Intro: Hi everyone, it's really great to be here. Before we get started I've put all my slides up at this url, which I can't believe wasn't taken, but if you want to follow along, it's all there.

So, I'm Lena Groeger, I work at ProPublica in NY and this is our team of nerds. We're all developer-designer-journalists, and we make interactives, graphics, big data projects, etc. I've been at ProPublica for a little over 4 years and pretty much learned everything I know about data visualization working with these folks.

But before that, I studied science, particularly all the sciences related to the brain. I've been forever really interested in how the mind works, or how it doesn't work, and now, given what I do every day, I'm even more interested in what all this new stuff we're finding out in neuroscience and psychology and behavioral sciences, what that means and how all that affects how we make and read graphics.

So let's back up a little bit and look at how our brains function in the real world. We tend to think our minds work pretty well. We might be flawed some of the time, but usually we make informed decisions, remember things pretty well, and generally not affected by trivial kinds of things. But actually, that's totally wrong. Our brains fool us all the time. And we typically have no idea that it's happening.

1. Our Mind's Everyday Quirks

So that's what I'm going to talk about today. And I'll start with few examples of the wacky things our minds make us think and do.

What The Judge Ate for Breakfast: In one now famous study of Israeli judges, researchers were trying to figure out what caused a judge to rule favorably or not in a case. This was rulings to grant parole or move a prisoner to a different prison. You might expect maybe their decision would have something to do with how serious the crime was, or how much time had been served already, or how many times this person had gone to jail before. But no. The factor that they found had a HUGE effect on the ruling, was literally how long it had been since the judge had a snack. As you can see in this chart, favorable rulings start close to 65% then drop to almost ZERO, and then spike back up again as soon as the judge has had something to eat.

What WE Ate for Breakfast: I'd like to point out a striking similarity to this other chart. All the Malofiej judges should probably now think very deeply about what this means given our last few days….

We Hate to Wait: So, another example. The Houston airport was getting all these complaints about the LONG time they had to wait to pick up their baggage. The airport was trying to figure out what to do, so they studied the situation. What was happening was, passengers would get off the airplane, then walk about a minute from the gate to the baggage claim, then wait 7 minutes for their bag – so most of there time was standing and waiting.

So the airport decided to change that. They reroute the bags to the other end of the airport, which meant that people were now walking for 7 min and waiting for 1. Can anybody guess what happened next? Complaints dropped to zero.

The Average Investor: So besides being really dependent on lunch time and hating to wait, we're also really bad a predicting the future. Here's the average investor in the stock market. In fact, Fidelity did a study where they looked at all their accounts to see what type of investor did the best. They found that the best investors were the people who either FORGOT they had an account in the first place or were dead!

Another few examples of how wacky our brains are.

The Weight of Authority: In one study, holding heavier clipboards made people perceive issues as more important and more expensive than the people holding lighter clipboards.

The Warmth of Personality: In another study, people holding a hot cup of coffee thought strangers they met were more warm and friendly than the people who were holding a cold glass of iced coffee.

We may just think of them as metaphors, but the association of "weight" with "authority" and "warmth" with "affection" are deeply internalized. One theory by linguist George Lakoff goes that this happens because of repeated experiences we have as children, that sort of drill these connections into our mind. But whatever the reason, it seems that these unconscious metaphors really do drive us to make judgments and decisions based on totally irrelevant factors.

The Whiff that Keeps on Giving: In another study, people were more likely to help strangers after walking past a bakery and smelling freshly baked bread.

A Tasty Sight: A little known fact that eating soup out of a blue bowl makes it saltier. There's actually a whole New Yorker article about the connection between sight, sound and taste that is just amazing.

Frame of Mind: Just the way I say something has a huge effect on what you think about it. It's called framing. Suppose I were your doctor and you needed an operation and I said: "of 100 people who have this operation, 90 are alive after 5 years". Do you want the operation? What if I said "of 100 people who have this operation, 10 are dead after 5 years". Now do you want the operation? The same exact information, framed in two different ways, can drastically alter your decision.

Words of Difference: Small words can even change our memories, in what's called priming. In one study, witnesses were shown scenes from a car crash. Then, some were asked "How fast was the car going when it hit the other car?" Others were asked "How fast was the car going when it **smashed** into the other car?" Those who were asked the "smashed" question reported that the car was going much faster, and some even "remembered" seeing broken glass at the scene, of which there was none.

Bias list: Remember when Alberto yesterday talked about the Sports Illustrated jinx? That fallacy, the "regression to the mean", is just one of a huge numbers of fallacies, biases, effects, illusions and blindspots that rule the inner life of our brain every single day. When you've flipped heads three times and think that tails is somehow "due", that's called the gamblers fallacy. When people vote for the person just because they've heard the name before, that's the salience effect.

2. Visuals Fool Our Minds, Too

These quirks make no sense, but they are real, and very hard to dismiss. And they have very real consequences when they appear in maybe, more serious contexts. So let's take a peek into the world that all of us are in – visuals and the display of information.

Judging a Face: In one study of Florida inmates, it was found that prisoners who's faces seemed less "trustworthy" were more likely to have gotten the death penalty than faces that were rated as more trustworthy. That was true even if the prisoners were later found to be NOT GUILTY. So consider what this means – just what they looked liked could have had a very real affect on whether they were sentenced to live or die.

Swayed by the Brain: People rate evidence as more credible when it's paired with scientific-looking imagery. So, the fact that brain scans are making their way into more and more courtrooms may be of some concern, since neuroscience is still pretty far from being able to say much at all about crime, especially how it relates to a picture of your brain. A study came out just a few days ago that found that judicial opinions referring to neuroscience as evidence doubled between 2005-12.

Bars vs Lines: Now more in line with the graphics and charts that many of us create, my all time favorite study of bar charts. Barbara Tversky at Columbia showed people the same information: average height of men and women. When presented as a bar chart, people got it – men, on average, are taller than women. But when they presented it as a line chart, people said things like ““The more male a person is, the taller he/she is.” I love this! Our intuitions abut how to read lines as trends is SO STRONG, that it leads us to say these totally nonsensical things.

So we have these mind glitches or quirks, that cause us to act in all sorts of crazy ways and lead us to say and do all kinds of crazy things. So what in the world can we do about it? Well, I think graphics are in a great position to really show people just how how wrong and irrational we can be.

3. Optical Illusions Can Show Us Our Errors

And actually, graphics have been doing this for a pretty long time. They are called optical illusions.

Same Colors Look Different: Here each of the lines in those X’s are the same color. You probably won’t believe me until you look at the closeup at the bottom.

Straight Lines Look Curved: These lines looked curved, but are actually totally parallel and straight.

Ikea Nightmares: This shelf seems to make sense, until you realize it doesn’t.

Lines Don't Look the Same Length: These two lines are really the exact same length.

Rectangles Don't Look the Same Size: And no matter how hard you look at these two tables, you will never actually believe that they are the same shape and size.

But they are!!: I actually went and searched for a gif of this to show you because it is just so bonkers. Now, this is a good time to point out that while a lot of these illusions seem arbitrary, they actually exist to let us see and understand the world successfully. We see these tables as different sizes because our minds are really good at judging lengths in 3D space. But in other contexts, like 2D space, they totally fail.

This Dancer Spins Both Ways: Here’s a fun one. Depending on which side you look at, the dancer spins to either the left or the right. It is all the same image.

An Impossible Chocolate Bar: And, just cuz it's fun: a very mysterious Chocolate Bar.

4. Graphics Can Reveal Our Blind Spots

So, optical illusions are great. They're fun, they are quick, and they teach us a lot about how our eyes and brains work together to fail us. But as we saw at the beginning, there are tons of other mental quirks that don't have to do with visual processing, like unconscious metaphors or framing or bias. And I think news graphics and interactives can, in tradition of illusions, help with this. And they some already have!

Our Rose (or Blue) Colored Glasses: Here's an example from a few years ago where the NY Times shows how the same chart about the job report could be read two very different ways depending on whether you're a Democrat or Republican. We've all heard of confirmation bias, the idea that we look for information to back up what we already believe, and this graphic really points that out to you.

The Ease of Reading: If the last graphic helped us see through politically colored glasses, this one helps us see through a different sort of lens. It's a simulation of what it might be like to have dyslexia. The person who created it was inspired by a friend with dyslexia who said that for her the letters seemed to "jump around." It's not perfect, and some might argue it's not even a graphic, but it uses something visual to hint at what we might take for granted if we don't have this difficulty.

Our Terrible-ness at Big Numbers: Another thing we're really bad at: comprehending large numbers. I'm sure a lot of you have heard the legend the king who proposed to pay any reward to someone who beat him in a game of chess. The man who accepted the challenge said if he won his prize would be rice: measured by placing a single grain of rice on the first chess square, two on the next, 4 on the next, and so on. When the king lost he soon realized that the amount of rice he would need would cover the entire Earth a few inches deep. This king, as many of us are, was really bad at big numbers.

The Size of a Population: So, a number of newsrooms have come up with interesting visual ways to convey this sense of scale to people. One strategy is to map these number onto unexpected geographies. So in this example from Al Jazeera, they place 11 million Syrian refugees into various parts of the US.

The Extent of the Damage: In this example, the South China Morning imagines what would happen if an atomic bomb hit various cities all over the world.

The Sheer Number of Detainees: Another way to give us a sense of scale is to use lots and lots of tiny dots. Dots seemed to really come into their own in 2015. They're not always the best, but sometimes can be a really powerful way to convey the sheer number of people. Here's one from the Guardian that highlight the number of police detentions taken to Homan Square in Chicago, over 7,000 people.

"Rhetorical Scroll": Other times we see what has been coined as the "rhetorical scroll", using scroll for the effect of helping us grasp large numbers.

The Number of Foreclosed Houses: The NY Times uses it to show us just how many homes were foreclosed in the housing crisis.

The Depth of the Ocean: The WaPo uses this technique to show us just how far underwater signals were detected (from what they thought at the time could have been the Malaysian airliner.)

The Distance Between Planets: Here it's used to show the distance between planets in our solar system.

The Number of Deaths: Here's another one from the NY Times that uses every trick in the book and combines both dots AND rhetorical scrolling to illustrate the number of people killed in the Syrian conflict.

5. "You do it" Graphics Help Us Realize: But another technique that graphics and interactives use to show us how fooled we are by our own minds, is to actually put us in the drivers seat. What I mean by these "You do it" graphics are interactives, mostly, is that they depend on the user actually DOING something for them to get the complete story or point.

Now if anyone can come up with a better name please let me know, but for now, we'll go with this hashtag. Ok let's check some out.

Terrible at trading stocks: So like in this interactive, Bloomberg has set up a sort of simulated stock market where you have to buy and hold and then sell your stock at some point of your choosing. It's not that long before you realize that your day trading skills are not really all that hot.

Your guesses are not (always) correct. Or in this example, where you have to guess what the relationship is between parent income and children who attend college. Rather than just tell you, they make you draw it! And then compare your line with the actual one.

Prison population: Here's one from the Marshall Project where you get to adjust a bunch of different factors to see if you can reduce the prison population by half. You do it, and then realize that without being more lenient on violent crimes, which is not something a lot of people want to do, it may be impossible to reach that goal.
Lottery: Here the LA Times has you actually play the lottery, and helps you realize that even if you spend a TON of money you will likely lose it all.

Minimum wage: Here the idea is to simulate what it is to live on minimum wage. You have to enter in all your expenses and as you do, you see your money disappearing as you try. You're faced with real decisions about what to cut and how to save, which I think at least gives you a tiny sense of what someone who has to make these decisions on a daily basis is going through.

And this is a good time to point out that in some of these graphics, what we realize is not just about ourselves (wow we're bad at stocks) but also about others (it's pretty hard to live on minimum wage). In this way they're sort of like digital empathy tools. When we're forced to make decisions or do something that we don't normally have to do, we get a little more of a glimpse into what it might be like to be another person. It's definitely not a perfected tool yet, but I think we can take this much farther.

Small biases: I'm going to end on one of my all time favorites, it's more of an interactive game called the "Parable of the Polygons." Basically you have to follow certain rules about where to move these blue and yellow shapes. One rule might be "I will move if less than 1/3 of my neighbors are like me." And then you drag around those shapes until they are all happy with their neighbors. But even slight preferences for similar neighbors leads very quickly to totally segregated populations of blue squares and yellow triangles.
Biases 2: So by playing this game you quickly realize how small biases in society can lead very quickly to widespread segregation. They've also got another section that shows how difficult it is, once segregated, to integrate these triangles and squares. It takes an active preference for diversity to change the system in place. I love this idea, right, this is a game that tackles systemic racism! I really want to see more interactives trying to explain big intangible issues like this.

So in the end, I think we're only at the very beginning of taking advantage of the ways graphics and visuals reveal our minds quirks, our biases, our very bizarre behavior and our blind spots – to our own minds and to the situations of other people. But I do think graphics can help, and to get started, here's that list of all the named biases and quirks that have been found and named already.

I think we'll be busy at it for a long time. Thanks!