Deceptive data and charts that cheat

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Required Annotations		Student-Created Annotations		Summary / Questions / Reflection	

Student-created	Required (bold)

Scroll through social media, glance at an ad, watch the news, or pay attention to politics. You'll see graphs, charts and other data **visualizations** everywhere. Data visualizations, graphs, and charts are pictures representing data or numbers. On the one hand, graphs can inform, explain, and enlighten, especially when they're well-designed. On the other hand, they can misinform or mislead you. Fortunately, you can learn to spot tricks by becoming a data decoder.

The Case of the Cut-off Axis

When Stephanie Evergreen sorted through her junk mail one day, a postcard from an energy company caught her eye. "I'll never forget it," says Evergreen, a data visualization expert and author. "They had included this bar graph of how much money a person would save by switching to this new energy company." In the graph, the bar for one company (company A) was very tall. It looked like Evergreen could save a ton of money by switching. In comparison, the bar for another company (company B) was tiny. Evergreen didn't get her power from either A or B. When she looked at the actual numbers, it showed company A would save her $3.05 a month. Company B would save her three dollars a month, only a nickel less than company A! Why did the graph look like company A would save her so much money?

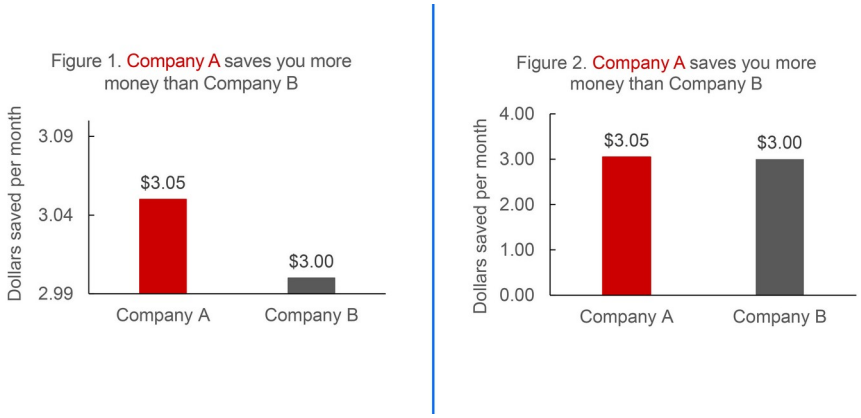

Image 2. (Left) Figure 1 is a bar graph where the vertical axis starts at $2.99. (Right) Figure 2 shows the same data as Figure 1, but the vertical axis starts at zero. Photo: Cricket Media

Look at a recreation of the bar graph on Evergreen's postcard in Figure 1 to see if you can figure it out. Need a hint? What do you notice about its vertical axis? The bottom part is cut off so the axis starts at $2.99 instead of zero! Figure 2 shows the same data, but when the axis starts at zero, the bars don't look so different. Humans detect differences in length really well. Since bar graphs use length to display data, it's essential that the vertical axis starts at zero. When the bars show their full length, our eyes can accurately **assess** any differences.

The Case of the Unnecessary Zero Baseline

You may have heard of something called climate change, the idea that Earth's average temperatures are rapidly increasing. What if someone wanted to make it look like climate change wasn't real? That person might make a graph like Figure 3.

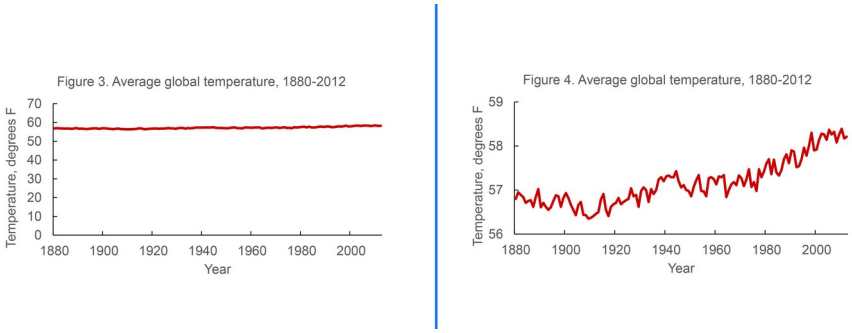

Image 3. (Left) Figure 3 shows average global temperature from 1880 until 2012. (Right) Figure 4 shows the same data, but the vertical axis starts at 56 degrees Fahrenheit. Photo: Cricket Media

Figure 3 shows Earth's average yearly temperature from 1881 to 2012 using real data from NASA. The line looks pretty flat, right? Anyone glancing at this graph might conclude that Earth isn't warming at all.

If you take a look at the vertical axis, though, you'll notice that it starts at zero. That's good, right? Well, not always. It can be OK to zoom in on the vertical axis for line graphs showing data over time.

Figure 4 shows the same data as Figure 3, but zoomed in. It doesn't include a zero baseline for two reasons. First, because zero degrees isn't in the range of average global temperatures. Even during ice age extremes, global temperatures were just a bit cooler than now and not even close to zero. Second, Figure 4 allows the reader to see small changes in temperature over time. Many scientists agree that increases of 2 to 4°C could result in **catastrophic** changes for Earth. Changes like rising sea levels, melting ice, and epic floods, storms, and droughts.

Figure 4 shows a more relevant picture of global warming. By zooming in on the vertical axis, it features a range of reasonable temperatures and highlights small changes in temperature that could **translate** to big changes in real life.

The Case of the Irregular Spacing

Line graphs may not need a base-line that starts at zero, but they can be deceptive in other ways. What if your teacher says he'll throw a pizza party if your whole class reads at least 10,000 minutes a month for the whole school year? Great, you think, that's only about 11 minutes per person per day. You and your classmates fill out reading logs, and the teacher charts the class's progress for everyone to see. But what if your teacher is messing with you? What if he knows how to make the data lie so you'll never earn that pizza?

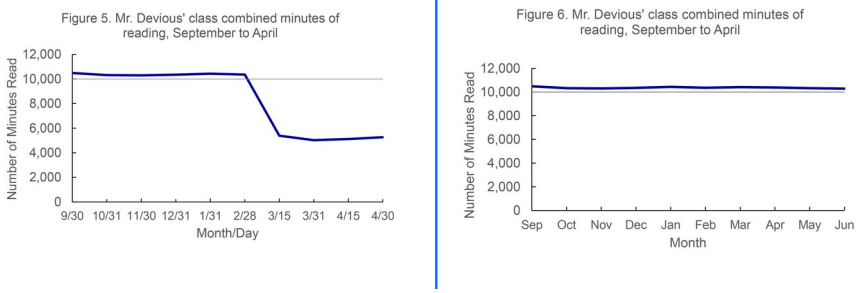

Image 4. (Left) Figure 5 shows how many minutes student spend reading from September to April. (Right) Figure 6 shows how many minutes students read from September to June. Photo: Cricket Media

Figure 5 shows your teacher's chart. When March rolls around it looks like the number of minutes suddenly drops below 10,000. But take a closer look at the horizontal axis. From September to February, the tick marks are placed monthly. Then, in March and April, there are two tick marks each month! One is on the 15th and the other is on the last day of the month. If you add up the total number of minutes read for March, you get 10,409. (That's 5,386 for the first half plus 5,023 for the second half.) More than 10,000 minutes! By changing the interval (the spacing between the data points), your devious teacher made it look like the class dropped below the 10,000-minute mark. Luckily, you and some other data detectives in class create a corrected version of the graph, like Figure 6. Your version has consistent spacing along the horizontal axis, and it has more than 10,000 minutes for every month. Who wants **pepperoni**?

The Case of the Missing Information

Some misleading graphs alter the scale of the horizontal or vertical axis. Other graphs leave out important information altogether.

Take a look at Figure 7, which uses real data from a survey of American youth. It shows the percent of 12th-graders who said they "often feel left out of things" the year before and the year of the release of the first iPhone. There's a pretty big drop in loneliness, from 30.5 percent to 24.5 percent. Someone might use this information to persuade others that iPhones reduce loneliness.

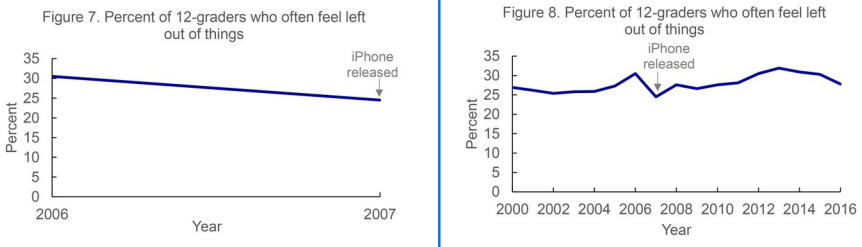

Image 5. (Left) Figure 7 showing how many 12-grade students feel left out between 2006 and 2007. (Right) Figure 8 showing how many 12-grade student feel left out between 2000 and 2016. Photo: Cricket Media

What if you saw a different version of the graph, like Figure 8? It shows more data over time. You still see a drop in loneliness from 2006 to 2007. But you also

see that feelings of loneliness were lower before 2006 and the release of the first iPhone. After 2007, you see that feelings of loneliness rose again. At the same time, smartphones became more popular. Are you still convinced that iPhones reduce loneliness? Some researchers think smart-phones have actually increased these feelings over time.

When graph designers show only certain pieces of data, it's called cherry picking. When you pick actual cherries in an orchard, you pluck only the best-looking fruit that's tastiest! Cherry picking data works the same way. Graph-makers may pick and choose only the most enticing bits of data to support the story they want to tell.

How can you spot cherry picking? You can't always. "A chart shows only what it shows and nothing else," says Alberto Cairo, professor of data visualization at the University of Miami. You may need to dig deeper.

Practice Makes Perfect

Graphs may show cut-off axes or unnecessary zero baselines. They may have irregular spacing or cherry-picked data. Your best bet at exposing them is to ask questions. Does the graph make sense? Where did the data come from? Is it a reliable source? Are the data telling the whole story? As Cairo says, you want to "develop some sort of sixth sense that says, 'Hmm, what's going on here? ' And you only develop that through practice." In no time, you'll be sleuthing the truth behind misleading graphs.

1. Which sentence from the article shows the MAIN problem with using the graph in Figure 3?
   a) You may have heard of something called climate change, the idea that Earth's average temperatures are rapidly increasing.
   b) Figure 3 shows Earth's average yearly temperature from 1881 to 2012 using real data from NASA.
   c) Anyone glancing at this graph might conclude that Earth isn't warming at all.
   d) Many scientists agree that increases of 2 to 4 degrees Celsius could result in catastrophic changes for Earth.
2. Which sentence from the article shows how the problem with Figure 6 was corrected?
   a) You and your classmates fill out reading logs, and the teacher charts the class's progress for everyone to see.
   b) Line graphs may not need a base-line that starts at zero, but they can be deceptive in other ways.
   c) By changing the interval (the spacing between the data points), your devious teacher made it look like the class dropped below the 10,000-minute mark.
   d) Your version has consistent spacing along the horizontal axis, and it has more than 10,000 minutes for every month.
3. Read the following paragraph from the section "Practice Makes Perfect."
   Graphs may show cut-off axes or unnecessary zero baselines. They may have irregular spacing or cherry-picked data. Your best bet at exposing them is to ask questions. Does the graph make sense? Where did the data come from? Is it a reliable source? Are the data telling the whole story? As Cairo says, you want to "develop some sort of sixth sense that says, 'Hmm, what's going on here? ' And you only develop that through practice." In no time, you'll be sleuthing the truth behind misleading graphs.
   How does this paragraph contribute to the development of the main ideas of the article?
   a) It shows that it is a common practice for graphs to have unnecessary zero baselines.
   b) It shows that it is difficult to find a graph with cut-off axes even with lots of practice.
   c) It highlights examples of graphs that have irregular spacing or cherry-picked data.
   d) It highlights some questions that can help people become better at decoding data.
4. How does the Introduction [paragraph 1] relate to the section "The Case of the Cut-off Axis"?
   a) The second section introduces the idea that graphs can be deceptive, which was not in the introduction.
   b) The second section supports the idea from the introduction that graphs can be intentionally misleading.
   c) The second section contradicts the idea that graphs are helpful, which is stated in the introduction.
   d) The second section further explains the idea from the introduction that graphs can be informative.