Bar Widths and the Spaces in Between

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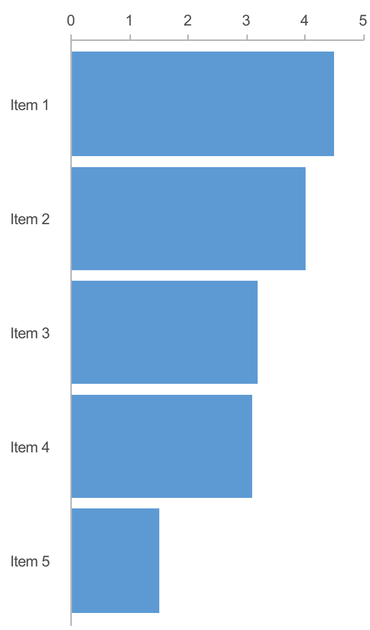
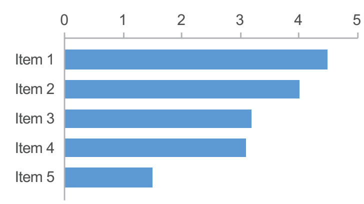
A bar in a bar graph encodes a single value by varying its size in one dimension only: length. We should think of bars as thick lines that vary in one dimension only rather than rectangles that vary in two. We give these lines width in the form of bars merely to make it easy to see their lengths, read their values, and compare them. There is a threshold of width relative to length beyond which the functionality of bars is reduced. Excessive width distracts attention from the lengths of bars, wastes space, and just plain looks bad.

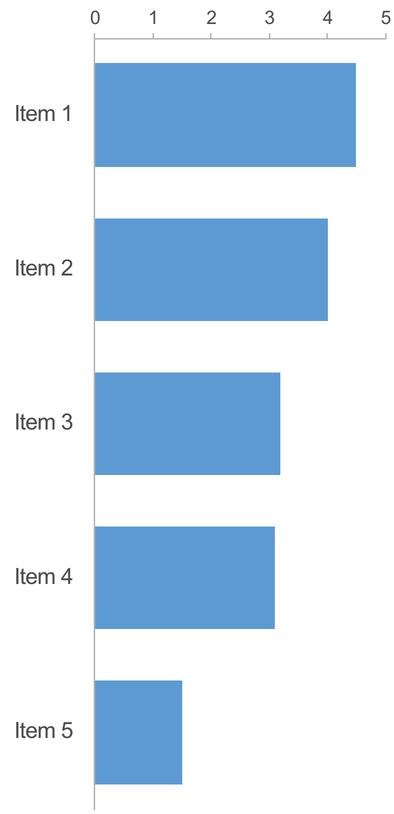
The width of a bar, in and of itself, is not the issue. It is the ratio of length to width that we should consider. This is because our perception of a bar's length is influenced by its width. Two graphs with bars of the same length do not seem the same if the bars in one are much wider than the bars in the other. The thinner bars appear longer. In the two graphs below, the bars in the left-hand graph are precisely the same lengths as the corresponding bars in the right-hand graph, but it doesn't appear so.



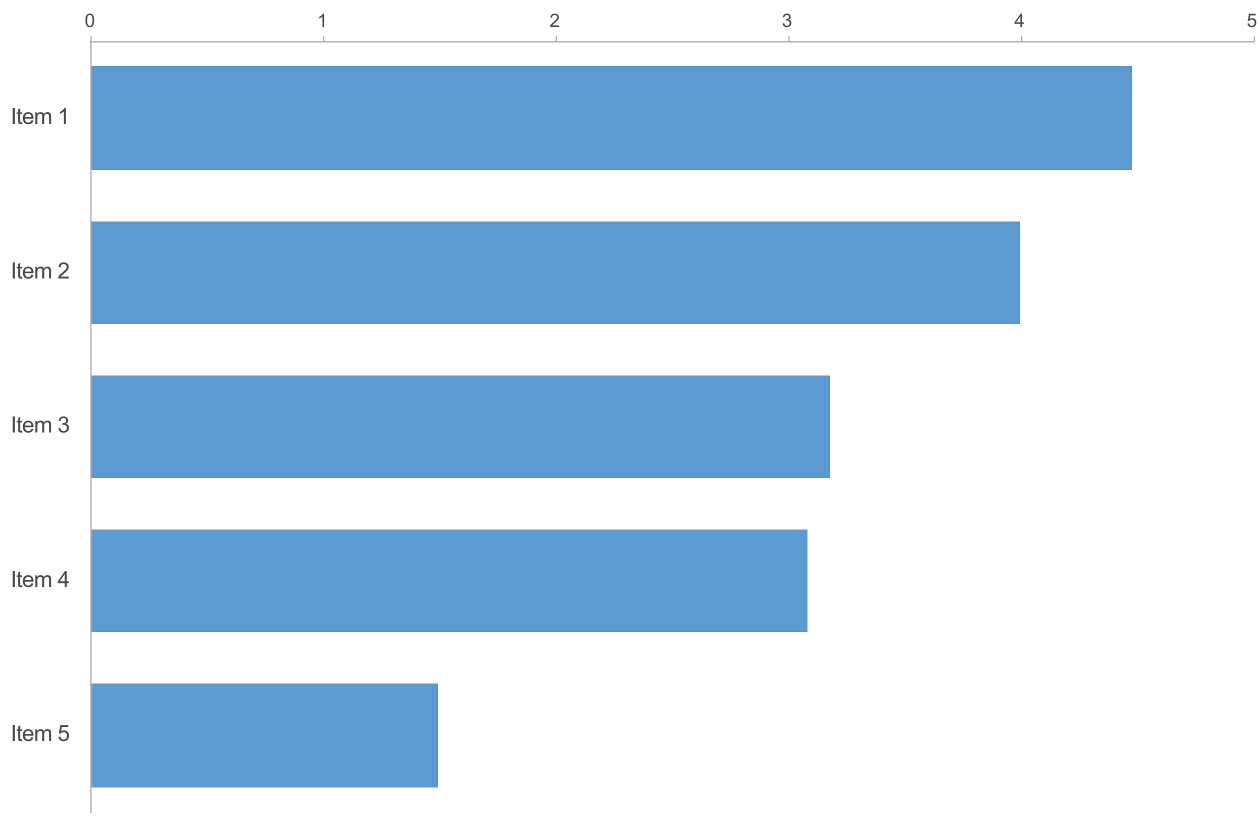


In creating this example, I was careful to keep everything precisely the same except for the widths of the bars. If you doubt me, measure any corresponding pair of bars to see for yourself. Perception of a bar's length is influenced by its width, but you might argue that this doesn't matter because a set of bars that all have the same width, regardless of size, still accurately encodes the values. While this is true, three problems seem to exist when bars fall below a particular length to width ratio. Excessive bar widths (1) make the overall graph larger than it needs to be, which is a problem when space is limited, (2) distract attention from the only dimension that matters, which is length, probably resulting in a loss of perceptual speed and accuracy, and (3) are aesthetically displeasing.

In the graph on the following page, the bars are the same width as those in the left-hand graph above, but this time the spaces between the bars equal 50% of their widths and the size of the text has been enlarged to better match the width of the bars.



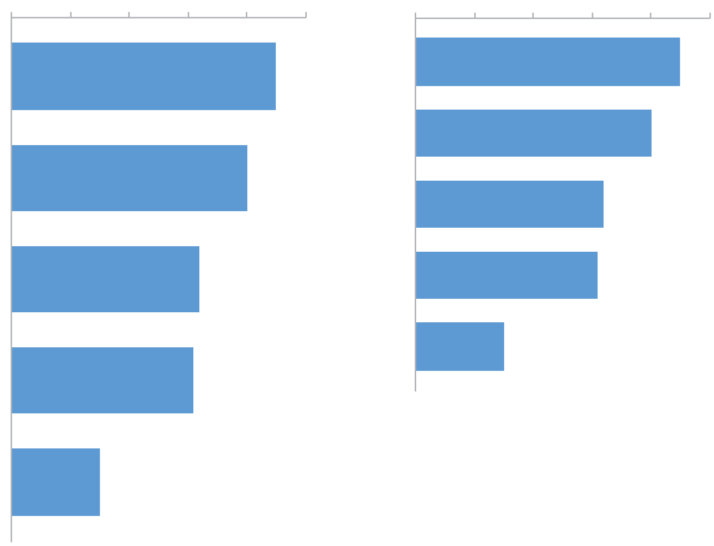
The bars appear stubby, don't they? It isn't that the bars are too wide, but that they are too wide relative to their lengths. In the graph below, the bars are the same width as above, but their lengths are now four times greater, resulting in a better balance between length and width.



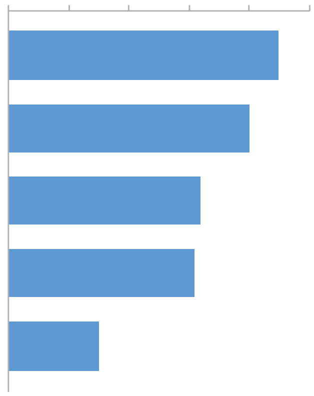
The wide bars no longer appear stubby or excessively wide. To my eyes, the relationship between the lengths and widths of these bars appears more balanced and their widths no longer distract attention from their lengths.

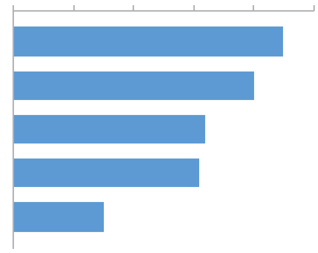
Let's go back to where we started, with excessively wide bars, shown on the left in the following figure. Let's reduce the width one step at a time. In the examples that follow, I've removed the labels because they aren't relevant to our purpose, and I've consistently kept the space between the bars equal to 50% of their widths. In the graph on the right below, the bars have been reduced in width by approximately a third.

The graph on the right looks better, but the bars still appear a bit too wide in relation to their lengths, don't they? Let's reduce their widths further.



The ratio of bar length to width on the right now appears more balanced, but let's keep going.

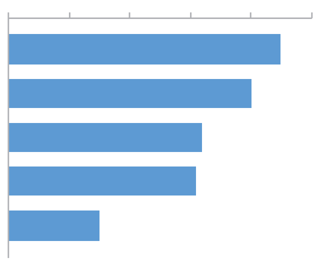


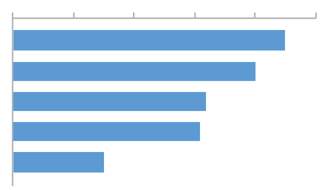


To my eyes, this new graph looks even better.

This is perhaps an appropriate place to clarify two facts. First, what I'm saying about the aesthetics of these examples (i.e., a pleasing ratio of bar length to width) and about the degree to which excessive bar widths distract from their lengths is based on my perceptions alone. I have not performed experiments to confirm that my perceptions are typical, so I am not claiming a scientific finding. This is often how scientific exploration begins. We use our own senses to make observations and from those observations we form hypotheses that must then be tested. I'm fairly confident that my expertise in graph design has given me a well-honed ability to generate valid opinions on these matters, but I'll leave it to others to put them to the test. The second fact that I should clarify is the way that I'm determining the ratio of bar length to width when describing a graph with bars of various lengths. I'm basing the ratio on the longest bar.

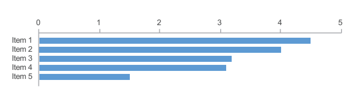
Let's continue reducing the widths of the bars.





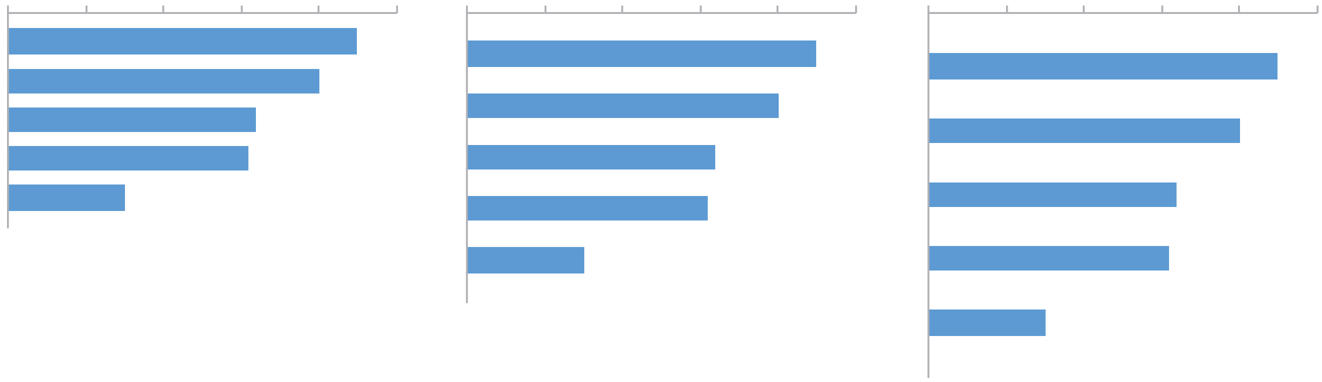
The ratio of bar length to width in the new graph seems to work well, but not necessarily better than the one on the left. Both of these graphs appear to be in the zone of an effective length to width ratio.

Let's take it one big step further. In the next example, the widths of the bars have been reduced to roughly 30% of their widths in the graph above on the right.



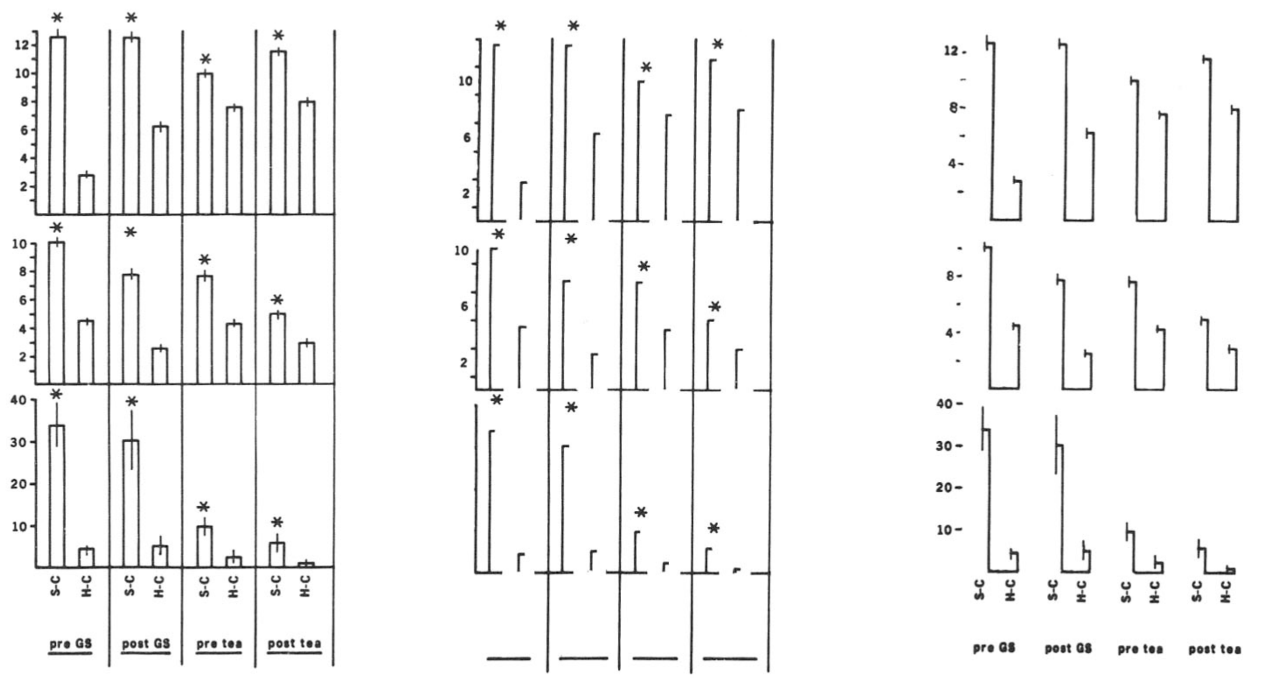
I put the labels back in to show that at this point the text would have to be small to fit along the Y axis, which has rendered it difficult, if not impossible, to read. We can still see and compare the lengths of the bars, but not with ease. We've gone too far.

As I mentioned before, in this series of examples I kept the spaces between the bars consistent in proportion to the widths of the bars: in each case the spaces between the bars were 50% of their widths. This matters. To illustrate this fact, in the example on the following page, I begin on the left with a graph that works well with spaces between the bars that are 50% of the bars' widths, followed by a graph in the middle with the same bars separated by spaces that are 100% of bar widths, and end with a graph on the right with the same bars separated by spaces that are 150% of bar widths.



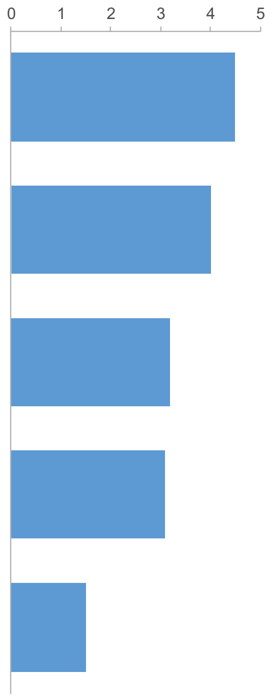
To my eyes, spaces between bars that range from 50% to 100% of their widths (the left and middle examples) look fine, but greater spaces than 100% look exaggerated, to say nothing about the fact that they waste space without providing any benefit. Actually, I find the 50% spacing more pleasing than the 100% spacing, which inclines me to set the spacing between 50% and 75% of bar widths in most circumstances. If you've read my book *Show Me the Numbers*, you might remember that I expressed a different opinion there when I wrote: "Personally, I prefer ordinarily to stick within the range extending from a ratio of 1:1.5 to 1:0.5 and lean toward a ratio of 1:1 as ideal." Now that I've given this matter more thought, I prefer a ratio in the range of 1:0.5 to 1:0.75.

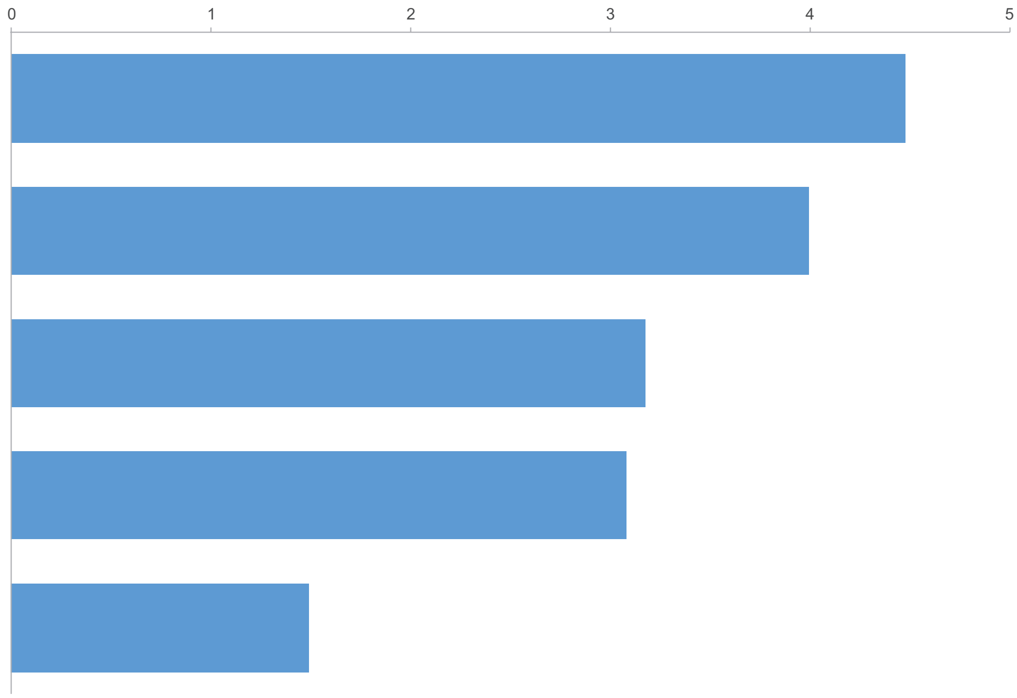
If you've read Edward Tufte's wonderful first book, *The Visual Display of Quantitative Information*, you might remember that he proposed a bar graph design that reduced bars as far as possible without sacrificing meaning, illustrated below. These particular graphs are a bit more complicated than normal in that they include ranges of uncertainty at the tops of the bars.



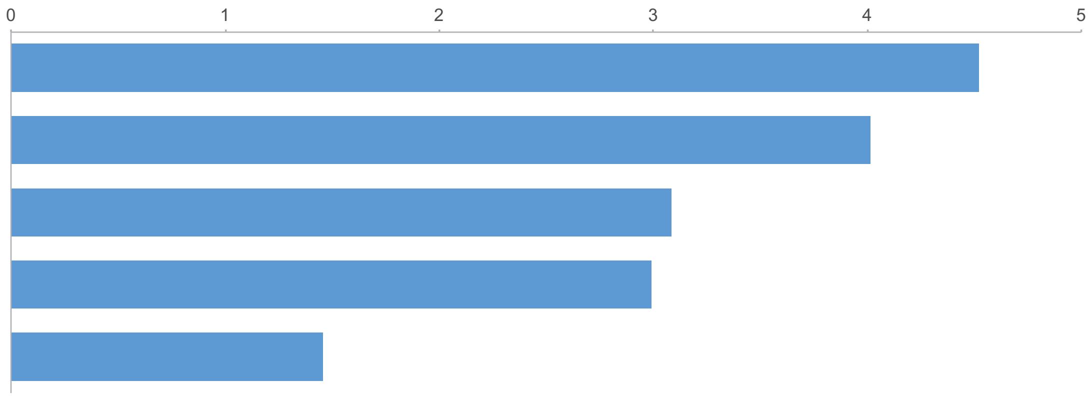
I agree with Tufte that non-data ink should be reduced to a minimum, but not that the same design principle should be applied to data ink to the same degree. Bars represent data. While it is true that we only need so much ink to represent data, there is definitely a point below which functionality is lost. In my opinion, Tufte's minimalist version of bars falls below this threshold.

The ratio of length to width of the longest bar in the left-hand graph below is 2.5:1 (i.e., the length is 2.5 times the width). In the right-hand graph, I've improved the ratio by increasing the lengths of the bars to create a 10:1 ratio.

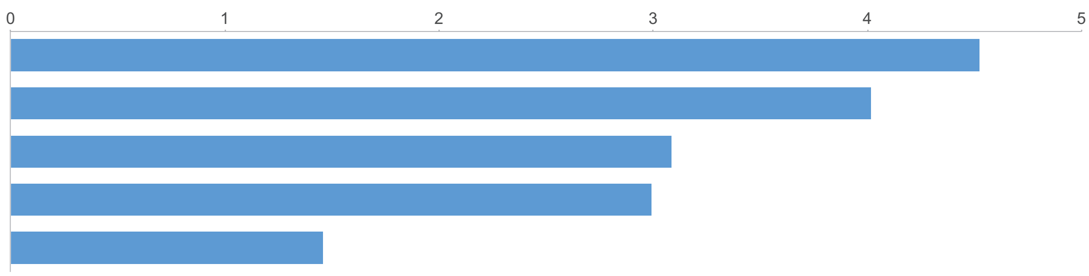




In the graph below, the ratio has been increased to 20:1, and it still looks good.



And in the final example below the ratio is 30:1.



It appears that a ratio below 10:1 or thereabouts suffers from a perceptual imbalance, but the ratio can be increased considerably before an imbalance at the other extreme emerges. There is probably an upper threshold beyond which a loss of functionality emerges, but this is less likely to occur in practice and therefore needn't concern us as much.

It is not my intention in this article to propose a rigid set of rules for determining the widths of bars and the spaces between them. Rather, I'm pointing out that these aspects of a bar graph can affect its usefulness and should therefore be considered. Until research is done to determine the ratio between bar length and width below which problems begin to occur, a minimum 10:1 ratio is probably a good rule of thumb to follow, with spaces between bars in the range of 50% to 75% of their widths. I'm not suggesting that you take the time to measure these ratios. That level of precision isn't necessary. Rather, I'm suggesting that you keep this issue in mind and use your eyes when creating graphs to prevent excessively wide bars or excessive spacing between bars. It would be helpful, of course, if the tools that we use to create graphs would incorporate similar rules as defaults.

It would be worthwhile to put this advice to the test to determine effective guidelines and also to determine the extent to which excessively wide bars or bars with large spaces between them degrade the performance of bar graphs in perceptual speed and accuracy. Experiments to test this should be easy to design and conduct.

In this article, I've attempted to model a process that all expert data visualization practitioners can participate in. If our own perceptions are well-honed by the study of data visualization theory and a great deal of practice, we might notice problems that have not been addressed by tool vendors and infovis researchers. We can use our own senses to investigate these problems and propose tentative solutions that the research community can then test and, once validated or revised, vendors can then incorporate into their tools. We are part of a data sensemaking system that can benefit from our help. I invite you to share your observations with me: either problems alone or with proposed solutions as well. I'll gladly give your valid concerns and viable solutions the exposure that's needed to set improvements in motion.

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About the Author

Stephen Few has worked for over 30 years as an IT innovator, consultant, and teacher. Today, as Principal of the consultancy Perceptual Edge, Stephen focuses on data visualization for analyzing and communicating quantitative business information. He provides training and consulting services, writes the quarterly *Visual Business Intelligence Newsletter*, and speaks frequently at conferences. He is the author of four books: *Show Me the Numbers: Designing Tables and Graphs to Enlighten*, Second Edition, *Information Dashboard Design: Displaying Data for at-a-Glance Monitoring*, Second Edition, *Now You See It: Simple Visualization Techniques for Quantitative Analysis*, and *Signal: Understanding What Matters in a World of Noise*. You can learn more about Stephen's work and access an entire library of articles at www.perceptualedge.com. Between articles, you can read Stephen's thoughts on the industry in his blog.

