BIOLOGY | PSYCHOLOGY

# Five Ways to Lie with Charts

*Want to spin your data? Here's how.*

BY BECCA CUDMORE
ILLUSTRATION BY JENNIFER DANIEL
NOVEMBER 6, 2014



A chart's purpose is usually to help you properly interpret data. But sometimes, it does just the opposite. In the right (or wrong) hands, bar graphs and pie charts can become powerful agents of deception, tricking you into inferring trends that don't exist, mistaking less for more, and missing alarming facts. The best measure of a chart's honesty is the amount of time it takes to interpret it, says Massachusetts Institute of Technology perceptual scientist Ruth Rosenholtz: "A bad chart requires more cognitive processes and more reasoning about what you've seen."

It helps to know the kinds of tricks that charts can try to pull. Here are five.

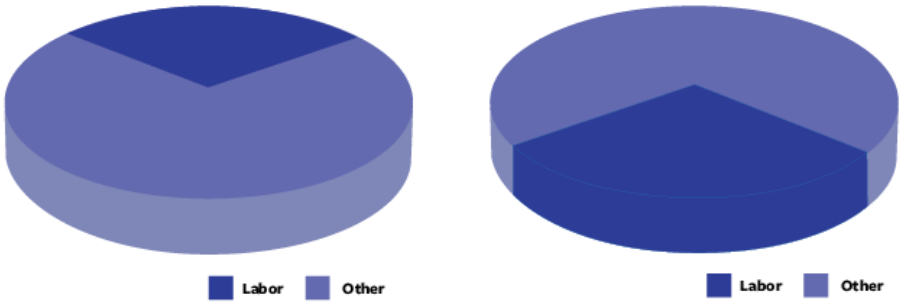
## Puzzling Perspective

ALSO IN PSYCHOLOGY

## The Man Who Played with Absolute Power

By Matthew Sedacca

In his 2008 TED Talk, Philip Zimbardo introduced his subject by showing his audience M.C. Escher's Circle Limit IV, a set of black and white tessellated angels and demons. The art, Zimbardo explained, reminds us that "good and evil are...**READ MORE**

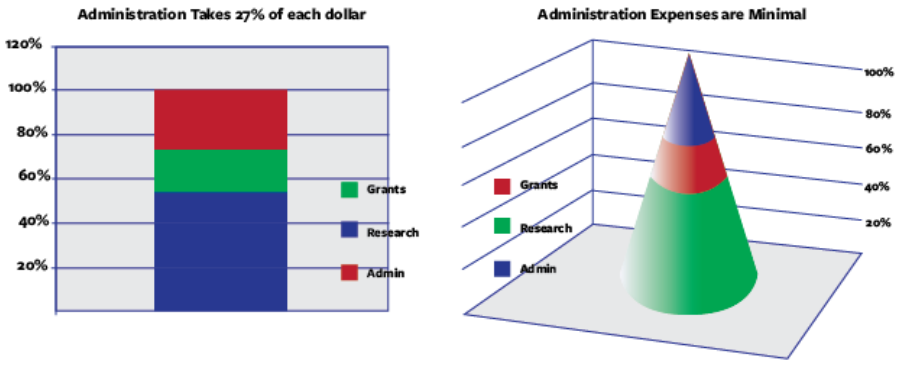



Data from http://www.mrexcel.com/tip142.shtml

Both of these pie charts show "labor" taking up 30 percent of some total. But you probably noticed that the chart on the right makes the labor slice look a lot bigger by positioning it in the foreground, which gives it a thick 3D edge and more than double the number of dark blue pixels than when it's in the background.

Human vision isn't very good at interpreting the third dimension, says Rosenholtz. When confronted with a 3D chart, we assume that more color indicates a greater amount. So when more pixels are used to represent one slice of a pie chart, the slice appears more significant, Rosenholtz says. That's why we can assign a greater value to foreground slices in 3D pie charts.

**Swindling Shapes**

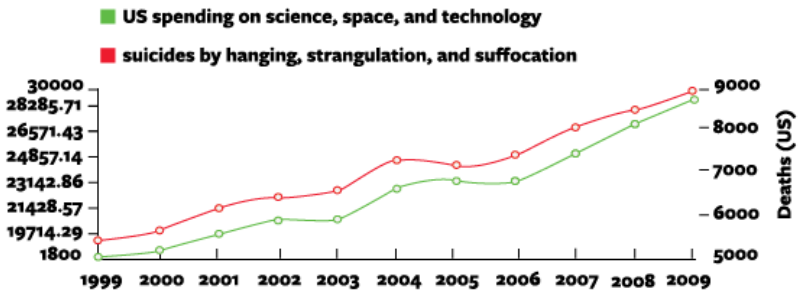



Data from http://www.mrexcel.com/tip142.shtml

A classic way to lie with a chart is to introduce irrelevant information. In the chart on the right, the only relevant property is cone height. But, while the cone volume is irrelevant, it is also very difficult to ignore, encouraging us to assign a greater value to the larger part of the cone.

In both charts, administrative costs take almost a third of each dollar. While this matches reasonably with the left chart, the right chart seems to shrink administrative costs to something much less than a third. “Anytime you ask anyone to judge just height and ignore the other measurements,” says Rosenholtz, “it’s going to take extra cognitive load to disregard these other cues.”

**Trendsetters Are Tricksters**

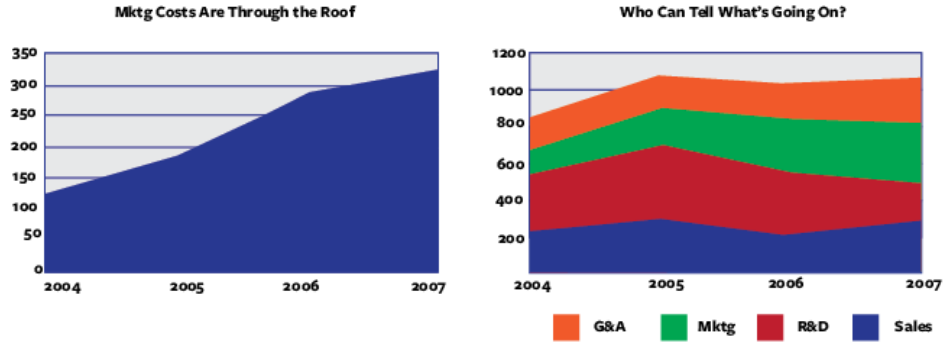



Data from http://tylervigen.com/

When two or more lines appear together in a chart, and they look similar to each other, we have the tendency to assume they are related. The red line in this chart represents suicide rates while the green line represents spending on science and technology—two completely independent sets of data. But on first glance, we tend to ask ourselves whether there could, in fact, be a causal correlation (if you can think of one, tell us in the comments section below).

We like trends because they tell a story that make data more meaningful, Rosenholtz says—that's why we're always on the lookout for connections, even when they don't exist.

### Hiding in Plain Sight




Data from Jones, G.E. How To Lie With Charts BookSurge Publishing, Charleston, SC (2006).

We're pretty good at noticing trends. But what if there's one that someone doesn't want us to see? The left chart clearly shows that marketing costs have tripled over three years. This same fact is there in the right chart, but it's hidden among a host of other data, softening the impact of the sharp incline in marketing costs, and making that incline nearly impossible to quantify.

"Comparing the change in height between data sets while they also move up and down is not a natural visual task for us," says Rosenholtz. "It's not clear to me whether I'm supposed to be looking at the overall height or the width or what. Any kind of comparison like that is more cognitive and less effortlessly visual."

### Honey, I Shrunk the Scale!

Data from Jones, G.E. How To Lie With Charts BookSurge Publishing, Charleston, SC (2006).

At first glance these two charts seem to depict two different data sets. But home in and you'll see that the only difference is scale.

This trick works because it's difficult for us to examine a chart's scale and data at the same time, says Rosenholtz. Instead, we often get the gist of the curve first, then (if we decide we need to) look at the scale. By that point, though, our first impression has already been made.

As devotion decreased, so do prayers. Thus, the decline of overall prayers in the world correlates with the increased number of earthquakes and other natural disasters !

So has Pastafarianism been born : the decreased number of pirates in the world indicates a rise in global average temperature (https://en.wikipedia.org/wi...

1 ^ | v • Reply • Share ›

**Kala** ➚ kevin • 4 years ago

actually kindda makes sense...

^ | v • Reply • Share ›

**Grant** • 5 years ago

The more spent on science and tech, the more blue-collar jobs get replaced with automation, causing an increase in unemployment, leading to suicide in the less-educated population who cannot find new employment in the tech world.

24 ^ | v • Reply • Share ›

**ZuilSerip** ➚ Grant • 5 years ago

Interesting hypothesis, but it would certainly not have an immediate effect. An increase in the money spent on R&D would not have a negative impact on blue-collar for many years (if ever).

8 ^ | v • Reply • Share ›

**grant? really?** ➚ Grant • 5 years ago

Congratulations on your logical leap and batshit insanity.

2 ^ | v • Reply • Share ›

**Tracy Barnes** ➚ Grant • 5 years ago

"The more spent on science and tech, the more blue-collar jobs get replaced with automation"

How about: The more spent on science and tech, the more white-collar jobs get replaced with automation.

^ | v • Reply • Share ›

**Lex Wattz** ➚ Grant • 5 years ago • edited

Good! Educate yourself beyond putting round peg in round hole.

^ | v • Reply • Share ›

**Robin** • 5 years ago • edited

LOL. not a single comment about lying with charts. Give the Internet any puzzle to solve and off they go.. :))
Great article. These are some useful tips for when presenting to the management team! ;)

13 ^ | v • Reply • Share ›

**corin** • 5 years ago

I can think of a *correlation*: the one clearly visible in the plot. But what I believe there isn't is *causality*. Please use the right terms.
Apart from that: all true and very important.

13 ^ | v • Reply • Share ›

**Aaron J. Angel** ➚ corin • 5 years ago

Exactly! Correlation is precisely the phenomenon being described, there. Causality is what is lacking. A fairly trivial mistake in word-choice, it leads to complete nonsense.

6 ^ | v • Reply • Share ›

**constantine** ➚ corin • 5 years ago

The article says CAUSAL correlation.... (but maybe they fixed it later)

2 ^ | v • Reply • Share ›

**Kneejerker** • 5 years ago

As more scientists receive funding, they are increasingly able to afford to assassinate their enemies. Eventually, faced with the overwhelming weight of their guilt, some commit suicide. Pretty obvious.

7 ^ | v • Reply • Share ›

**Stephen Richard Watson** ➚ Kneejerker • 5 years ago

Plus, they make the assassinations look like suicides.

5 ^ | v • Reply • Share ›

**J** • 5 years ago

Swindling Shapes - your approximation of 27% to a third (33.3%) rather than a quarter (25%) is the biggest swindle!

6 ^ | v • Reply • Share ›

**Daniel Schegh** • 5 years ago

Here are few potential causation mechanisms for the correlation:

1. An increase in suicides cause an increase in spending on research into the psychology of suicide, on research into pharmaceuticals to address it, and technology monitor, address, and support people at risk.

2. When an economy gets worse there are job losses and people tend to commit suicide more, but to address the economy getting worse we tend to invest more in research and science as both a spending stimulus to re-start the economy, because it is cheaper (when there is higher demand for jobs), and because such investment tends to pay off well, thus improving the economy,

3. Both indicators are in absolute terms so simply follow changes in population size. In terms of per capita, perhaps both are relatively constant. (Also note the typo of '1800' on the left vertical axis which I believe is supposed to be '18,000'.)

4 ^ | v • Reply • Share ›

**I'm smarter than you** ➚ Daniel Schegh • 5 years ago

Its good to have hypotheses, but you cannot say that there is a causation when observing correlational data. You are listing possible external variables, mediator variables, or moderator variables.

3 ^ | v • Reply • Share ›

**Panoptes** • 5 years ago

Well this is easy to explain, of course. As science research funding increases, more funds become available for the all important research into effective suicide methods. You can get university undergrads to do just about anything with the promise of pizza and beer!

1 ^ | v • Reply • Share ›

**Todd Chamberlain** • 5 years ago • edited

The more money spent on space, science, and technology, the more advancements are made in the field of robotics. These advanced robots then go do what advanced robots always do; they murder people by hanging them, strangling them, and suffocating them. It's pretty obvious.

1 ^ | v • Reply • Share ›

**Edward Krug** • 8 months ago

If you look at the time scale, you see that suicide rate and science funding rise and fall almost together, year by year. Which line leads the rise or fall is also not consistent. Collectively these suggest that which is cause and which is effect is not consistent.

This graph is intended to imply association. My contention is that they are both the effect of a cause not displayed on the graph. The single dip and rise event between 2003 and 2005 makes me think that there was an external event underlying both funding and suicide.

I suspect that funding for science is the place to start and that increased funding for science is based on politics and a stronger economy.

Wikipedia describes an association between a tough economy economy and increased suicides. A tough economy is one where you are left out.

Missing in the legend is if this increased spending is just government or industry spending, or both. The answer to this question might lead to insights on who's spending is being displayed. In either case, a stronger economy is my conjecture.

The very selective types of suicides catches my attention. A quick web search revealed that firearms account for about 51% of suicides. Suffocation is 27.7% and overdose is 13.9%. This raises the question of which demographic chooses suffocation for suicide?

I suspect cherry picking the data to get a best curve match was done.
Here is the data source https://afsp.org/about-suic...

Have fun,
Ed

^ | v • Reply • Share ›

**Prompt Critical** • 8 months ago

"But on first glance, we tend to ask ourselves whether there could, in fact, be a causal correlation..."

Well, I think that there obviously is some causal connection. Probably both are linked to something else. Or to two other factors that are themselves both linked to a more remote common cause.

^ | v • Reply • Share ›

**Tutor Sentih** • 8 months ago • edited

Beautiful article. I tutor statistics and data analysis at www.GraduateTutor.com and this will be a great exhibit to charting! Lies, More lies

and statistics :)

Reply • Share ›

**disqusisbad** • 3 years ago

Time is passing. Time passing causes the increasing trends in money spent on tech and suicides to both continue.

Next time detrend before even saying the word 'correlation', lest you be an idiot like Tyler Vigen.

Reply • Share ›

**Martin Cohen** • 4 years ago • edited

Seems very similar to Huff's 1954 classic "how to lie with statistics".

Reply • Share ›

**Mike Ciaraldi** ➚ Martin Cohen • a year ago

I recommend Tufte's _The Visual Display of Quantitative Information_ for a very thorough look at how to use and mis-use charts.

Reply • Share ›

**399dkLWK2C4f** • 5 years ago

For a real world example, see: http://www.businessinsider....

Reply • Share ›

**David** • 5 years ago

"There are three kinds of lies: lies, damned lies, and statistics." - Benjamin Disraeli
"Lies, Damn Lies, and Infographics" - Mark Bennet

Reply • Share ›

**JokingKoala** • 5 years ago

The more money spent on Space, science and technology the more people waste that money, thus causing smart people to kill themselves because they live in a world of resource wasting baboons.

Reply • Share ›

**jamie** • 5 years ago

Tech advancements in medicine, safety, and warfare have reduced the rate of death due to illness, accident, and war. The only thing left is suicide. I think there was a movie about that.

Reply • Share ›

**Davidas** • 5 years ago

Excellent article, BTW! :)

Reply • Share ›

**Davidas** • 5 years ago

Easy money. A correlation can be seen in the similar masses of the negative (white) spaces above the trend lines. The more money spent on science, space & technology means that there are more fledging scientists in the job market than there are high level jobs in science & technology to go around, increasing the levels of depression in the science community, driving more out of work scientists to commit suicide (Heaven forfend) using non-invasive means.

Reply • Share ›

**fogbound** • 5 years ago

The only similarity between the two are a increased population. The percentage of suicides remains the same, just a increase in population makes the overall number higher. The same is relative to the increase in spending on education in the sciences.

Reply • Share ›

**Not Saying** • 5 years ago

Both suicides and science spending tend to increase in line with population growth.
Change both graph lines to per-capita measures and I suspect the correlation would go away.

Reply • Share ›

**Nobody cares about correlation** • 5 years ago

Correlation between science spending and suicides is evident and is meaningless. Would be fun to include total season wins for the Red Sox, it would follow the same pattern.

Reply • Share ›

**Qq** • 5 years ago

They are probably correlated to population size and therefore would be correlated to each other

They are probably correlated to population size and therefore would be correlated to each other.

Reply • Share ›

**TJ Markey** • 5 years ago

The increased spending on science and technology caused more prescription drugs to be put on the market. Addiction leads to depression, leading to suicide. Also astronauts get lonely

Reply • Share ›

**Trevor** • 5 years ago

Brilliant article! I'm going to use these tips in the future. </evil>

Reply • Share ›

**Aaron J. Angel** • 5 years ago

Correlation isn't lying, it's the truth. Those two lines correlate pretty well at that scale. You aren't lying, unless you indicate unsubstantiated causality.

Changing the scale isn't lying, either, unless it is done to misrepresent the data. The scale should be appropriate for the data. In the last example, orders per person, the first scale may be more appropriate if there aren't that many salespersons and, thus, not that many orders. If, on the other hand, there are a lot of salespersons and, thus, a lot more orders, perhaps the second scale is more appropriate. Or perhaps a different chart is appropriate. An average of 3 and 3 is 3, as is an average of 1 and 5; but in the latter case, someone is getting overloaded.

The second charts in the first and third examples, however, do seem poorly designed. But perhaps I am inappropriately making an assumption about the intent. It is not difficult to see in the third example that marketing costs have tripled in either chart. Interestingly, here again the most significant variable is scale. It is interesting to note that R&D is down while marketing is up. Perhaps the first chart is leaving out the fact that marketing costs have increased as a result of product development coming to completion. Now who's lying?

Reply • Share ›

**WVMikeP** ➚ Aaron J. Angel • 3 years ago

They are lying. Whether you intend to or not, you're telling a story with your charts. They're conveying meaning to the viewer. If they're conveying the wrong message or implying the wrong thing, especially when that message or implication is incorrect, it's a lie.

1 Reply • Share ›

**Josh.0** • 5 years ago

Looking from the other side, less people sucking off the mental health industry frees up those funds to go into science and technology funding.

Reply • Share ›

**CdeS** • 5 years ago

The increase in technology spending and thus technology enhancements allows a user to be absorbed into technology that much more increasing the risk of anti-social behavior and then depression.

Reply • Share ›



NEXT ARTICLE:

BIOLOGY

Ingenious: Christof Koch

*By Kevin Berger*

RELATED ARTICLES:

CULTURE

One Percenters Control Online Reviews

*By Josephine Wolff*

CULTURE

Why We Keep Playing the Lottery

*By Adam Piore*

IDEAS

Why We Can't Rule Out Bigfoot

*By Carl Zimmer*

ABOUT
CONTACT / WORK WITH US
FAQ
PRIME
SUBSCRIBE
AWARDS AND PRESS
DONATE
MEDIA KIT
RSS
TERMS OF SERVICES

NAUTILUS: SCIENCE CONNECTED

Nautilus is a different kind of science magazine. We deliver big-picture science by reporting on a single monthly topic from multiple perspectives. Read a new chapter in the story every Thursday.