

Fact or Fiction: Five Common Downfalls of Data Visualizations

BY SANKET SHAH

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Visualizations and data representations are often misleading, deceptive or overcomplicated. It is important to avoid making common mistakes when trying to accurately convey data through visualizations.

In an age where information is consumed in mere seconds, we're seeing more and more visuals used to relay facts and figures – whether it be in business, politics or socioeconomics. Data visualizations, like graphs, charts, and tables, are commonplace in the news or business presentations. They can quickly establish trust, tell a story and illustrate complex messaging with little more than a glance. And as the saying goes, numbers don't lie, or do they?

Just like a photo can be altered to remove imperfections, visuals can be manipulated to support the narration an author wants to portray. Likewise, overly complicated visualizations are just as deceptive. Readers should not have to spend more than 30 seconds looking at a visualization to understand the message. Graphs should be easy to interpret, with clear lines and labels. As noted statistician Edward Tufte stated, "Excellence in statistical graphics consists of complex ideas communicated with clarity, precision and efficiency."

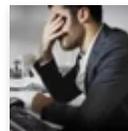


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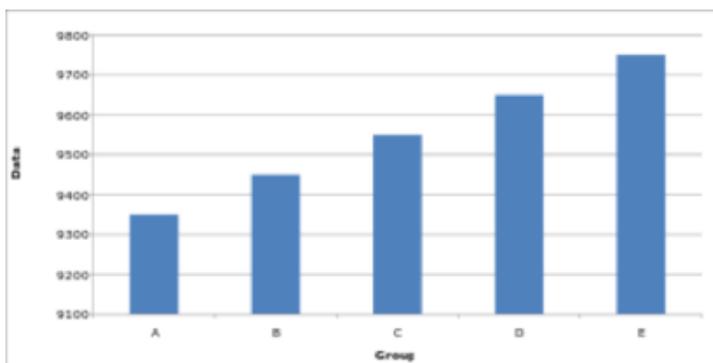
important decisions. The overall implications of deceptive data visualizations can have cascading residual effects, leading to repetitive miscommunication and ultimately a lack of trust.

To understand just how easily visualizations can deceive, take a look at the following examples and how they can be corrected:

1. Truncated graphs

One of the most common manipulations used to control the narrative is by omitting baselines or beginning the y-axis of a graph at an arbitrary number instead of 0, thus creating the impression that there is a significant difference between data points, when in fact, there is relatively little disparity.

To illustrate how a truncated graph can misrepresent the information with just a cursory glance, consider the two graphs below. Both contain identical data; however, the truncated graph appears to show a massive difference from A to E.



Source: Sanket Shah

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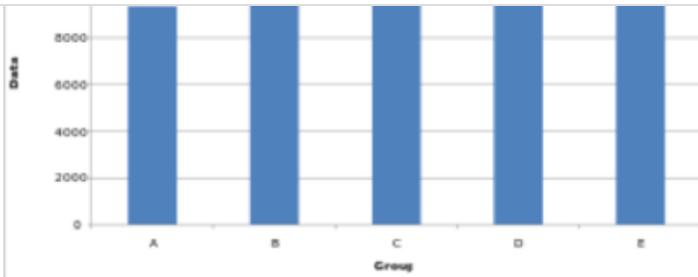
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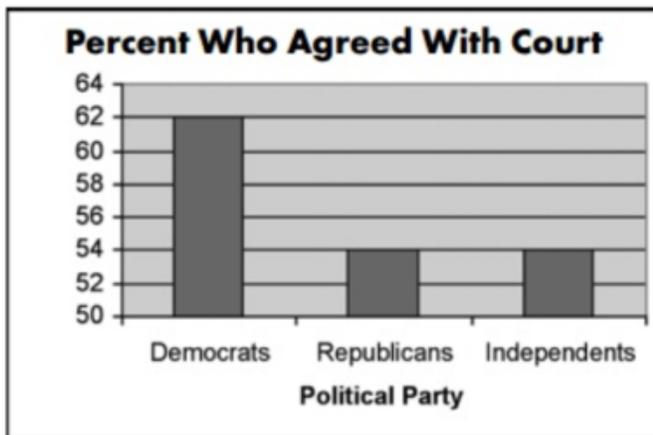
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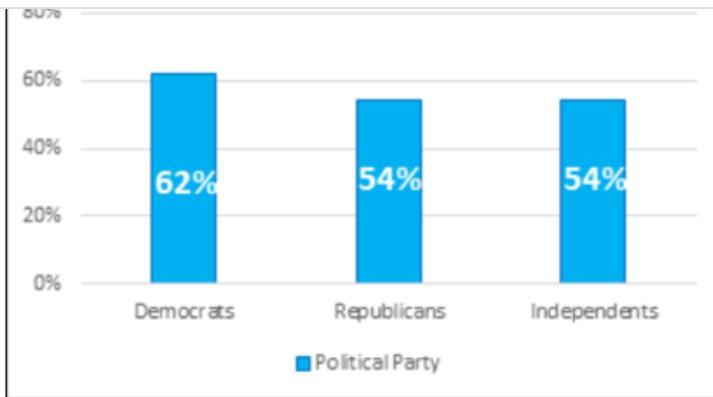
Source: Sanket Shah

For a real-life perspective, CNN used a similar graph to show political party support for the controversial court decision surrounding the Terry Schiavo right-to-die case in 2005. Here, it appears as though Democrats supported the decision by almost three times more than Republicans and independents, when in actuality, there's only about a 14 percent difference.



Source: Western Reserve Public Media

A better representation would have been to set the baseline to 0.

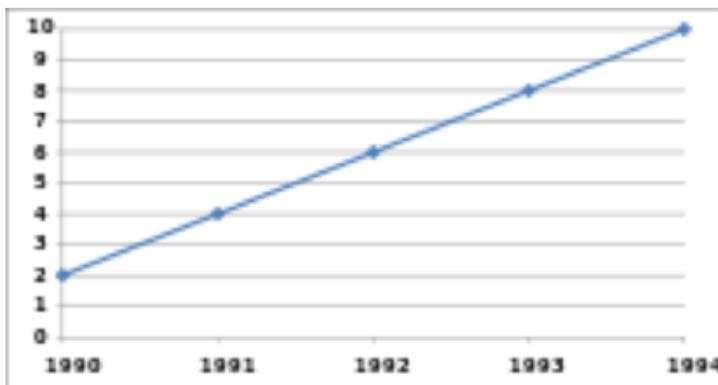


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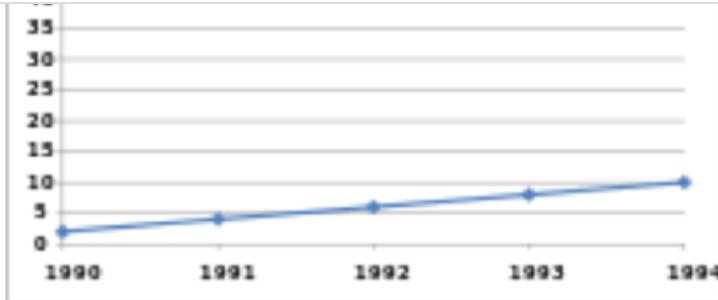
Additionally, clearly placed labels help further tell the complete story and decrease the amount of time it takes to process the information.

2. Exaggerated scaling

Often used to show rates of change over time, line charts are notoriously simple to skew in favor of a chosen narrative. Unlike the bar graphs above, it's not necessary to begin the baseline at 0 to accurately portray the facts. However, exaggerating the scale of a line graph can easily minimize or maximize the change shown. A higher y-axis value will cause a graph to reflect less volatility or growth. Conversely, a lower y-axis maximum will result in a steep line indicating increased volatility or growth.



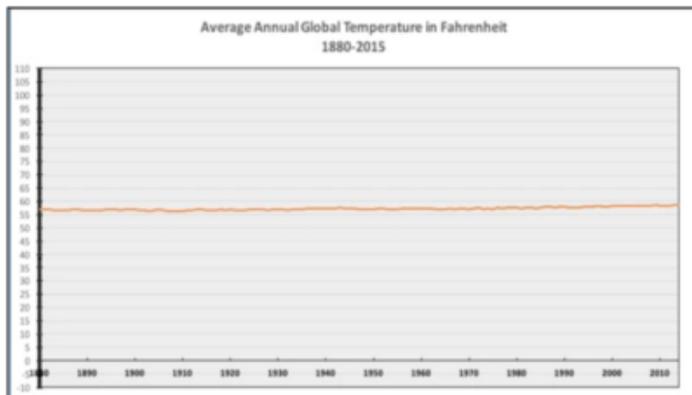
Source: Sanket Shah



Source: Sanket Shah

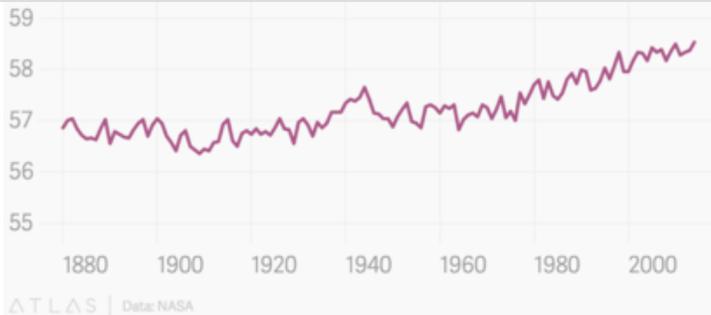
Taking into account the nature of a line graph, which is far more subtle than a bar graph, narrowing in on the y-axis value may help to provide a more precise visualization so that the message can be readily and more accurately understood in seconds.

Consider this representation of global warming over time. In the first image, the y-axis has been blown out causing the graph to indicate relatively no change over time.



Source: National Review @NRO Twitter

However, if you zoom in, minimizing the scale of the y-axis, you'll see a different, more factual representation.



Source: Sanket Shah

3. Improper extraction

Commensurate to a white lie, extracting only a portion of data to align with a particular narrative rather than letting the full story speak for itself can drastically alter perception.

Given this data visualization of General Electric Company's performance on the stock market, it appears they're on an upward swing.



Source: NYSE

But if you were to pull back and look at the complete picture, it would tell a different story.



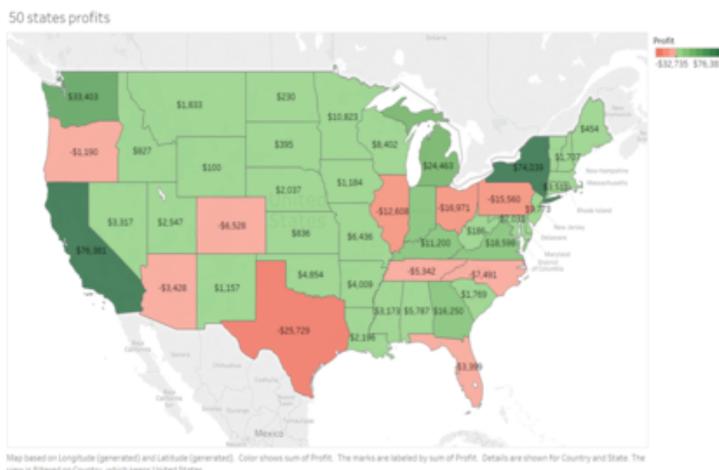
Source: NYSE

Without providing all the information it's impossible to make an informed decision, but, worse, only providing a snippet of information results in misinformation leading to poor decision-making.

4. Going against the norm

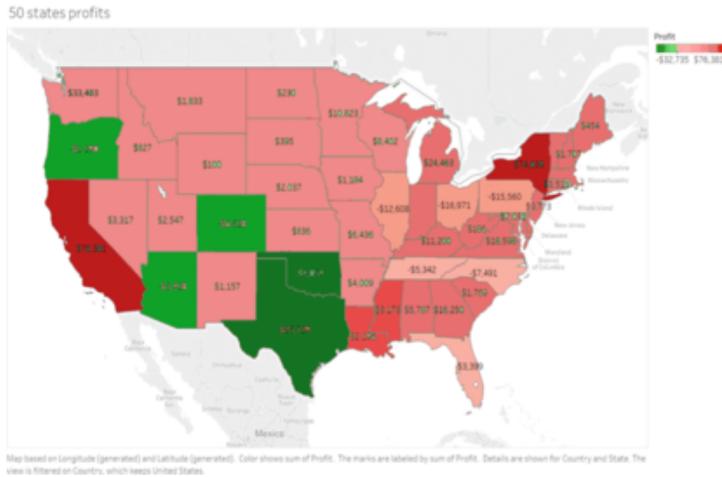
It's common knowledge that when talking finances, green indicates profits and red denotes losses. Deviating from these long-held conventions can create confusion and possible misinterpretation of the facts when taken at a glance.

Here, the original visualization uses standard colors to illustrate profits and losses by state. With a quick look, you can plainly see there are more wins than losses.



Source: Sanket Shah

would appear that losses far exceeded profits across the majority of the country.

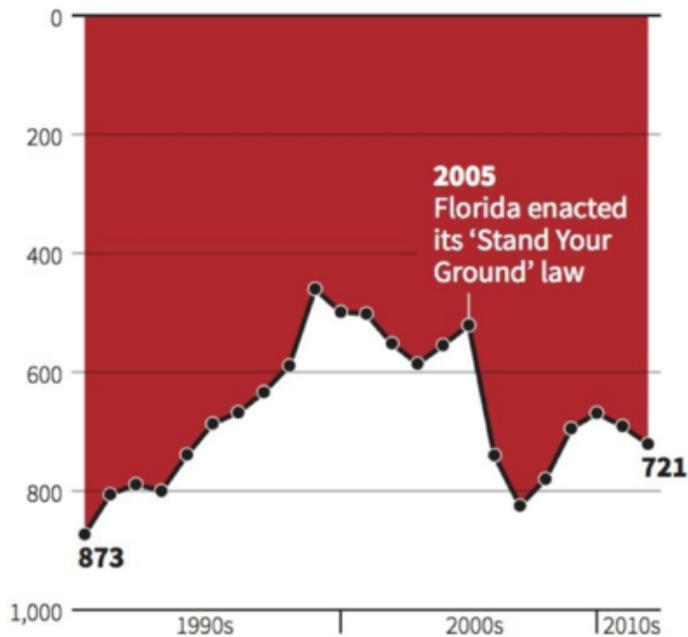


Source: Sanket Shah

Likewise, we're accustomed to viewing numbers increase vertically in a chart, making the following example intentionally misleading.

Gun deaths in Florida

Number of murders committed using firearms



Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

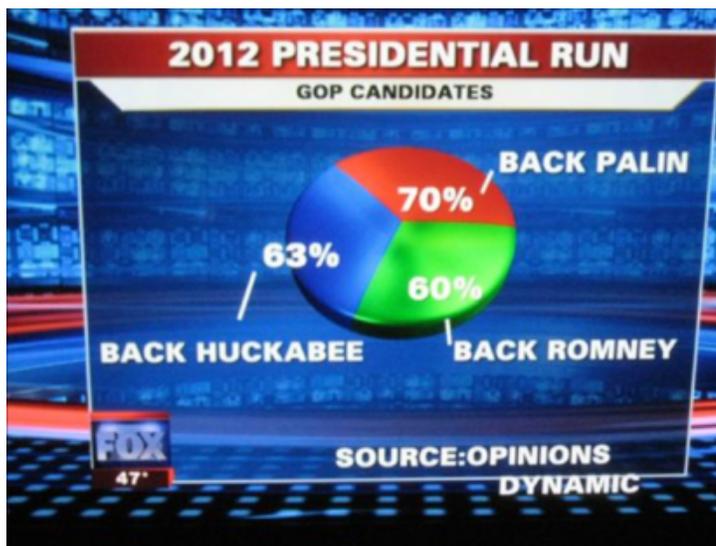


Source: FL Dept. of Law Enforcement

altering norms like colors or order drastically alters perception as well. To avoid this, stick with convention.

5. Too much pie

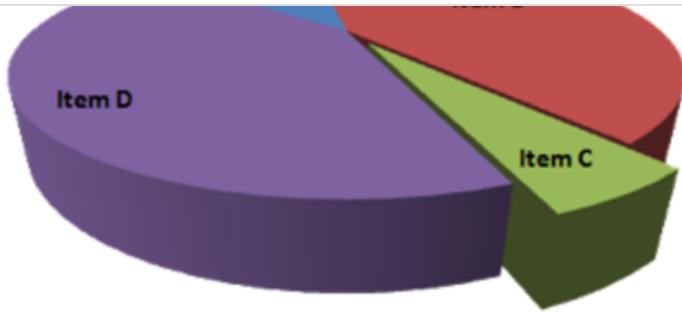
With pie charts, the sum of each slice must add up to the whole. When the numbers don't add up, you know there's an issue – whether it be sloppy mathematics or an intentional misrepresentation.



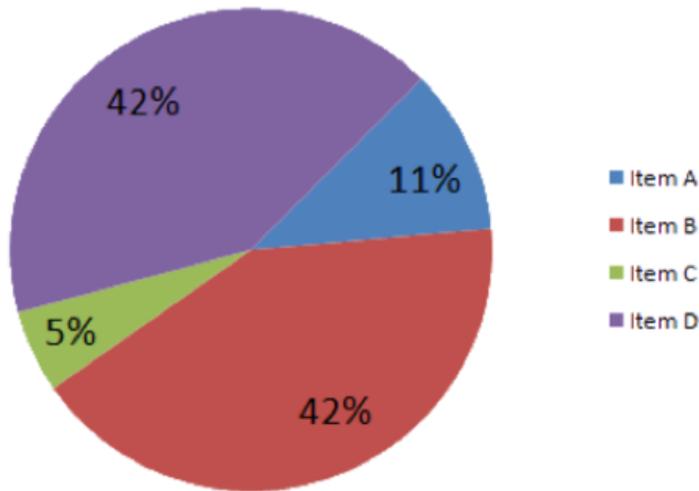
Source: Fox News

A pie chart should always add up to 100 percent, so always check your math.

Furthermore, while 3D pie charts may look appealing, they do little to help convey accurate information and, more often than not, can cause a misinterpretation of the data. As Edward Tufte [notes in Chartjunk](#), designers often get caught up in the design element of 3D charts, prioritizing design and technology over the readability of the chart. Returning to the simplicity of a 2D pie chart may be in the best interest of both the reader and the data.

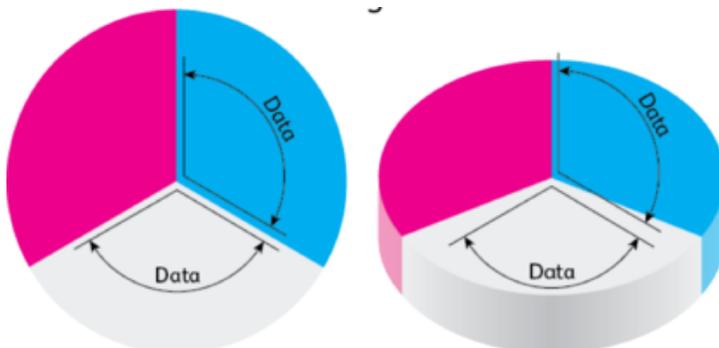


Source: Sanket Shah



Source: Sanket Shah

The following example further illustrates the distortion of angles that often occur in 3D pie charts.



Source: Visually

Thanks to technology, there is a wealth of data at our disposal. By falsely representing that data, we do a disservice to those that would benefit from its

overly complex or inaccurate images. As it turns out, the numbers do not lie, but the visualizations representing them may.

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Sanket Shah is an instructor for the University of Illinois at Chicago Department of Biomedical and Health Information Sciences (BHIS) at the College of Applied Health Sciences. Professor Shah has created a course curriculum focusing on healthcare business intelligence, healthcare data, knowledge management and consumer informatics. Professor Shah brings considerable strategic management and technology innovation experience, and has a wide range of experiences in healthcare information technology on the provider, payer, government and vendor sides of the healthcare business. He has served in positions in management, system design, logical database architecture, product management, consulting and healthcare value measurement for the past 10 years in the healthcare industry.



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