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Slow Reveal Graphs

by Chris Hunter

Graphs convey information at a glance. They tell stories to the people who see them. Reading graphs means so much more than capturing single data points Individual pieces of information alone don't tell a compelling story. Like reading text, reading graphs means analyzing and interpreting, inferring and predicting. Graphs ask us to examine the messages that they convey to us as readers and the messages that were intended by those who made them (i.e., to look for misleading graphs and to think about bias). Slow Reveal Graphs, the critical thinking routine described below, can help students become more media literate.

In this article, I'll invite you to take on two different roles. First, like the students in your classroom, I'll encourage you to look closely at a graph that I'll share. Second, I'll ask you to think about the activity from the perspective of a teacher.

Look at the graph below (Figure 1). What do you notice?

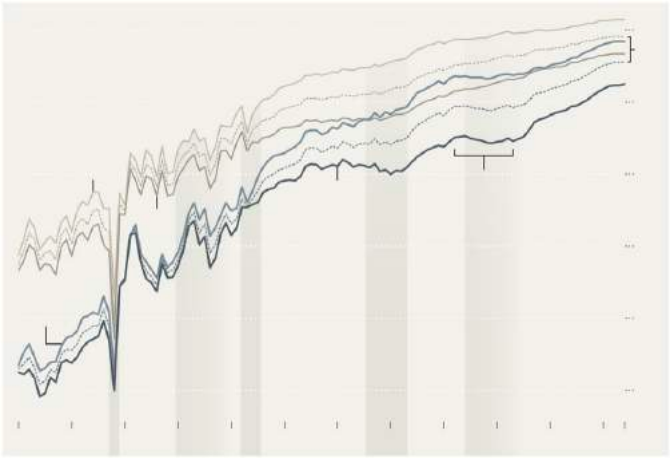

Figure 1

You may have noticed that this graph does not have labels, axes, or scales. And yet, despite the complete lack of context, there are several mathematically interesting features of this graph. Take a moment to think about some of the things you find mathematically interesting before you read my list below:

- there are six line graphs
- the six line graphs are made up of two sets of three
- both sets of three are made up of two solid lines and one dotted line
- each dotted line is between two solid lines
- there's an overall upward trend
- sometimes one line is decreasing while the others are increasing
- there are valleys—especially one dramatic drop
- two of the lines intersect at some point
- the data is volatile to the left, steady to the right
- there are vertical grey bands with varying widths

All of these observations—and maybe more—without knowing what the graph is about! By leaving out pertinent information, I've potentially created some curiosity. For example, you might be wondering:

- What do the different lines represent?
- What does the vertical axis represent?
- Is a comparison being made over time?
- What's causing the overall upward trend?
- What's causing the peaks and valleys?

You might be feeling a need to have your questions answered. Now that you're hooked, I can gradually provide you with more information (Figure 2).

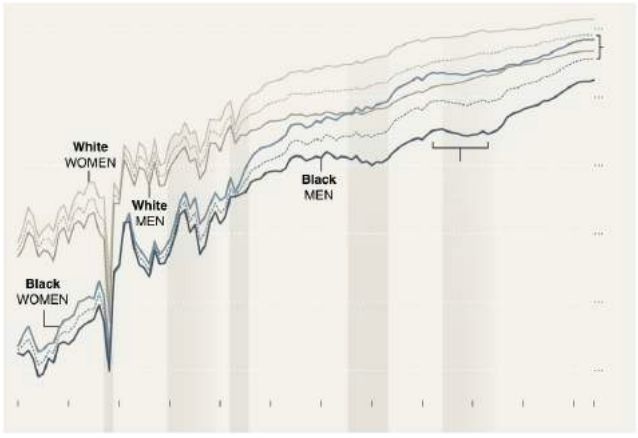

Figure 2

How does this new information change your thinking? The dotted lines can now be explained as black and white populations, graphical representations of the average of women and men. But what is being measured across these groups? Again, I can slowly reveal more information:

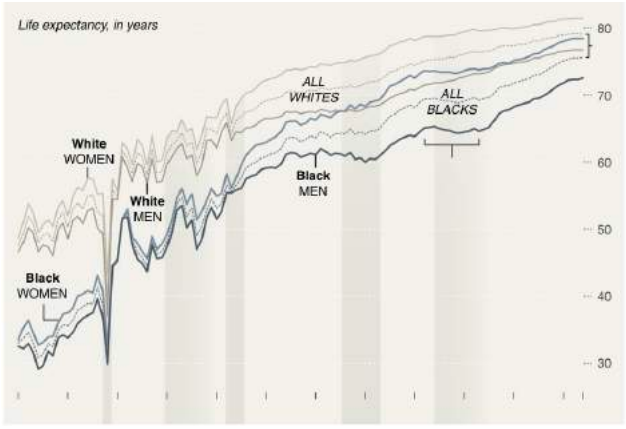

Figure 3

Did you anticipate that the topic is life expectancy? Did you consider—and then reject through reasoning—alternative topics?

You might suspect that life expectancy is being graphed over time and have some hunches about the grey bands as important moments in history. I can reveal the dates and events, in turn. Are your hunches confirmed in Figure 4 below?

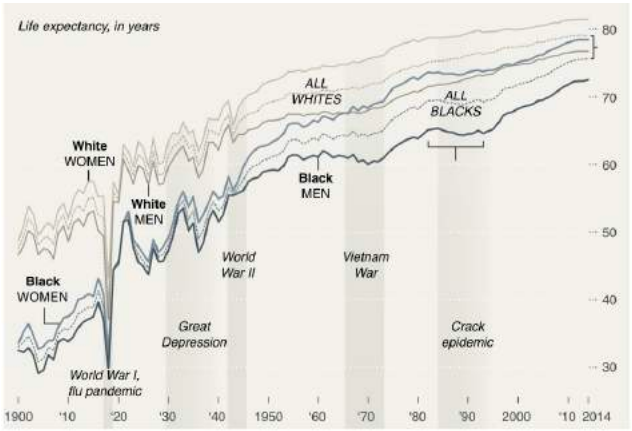

Figure 4

How does this information change your thinking? What do your initial mathematical noticings mean *in context*? For example, the "one dramatic drop" in life expectancy was a result of the 1918 influenza pandemic; the intersection of two lines as the life expectancy for black women surpassing that for white men in 1965. Finally, I can share the complete graph, as it appeared in *The New York Times* (Figure 5).

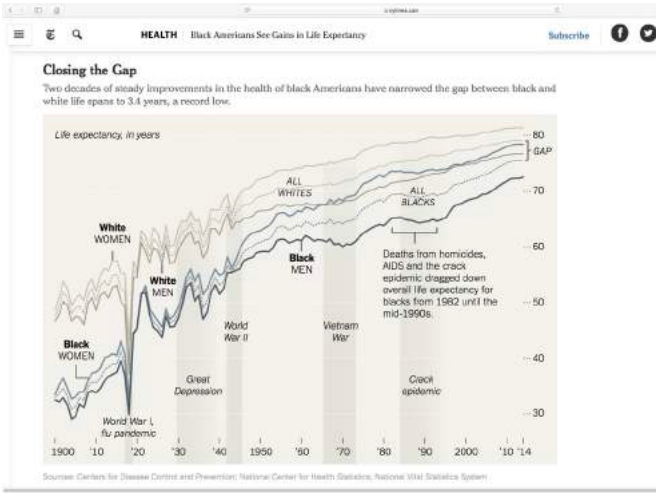

Figure 5

The text in *The Times* graph draws your attention to 1982 until the mid-90s, at which time the life expectancy for black Americans decreased due to the crack epidemic. During the Vietnam War, life expectancy decreased for black men whereas it increased for white men. This raises questions about racism and discrimination within the American military: Were African-Americans disproportionately drafted? Were black soldiers more likely to be assigned to combat units? How were rising racial tensions back home reflected in the ranks and on the battlefield in Vietnam? Mathematics can shed light upon these questions. Despite making up about 11% of the civilian population, African-Americans accounted for nearly 25% of all combat deaths in 1965; represented 16.3% of draftees and 23% of combat troops in 1967; made up 2% of the officer corps; and received 34.3% of courts-martial (https://www.nytimes.com/2017/07/18/opinion/racism-vietnam-war.htm).

What story do you think the graph in Figure 5 is telling? Do you agree with *The Times*' statement that "[t]wo decades of steady improvements in the health of black Americans have narrowed the gap between black and white life spans"? If not, can you write a different subhead that captures the graph's main idea?

What's the story since 2014? How did the opioid crisis affect life expectancies for blacks and whites? How about for women and men? What will this life expectancy graph look like in the future?

What new observations and questions do you have?

Above, I attempted to engage you in a learning experience similar to that of the mathematics classroom. With respect to content learning standards, I suggest this graph best fits functions and

relations in Foundations of Mathematics and Pre-calculus 10 or graphs in society in Workplace Mathematics 11; slope and rate of change also come into play. Just as importantly, you were engaged in curricular competencies—the doing of mathematics. You noticed and wondered; you analyzed and interpreted; you reasoned to draw conclusions and make predictions.

The activity above mimics an instructional routine that helps students across all grades make sense of data—Slow Reveal Graphs. In this routine, the teacher gradually reveals more and more of a graph, each time asking students to discuss how this new information changes their thinking. It compliments other instructional routines that may already be part of your classroom—Quick Images, Number Talks, Clothesline Math, Which One Doesn't Belong?, etc. Like these, Slow Reveal Graphs support students and teachers; for both, predictability means paying less attention to lesson logistics and more attention to student thinking.

Jenna Laib, a math coach in Massachusetts, created a website (slowrevealgraphs.com) to help teachers effectively implement this routine. Jenna shares several sequence Slow Reveal slide decks on her site. I will share with you one that she created: a circle graph from *Animals by the Numbers: A Book of Infographics* by Steve Jenkins.

First, display the "stripped" graph (Figure 6).

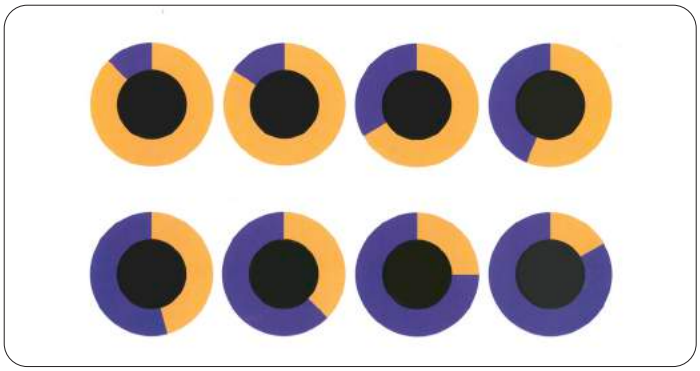

Figure 6

Ask your students, "What do you notice?" and record their observations. I prefer to project on the whiteboard so that I can mark up the graph as necessary. Possible observations:

- there are eight circle graphs
- each circle graph is made up two colours, yellow and purple
- some graphs are more yellow than purple, others more purple than yellow
- from top to bottom and left to right the amount of purple is increasing
- the graphs in the top row are less than one-half purple

Ask "What do you wonder?" and record students' questions. Possible questions:

- Why eight graphs?
- What do the colours represent?
- What is the topic of this set of graphs?
- Is something hidden behind the black circles?

Display a bit more of the graph (Figure 7) and ask "What new information do we have? How does this change our thinking?"

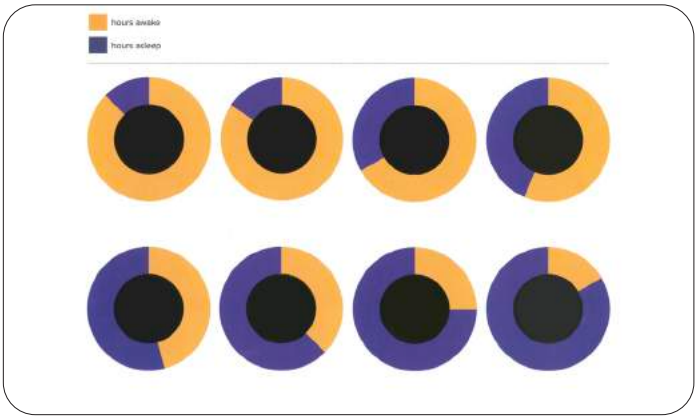

Figure 7

Given the two quantities—hours awake and hours asleep—a safe assumption is that a whole circle represents twenty-four hours. Display the hours asleep—8 hours—for the third circle in the top row (Figure 8). This single data point confirms this assumption; students see 8 hours as equivalent to the picture of one-third. This sets up a lovely estimation task: estimate the hours asleep for the remaining seven circles.

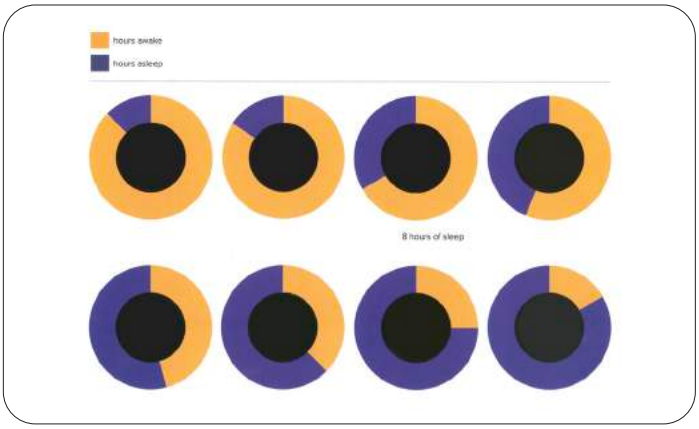

Figure 8

Of particular interest are the third and fourth circles in the bottom row. In the third circle, some students might determine the product of three-quarters and twenty-four. Others might add one-half and one-quarter of twenty-four. In the fourth circle, some students might see yellow as one-sixth and subtract one-sixth of twenty-four from the whole; others might see purple as "a bit more" than three-quarters. Reveal the values for each of the eight circles one at a time (Figure 9).

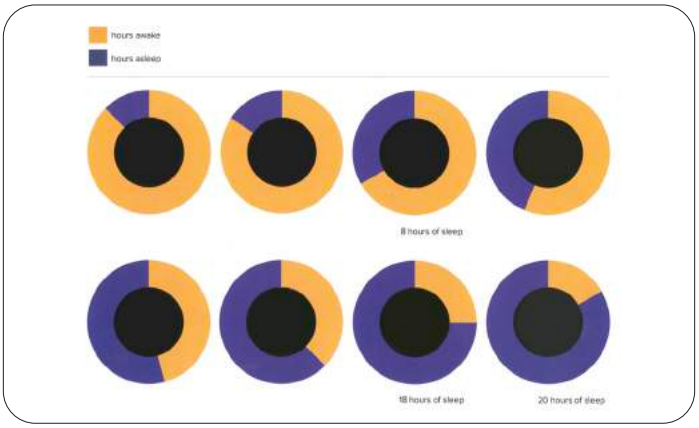

Figure 9

Again, ask "How does this information change our thinking?" Sometimes, I ask "What does this mean for what we've noticed and wondered?" You'll find a question that works for you. Whatever your phrasing, it's important to orient students to revising their thinking. Students will be guessing what the eight circles represent (e.g., "Different ages? Different days?"). Slowly reveal the different animals (Figure 10). Start with human then dog or cat—students will make comparisons to the people and pets in their lives.

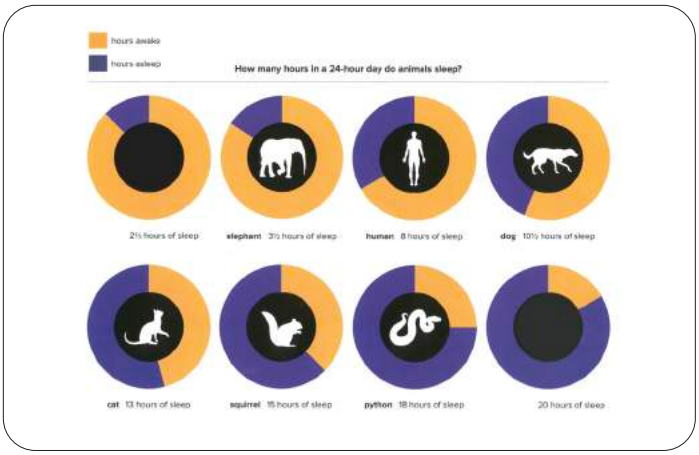

Figure 10

Finally, display and discuss the complete infographic.

This routine playfully compels students to "slow their rolls" and see what they might have overlooked at a glance. Further, through being placed in the position of a reader with a desire for missing labels and scales, students begin to appreciate the reason for attending to these elements when constructing their own graphs to tell their own stories.

As a teacher, this routine empowers me to build upon students' ideas in ways that typical textbook exercises like "What was the life expectancy for black men in 1970?" or "Which animal sleeps for 2½ hours a day?" do not. Each time that I facilitate Slow Reveal Graphs, students surprise me with observations or questions that I did not anticipate. Their engagement affirms my belief that our students are curious, creative, and capable mathematicians.

Resources

Related blog post and complete slide decks for the graphs above: https://reflectionsinthewhy.wordpress.com/2017/09/27/the-new-york-times-whats-going-on-in-this-graph/

The *New York Times*' What's Going On In This Graph? series: https://www.nytimes.com/column/whats-going-on-in-this-graph

Jenna Laib's Slow Reveal Graphs: https://slowrevealgraphs.com/

Kelly Turner's Graph of the Week: https://www.turnersgraphoftheweek.com/

References

Black Americans See Gains in Life Expectancy, https://www.nytimes.com/2016/05/09/health/blacks-see-gains-in-life-expectancy.html