

The Chartjunk Debate

A Close Examination of Recent Findings

Stephen Few, Perceptual Edge
Visual Business Intelligence Newsletter
April, May, and June 2011

In his first book, *The Visual Display of Quantitative Information* (1983), Edward Tufte introduced the term “chartjunk.” Ever since, people involved in data presentation have used this term to condemn what they perceive as flaws of various types in graphs. Let’s remind ourselves of how Tufte defined the term originally.

The interior decoration of graphics generates a lot of ink that does not tell the viewer anything new... Regardless of its cause, it is all non-data-ink or redundant data-ink, and it is often chartjunk. (The Visual Display of Quantitative Information, p. 107)

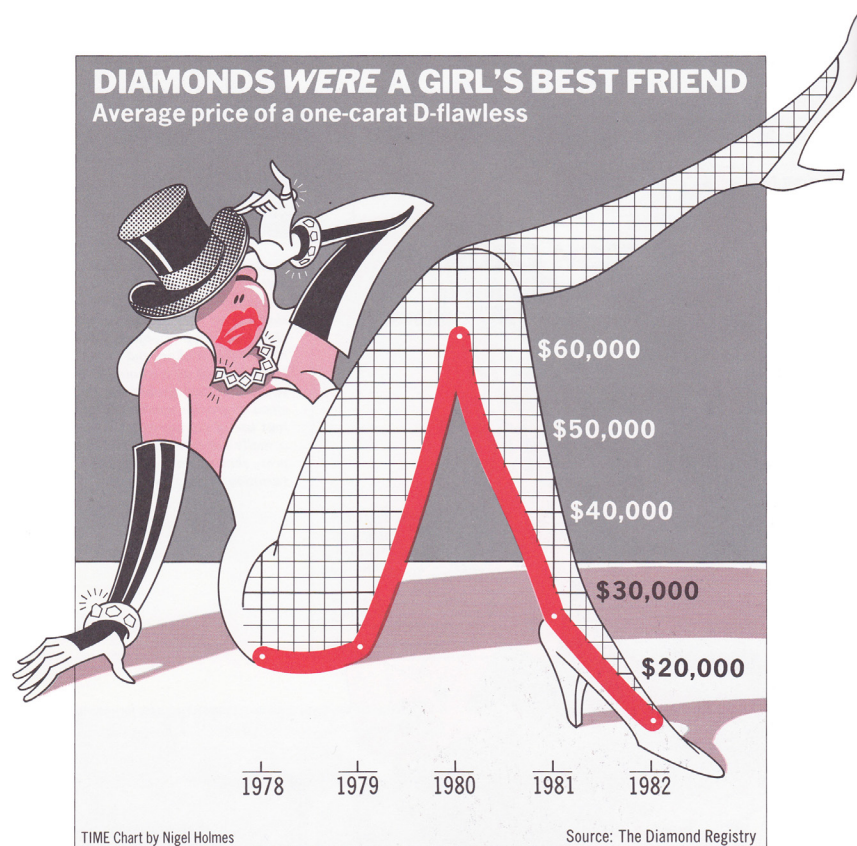
Fortunately most chartjunk does not involve artistic considerations. It is simply conventional graphic paraphernalia routinely added to every display that passes by: over-busy grid lines and excess ticks, redundant representations of the simplest data, the debris of computer plotting, and many of the devices generating design variation. (ibid, p. 107)

Chartjunk does not achieve the goals of its propagators. The overwhelming fact of data graphics is that they stand or fall on their content, gracefully displayed. (ibid, p.121)

Chartjunk can turn bores into disasters, but it can never rescue a thin data set. The best designs... are intriguing and curiosity-provoking, drawing the viewer into the wonder of the data, sometimes by narrative power, sometimes by immense detail, and sometimes by elegant presentation of simple but interesting data. (ibid, p. 121)

According to Tufte, chartjunk consists of non-data and redundant data elements in a graph. It comes in various types: sometimes artistic decoration, but more often in the form of conventional graphical elements that are unnecessary in that they add no value. Chartjunk is not informative and is often harmful.

I agree with Tufte’s basic assessment, but we differ somewhat in our understanding of what qualifies as useful expressions of information. Embellishments can at times, when properly chosen and designed, represent information redundantly in useful ways, and even when they aren’t information in and of themselves, can meaningfully support the display of information. Had Tufte said nothing more than the paragraphs above, chartjunk might have never become the rallying cry of a vicious debate that has raged for years. In 1990, however, he published his second book, *Envisioning Information*, and included a chart that was designed by Nigel Holmes about the price of diamonds, which appears on the next page.



Here's what he said about it:

Consider this unsavory exhibit at right—chockablock with cliché and stereotype, coarse humor, and a content-empty third dimension. It is the product of a visual sensitivity in which a thigh-graph with a fishnet-stocking grid counts as a Creative Concept. Everything counts, but nothing matters. The data-thin (and thus uncontextual) chart mixes up changes in the value of money with changes in diamond prices, a crucial confusion because the graph chronicles a time of high inflation.

Lurking behind chartjunk is contempt both for the information and for the audience. Chartjunk promoters imagine that numbers and details are boring, dull, and tedious, requiring ornament to enliven. Cosmetic decoration, which frequently distorts the data, will never salvage an underlying lack of content. If the numbers are boring, then you've got the wrong numbers. Credibility vanishes in clouds of chartjunk; who would trust a chart that looks like a video game?

Worse is contempt for our audience, designing as if readers were obtuse and uncaring. In fact, consumers of graphics are often more intelligent about the information at hand than those who fabricate the data decoration. And, no matter what, the operating moral premise of information design should be that our readers are alert and caring; they may be busy, eager to get on with it, but they are not stupid. Clarity and simplicity are completely opposite simple-mindedness. Disrespect for the audience will leak through, damaging communication. What E. B. White said of writing is equally true for information design: "No one can write decently who is distrustful of the reader's intelligence, or whose attitude is patronizing."

(Edward Tufte, *Envisioning Information*, Graphics Press, 1990, p.34-35)

And people think I'm harsh! These were fighting words. It isn't hard to imagine how Holmes felt about this. In Holmes' mind, Tufte became his nemesis and ever after these titans came to embody two sides of a debate that has raged for years. Unfortunately, this debate has rarely been conducted in a rational, evidence-based manner. It has mostly been fueled by people's blind commitment to one camp or the other: two armies hunkered down in their trenches lobbing insults at the enemy like flaming balls of napalm.

A study by Scott Bateman, Regan L. Mandryk, Carl Gutwin, Aaron Genest, David McDine, and Christopher Brooks of the University of Saskatchewan titled “[Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts](#)” recently entered the field of battle as a potentially refreshing alternative. To use it as a constructive contribution to the debate, it’s important that we understand what it actually says and the validity of its findings.

Since this study was made public, it has created a fair degree of buzz. Proponents of artistic visualizations of all types, whether similar in approach to Nigel Holmes’ or not, have used this study to defend their work. Holmes himself declared this study a victory for his cause. Some in the embellishment camp have exceeded the study’s reach by using it to justify design practices that research has firmly established as harmful and ineffective. Little of what it’s been used to support, however, is justified.

The Study

This research was designed to test the influence of chartjunk vs. plain (“minimalist”) graphs on two effects: comprehension and recall. Fourteen data visualizations were used, each consisting of two versions: one “embellished” and one “plain.” Twenty participants were recruited from the university. Each of the participants was shown all 14 charts, but only one version of each (7 embellished and 7 plain). For the comprehension part of the study—what the researchers called “reading and description”—participants viewed the charts one at a time on a computer screen and followed the instructions of a tester who sat with them. For each chart, participants were asked to answer the four following questions, further assisted by supplementary prompts as needed:

Topic	Question	Supplementary Prompt
Subject	What is the chart about?	Tell me about the basic subject of the chart.
Values	What are the displayed categories and values?	Tell me how the chart is organized and any relevant values.
Trend	What is the basic trend of the graph?	Tell me whether the chart shows any changes and describe these changes.
Value Message	Is the author trying to communicate some message through the chart?	Is the author trying to get across a specific point or is he or she merely presenting objective information.

For the recall part of the study, participants were divided into two groups: 10 were tested for immediate recall and 10 for long-term recall (two to three weeks later). In both cases participants were asked to recall as many of the charts as possible. Afterwards, for each that they recalled, the tester asked them the same four questions above and recorded what they correctly remembered. Following this, the tester then reminded the participant about the charts that they failed to recall and asked the four questions about those charts as well.

The Findings

In the Abstract section that begins the published paper, the researchers summarized their findings as follows:

We found that people’s accuracy in describing the embellished charts was no worse than for plain charts, and that their recall after a two-to-three-week gap was significantly better. Although we are cautious about recommending that all charts be produced in this style, our results question some of the premises of the minimalist approach to chart design.

Allow me to restate the findings with relevant qualifications:

When a simple message—one that could be expressed verbally in a single sentence—is presented in a chart that includes embellishments relevant to that message, along with quantitative values that are related to but incidental to the message, then a reader will comprehend the message as well as he would had the graph lacked embellishment and will also better recall the basic subject of the chart and pattern in the data two or three weeks later, but no better soon afterwards.

That's a mouthful, but it more fully describes the study's finding. It isn't surprising that we can usually recall an image that expresses a clever and entertaining visual metaphor better than we can recall an unembellished chart. Research has clued us into this for many years. Recalling the embellished chart better is only useful, however, to the degree that it conveys the message. In the case of Holmes' charts—those used in this study at least—the embellishments do in fact support the message and therefore serve as a useful mnemonic device. The application of this, however, is quite limited in scope. To the credit of the researchers, they suggested that “some charts and some topics may not be amenable to Holmes-style visual presentations.” How true.

Two additional findings were reported in the study that weren't mentioned in the abstract:

1. “Participants saw value messages in the Holmes charts significantly more often than in the plain charts.”
2. “Participants found the Holmes charts more attractive, most enjoyed them, and found that they were easiest and fastest to remember.”

Again, there are no surprises here.

In their conclusion, the researchers overreached when they stated: “Many experts suggest that visual embellishments and ‘chart junk’ cause interpretation problems and should be removed from all information charts, but many examples exist of embellished charts that seem to be successful.” Many examples? Actually, the examples in this study consisted only of a few embellished charts created by one person—Nigel Holmes—and they only succeed for an extremely specific, quite limited purpose.

Methodological Shortcomings

Beyond the expected finding stated above, this study is interesting as an example of methodological failures that are all too common in research. Built into it was the following set of inappropriate assumptions:

1. The purpose for which the charts in the test were used is typical of the way quantitative graphs are used in the real world.
2. The embellished charts by Nigel Holmes' represent extreme examples of chartjunk.
3. The plain charts were designed in the manner that proponents of graphical “minimalism” advocate.
4. A study involving 20 university students can produce trustworthy results.
5. This study identified relevant factors and adequately controlled them.

Typical Uses of Quantitative Graphs

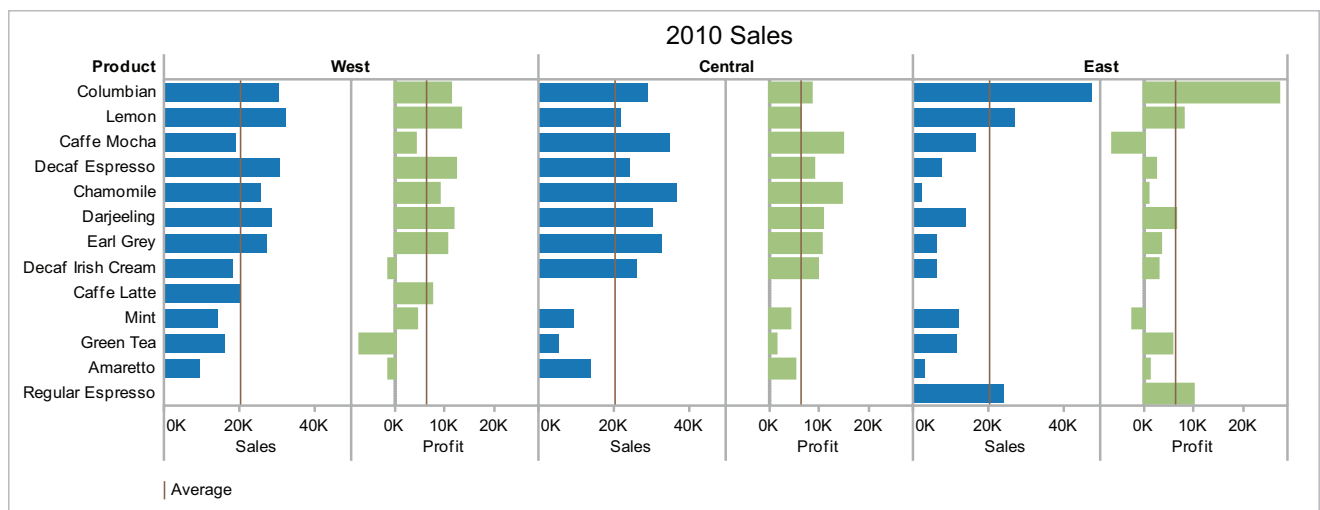
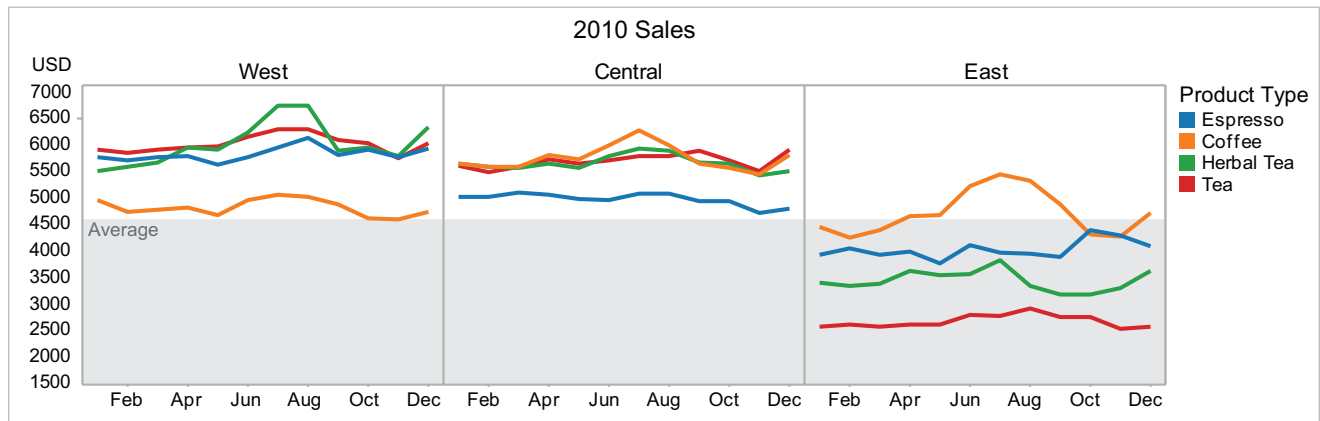
Embellished charts like those used in this study are only typical of a few news publications, probably best represented by that litterer of hotel hallways, *USA Today*. This type of embellishment, however, is not at all typical of quantitative graphs as they're used elsewhere, although some infographics of the non-journalistic type have adopted aspects of this style in recent years. The embellished charts that were used in this study exhibited the following characteristics:

1. The chart communicates an extremely simple, brief message; one that could be stated in words as a single sentence and in fact is summed up in the chart's title.
2. The chart contains a small set of quantitative values, which illustrates the message.
3. The embellishment is tied metaphorically to the message of the chart.
4. The chart is designed by a talented graphic artist.

These characteristics describe few of the graphs that are produced in the world and serve a different purpose than most. They are designed to catch the reader's eye, entertain, and make a simple point quickly. The values contained in the graph are incidental to its purpose; certainly not intended for close inspection. Because the

embellishments are visual, play a role in communicating the message, and are designed by a talented graphic artist, we tend to remember charts of this type. To the degree that the message is important and the information contained in the message is sufficient, the fact that these charts are memorable is useful. When the message is important, but greater understanding is needed, however, these charts fail. When charts of this type are promoted as examples of the way data visualization for other purposes should be designed, they are harmful.

The following two examples illustrate how graphs are more typically used in the world:



When graphs are used in this more typical manner, they should exhibit the following characteristics:

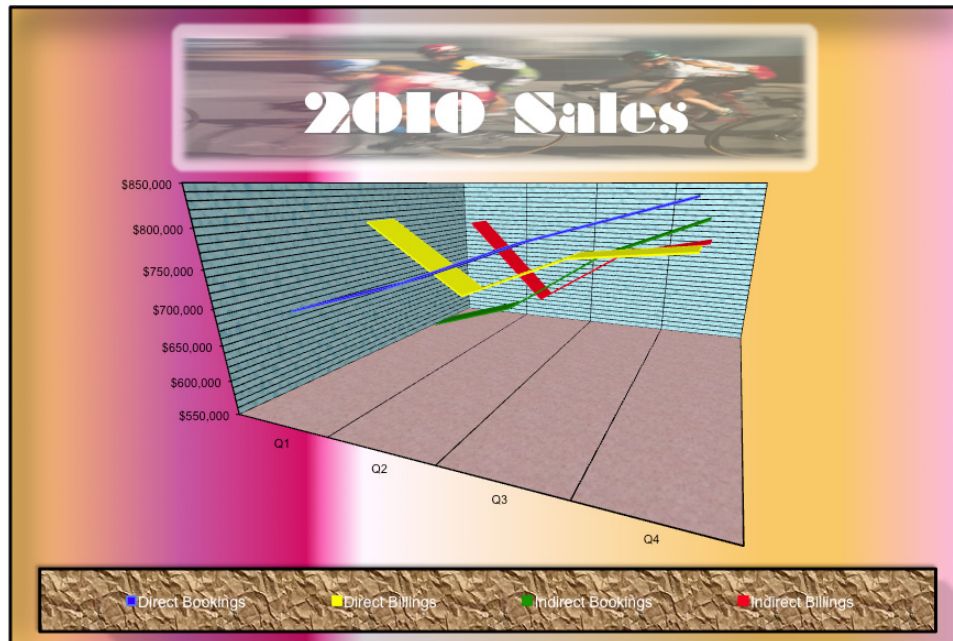
1. Present all the data that is needed for the audience to see and understand what's meaningful.
2. Present nothing that isn't needed.
3. Represent data accurately.
4. Represent data in a way that is easy for the eyes to perceive and the brain to interpret.
5. Provide appropriate context for interpreting the meaning of the data.

No one graph can display the full story that lives in a set of data, but it should provide the richest view possible for understanding what matters. Look at the graph above and try to imagine how this story might be told using a chart that's embellished in the way that was used in the chartjunk study. I can't imagine that Nigel Holmes would ever propose that a chart of that type should be used to examine the data in the salary graph above. I suspect that he understands the limited purpose for which embellishments of this type are useful. Holmes' charts vs. simple charts engage our eyes and brains in different ways: Holmes' into the metaphor and well-designed plain charts into the details.

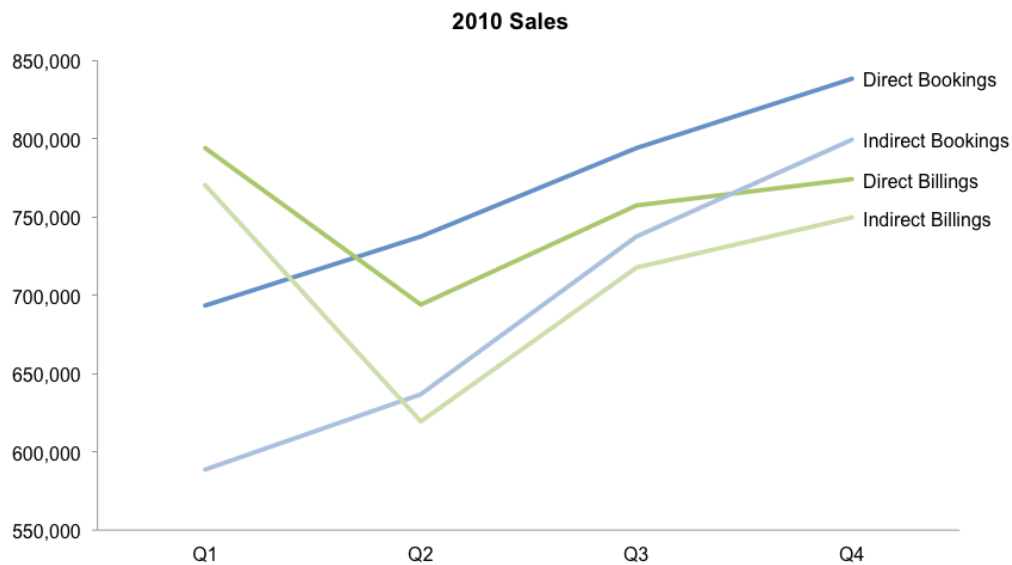
Extreme Embellishment

The researchers stated: "In our study we intentionally chose the most extreme type of visual embellishment that we could, namely, the full cartoon imagery used by Holmes." Actually, Holmes' style embellishments are not an extreme example of the kind of chartjunk that is commonly found in graphs. Rather, they are well-executed examples of a particular style of embellishment (not entirely chartjunk) that is not at all typical outside of a few publications like *USA Today*.

Here's an extreme example of typical chartjunk:



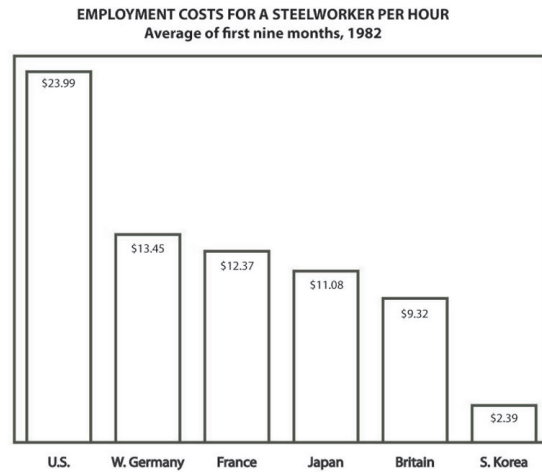
Trust me when I say that I've seen a lot worse. To produce this example, I merely took advantage of handy features in tools like Excel that people commonly use to unintentionally render simple quantitative messages completely incomprehensible. Photos, decorative fonts, 3D objects and perspective, gradients of color in the background, unnecessary grid lines made worse by making them dark, and artsy texture patterns are all readily available, to name a few. Below is another version of this graph, without embellishment:



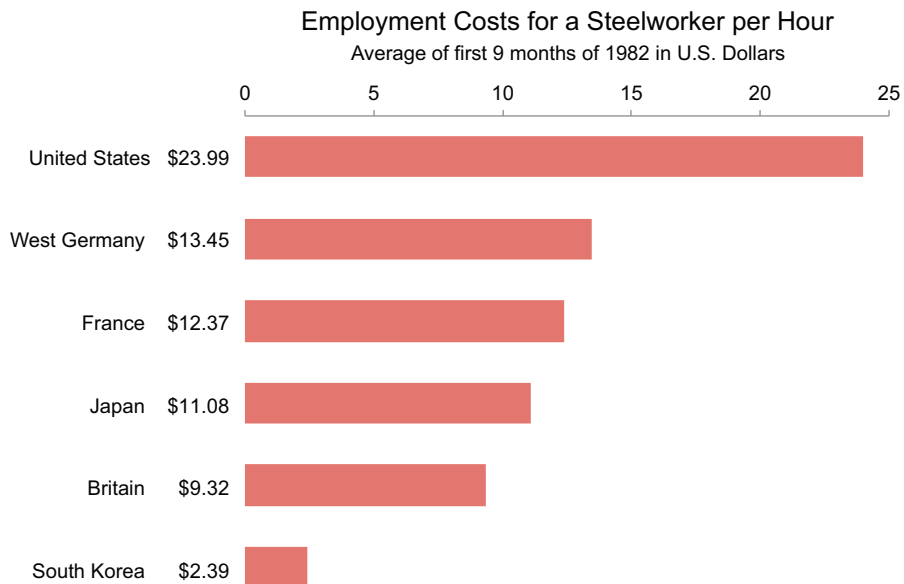
Is there any question that the embellished version would be much harder and less efficient to read and understand, compared to the plain version?

Well Designed Simplicity

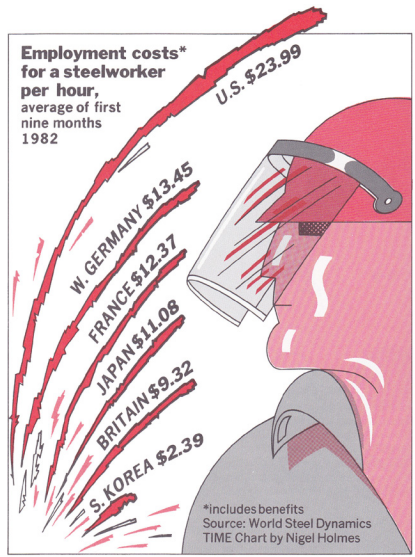
The plain charts used in this study were in fact plain ugly. In addition to being stripped of nonessential ink, the plain charts ignored basic principles of design, resulting in displays that were unnecessarily hard on the eyes.



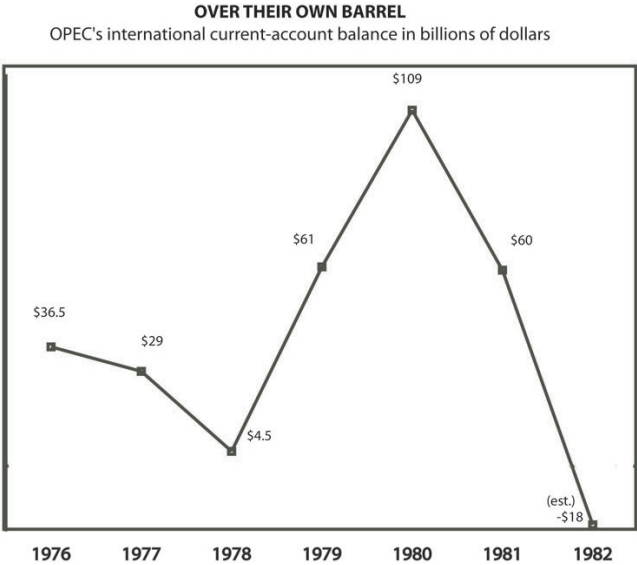
By displaying bar outlines only (no fill color) and enclosing the chart as a whole in a border of equal salience as the bar outlines, an uncomfortable visual effect is created. Below is a better-designed version of the same chart:



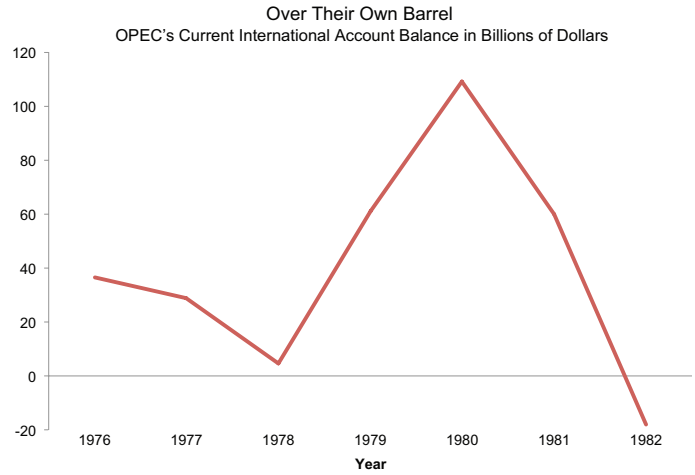
Now, when we compare this plain version to the embellished version on the following page, it isn't hard to understand why the embellished image might stick in our heads longer and why both charts do an equal job of communicating the basic message that steelworkers are paid a lot more in the United States than elsewhere, especially in South Korea. But if we want to dig further and compare the values, we can only use the embellished version to do this by reading the numbers, for the graphical elements fail this test.



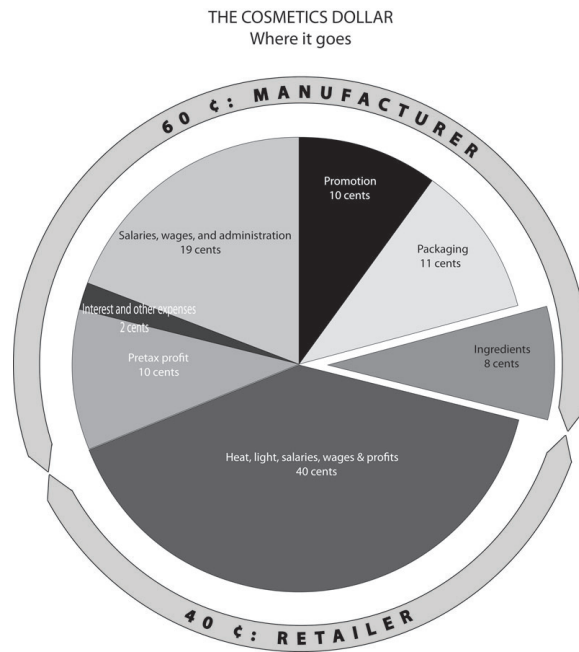
Some of the plain charts in the study were designed in confusing ways, such as the line graph below that connects positive and negative values without showing a reference line for zero:



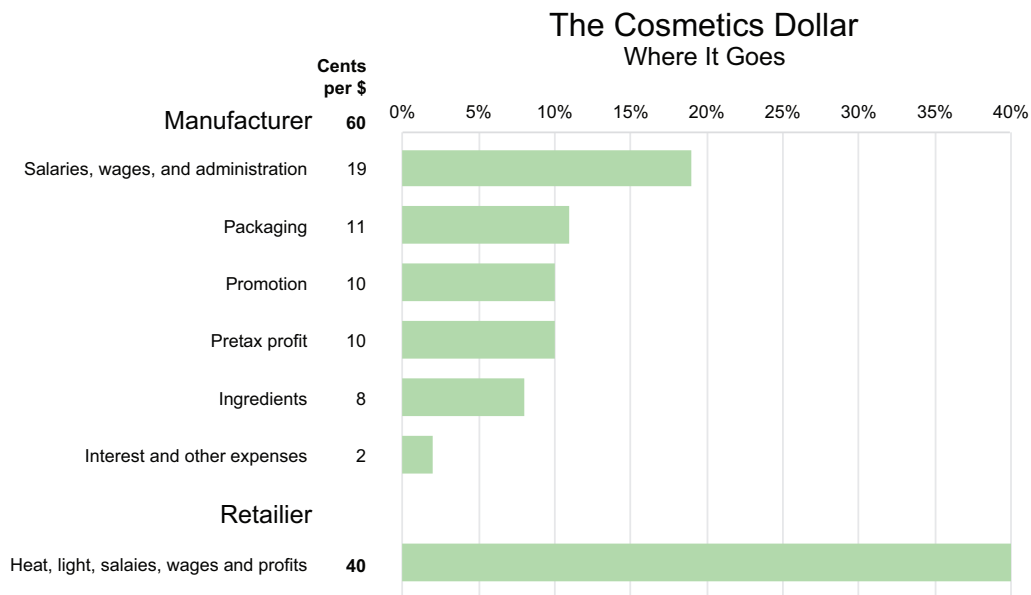
Here's a properly designed plain version:



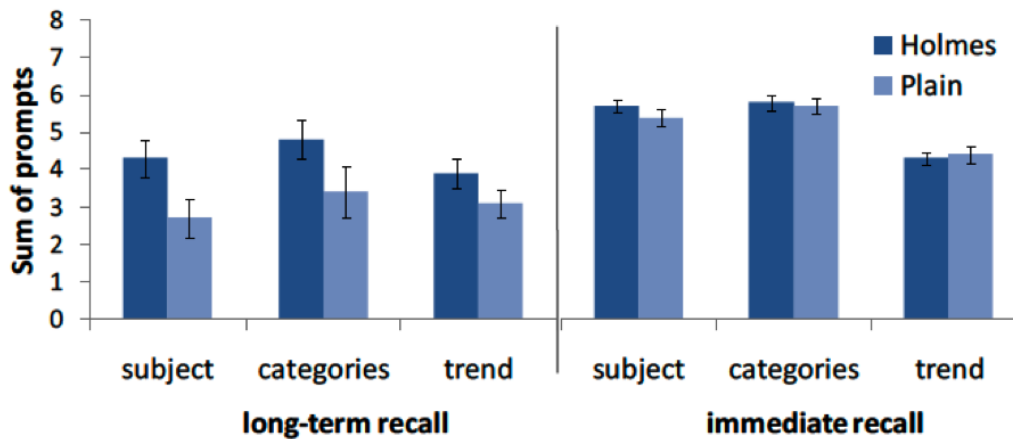
Some of the plain charts were displayed in ways that most advocates of simplicity, including Tufte and me, would never tolerate, such as the following pie chart.



The following bar graph displays the same data in a simpler, more understandable, and more visually pleasing way:



It's interesting to note that the researchers chose to use simple, unembellished graphs to report their results. The following graph was used to show that "for participants in the immediate recall group, there were no differences in the required amount of prompting to recall subjects of the charts ($t_9=1.41$, $p=.097$), categories in the charts ($t_9=0.32$, $p=.379$), or trends of the charts ($t_9=-0.32$, $p=.379$) depending on whether or not charts contained visual embellishments."



Small, Unrepresentative Test Groups

When research studies rely on a tiny group of test subjects and aren't careful to select a sample that represents the larger population to which their findings are meant to apply, they can't be taken seriously. At best we can treat the findings as suggestive of what might be true, but not conclusive.

Several problems in this study's design and in the way it was conducted raise flags of concern. Kaiser Fung has done a fine job of identifying and describing them in his [Junk Charts](#) blog, so I won't reproduce his work here.

Unconsidered and Uncontrolled Factors

Three factors in particular come to mind that should have been taken into account and controlled in this study:

- Characteristics of a representative sample of quantitative graph users
- Different purposes for which people use quantitative graphs
- Different types of chart embellishment

The study suffered from ignoring these factors, producing results that cannot be trusted, despite the fact that they are probably true, and cannot be used to evaluate the effects of chartjunk on most of the quantitative graphs that are used in the world.

What Really Qualifies As Chartjunk?

Tufte's term "chartjunk" is perhaps a little too loosely defined. In my opinion, nothing that supports the chart's message in a meaningful way is junk. Sometimes more than minimal ink and sometimes even redundant content is needed to communicate a chart's message and drive it home. By defining chartjunk too broadly, Tufte to some degree invited the heated controversy that has raged ever since.

The fundamental issue is whether embellishments support the data or to some degree distract from it or distort it. Embellishments that represent data, even metaphorically, can themselves qualify as "data ink." Embellishments that are not data in themselves can sometimes support the display of data in a useful manner.

Graphical embellishments can support the effectiveness of a data visualization in three potential ways: 1) by engaging the interest of the reader (i.e., getting them to read the content), 2) by drawing the reader's attention to particular items that merit emphasis, and 3) by making the message more memorable. Embellishments only enhance effectiveness, however, if they refrain from undermining the message by significantly distracting from it or misrepresenting it.

Tangential Benefits of this Study

This study contributes to data visualization research in the following ways:

1. It reminds us that simple messages can at times be presented in a more engaging and memorable manner through the use of properly designed embellishments.
2. It prompts us to define “chartjunk” more precisely. Embellishments are not always useless or damaging.
3. It prompts us to categorize chart embellishments into various types and to test their effects individually.

Future research can help us better understand the relative benefits of embellished vs. unembellished graphs. Until then, and perhaps forever, the debate will continue.

Note of Gratitude

I want to thank Scott Bateman of the research team for graciously supporting my efforts to write this article. Though he surely knows that I am not a fan of chartjunk, he provided me with his research data and answered all of my questions, without reservation. This openness to other perspectives is a sign of a fine researcher.

Discuss this Article

Share your thoughts about this article by visiting [The Chartjunk Debate](#) thread in our discussion forum.

About the Author

Stephen Few has worked for over 25 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 three books: *Show Me the Numbers: Designing Tables and Graphs to Enlighten*, *Information Dashboard Design: The Effective Visual Communication of Data*, and *Now You See It: Simple Visualization Techniques for Quantitative Analysis*. 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](#).