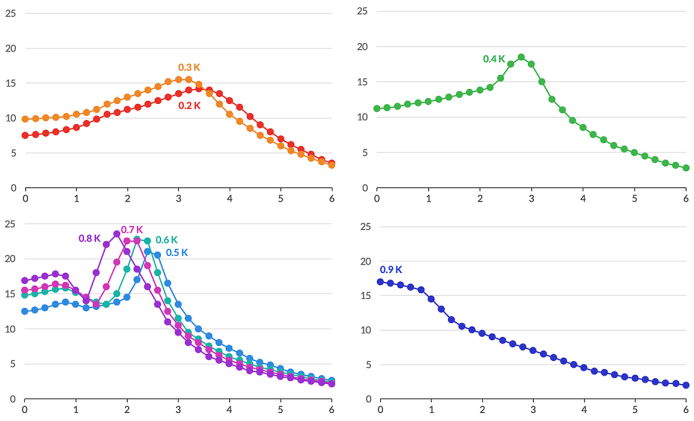


Fig. 7. Small multiples approach.

One of the ways researchers misuse the small multiples technique – or abandon it altogether – is that they perceive 'small' to mean 'one', that is, every chart in the visual can have only one series.

That is not the case. The small multiples technique means only that the figure is made up of multiple small charts rather than one big, dense, complex chart. Each small multiple graph can have more than one series, best grouped by some organizing principle. In Fig. 7, the series are grouped by pattern; in other cases, it might be series that move in the same direction or share a common element or are even ordered alphabetically. Any logical grouping will suffice – the point of the small multiples approach is to take a single, dense graph that readers will have a difficult time discerning (like Fig. 1) and break it up into smaller, more manageable chunks.

5. Conclusion

Visualizing data is a mix of science and art. The science comes in when we try to understand how people read and perceive information – the neurology and psychology of how our brains and other senses work together. The art comes in when we make the decisions on what and how to highlight or make clear to the reader.

Although I do not have a background in chemistry, the underlying principles of effective data communication are similar across fields: consider the needs and expertise of your audience; move their attention to the parts of the image that help support your argument; and use all design features with purpose and clarity.

Author Contributions

J. S. Conceptualization, Visualization, Writing – original draft, Writing – review and editing.

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[2] M. Boers, 'Data Visualization for Biomedical Scientists: Creating Tables and Graphs That Work', VU University Press: Amsterdam, **2022**.

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