5 tips on designing colorblind-friendly visualizations

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Note: The following is the first installment in a series of guest posts by Tableau Zen Master Jeffrey Shaffer.

This is a first in a series of posts about some of the well-known "data-viz rules." We often hear these rules, but the details behind them are often not examined in depth or overlooked completely. I wanted to examine a few of them to better understand how they should be applied. For the first in the series, I examined the issue of using red and green together.
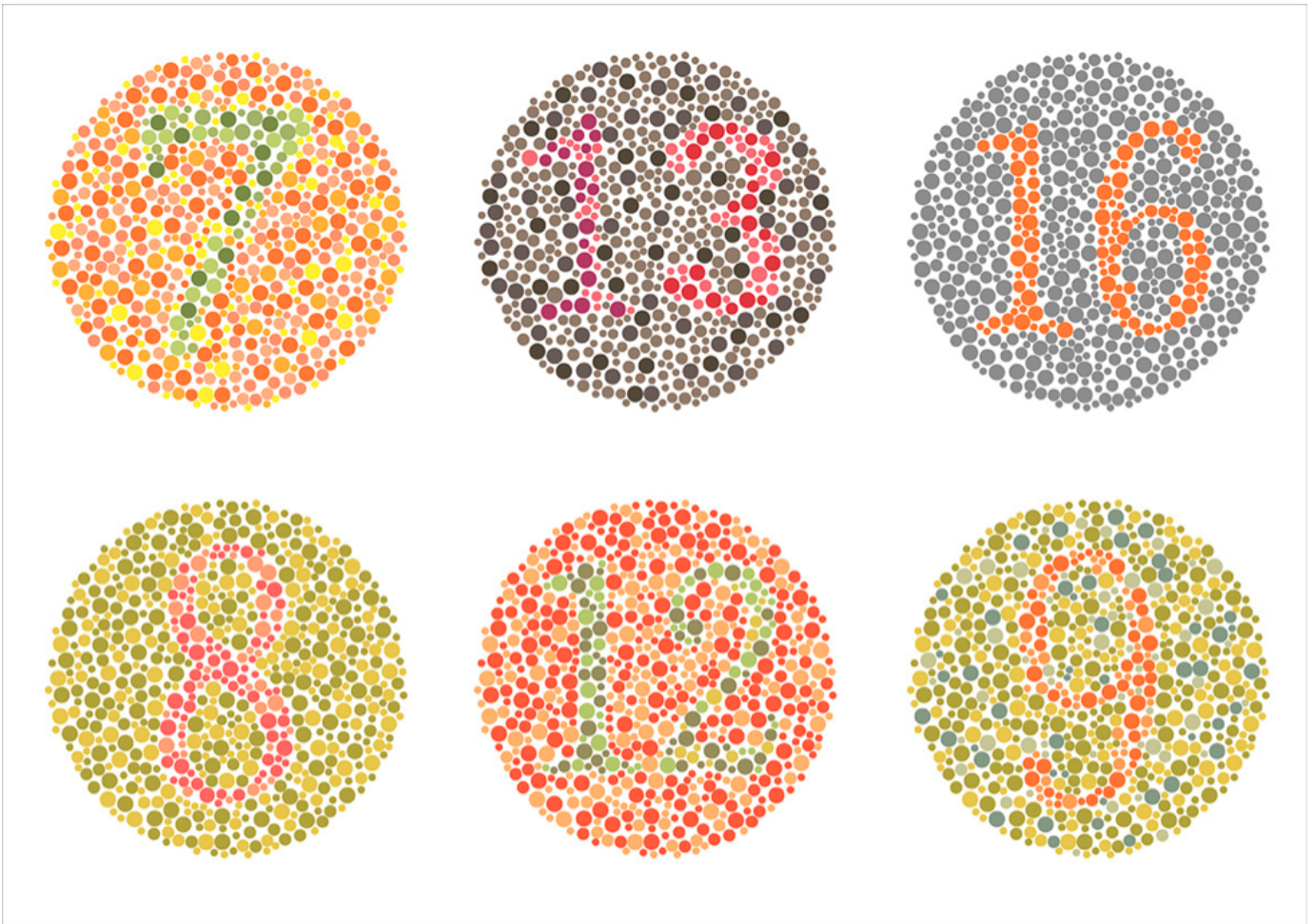
The data-viz rule: "Don't use red & green together."
The issue: "Ten percent of men are colorblind and mostly red/green issues."
Reaction: "Don't use red and green together."

Studies have shown that around 8% of men and 0.5% of women have color vision deficiency (CVD). This is more commonly referred to as colorblindness, although colorblindness is not the most accurate term.

Having CVD does not mean that a person can't see color unless you are the very rare person (one in 33,000 people) with achromatopsia. For the more common person with CVD, the key problem is that colors most people see as different will look the same.

The two most common types of CVD are deuteranomaly and deuteranopia, which together count for about 6% of men, and protanomaly and protanopia, which account for another 2% (more information available at color-blindness.com). These conditions are also commonly referred to as "red weak" and "green weak" or "red-green colorblindness." (Note: I will not discuss blue/yellow CVD because it is far less common.)

Here are some tips for designing vizzes that are colorblind-friendly.

1. Red and green together can be problematic, but they can sometimes be used together

So indeed, using red and green together is a common problem. People with strong CVD (strong meaning a more severe condition of CVD) would see both red and green as brown. People with weak CVD can see strong red and green colors as red and green. However, this can still be problematic when the colors are weak or blended together.

Keep in mind that being able to tell these colors apart is only an issue if color is the only encoding method used to make a distinct comparison—for example, a good number vs. a bad number in a table, or one line vs. another line in the same line chart. For example, in the chart below, color is needed to tell a good square from a bad square. Using deuteranope simulation, we can see how difficult this would be.
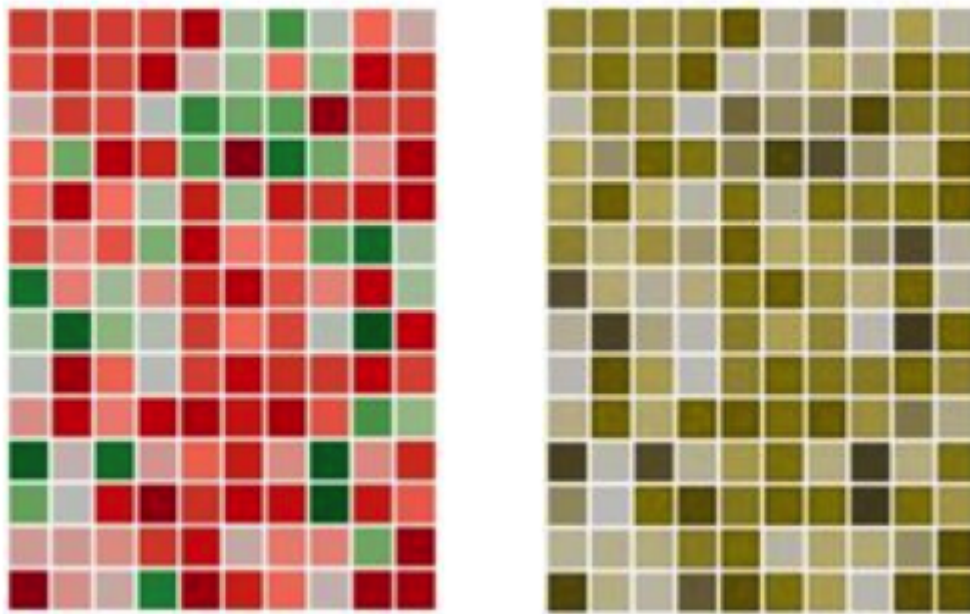
I've seen critiques regarding the use of red and green together in the same visualization, but the colors weren't being used in a way that required someone to tell the difference between them. If they stand alone—for example, two different charts, one red and one green—and they are labeled well, then it may not be an issue at all if they both appear brown in color.

The chart below offers one example where it's easy to see from the axis line that most numbers are positive and others are negative. Color is a secondary feature simply

encoding positive vs. negative. While this may not be the best choice of colors, someone with CVD can interpret this chart without the use of color to make the comparison.
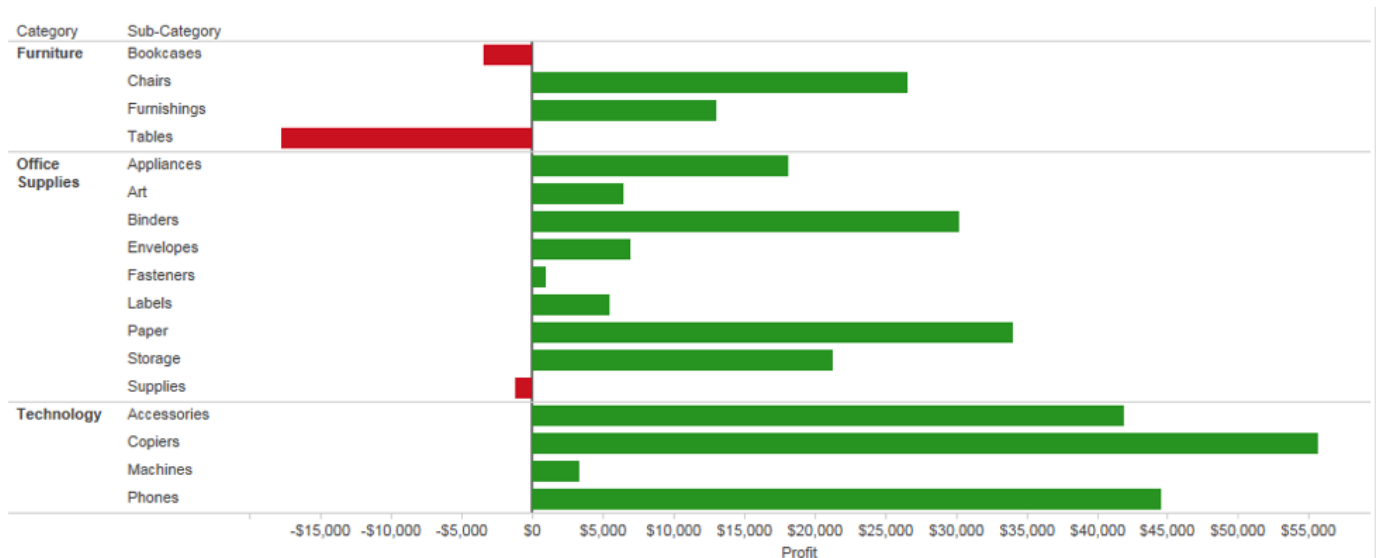
2. Be aware that it's not just red and green

Many data visualization tools have a "stoplight" palette built into them, and there are many companies (and clients and bosses) that still insist on using the stoplight palette. With all the talk of stoplight colors and the nicknames for the CVD conditions, it's no wonder that the data visualization rule has simply become "don't use red and green." Below is a simulation of Tableau's stoplight colors using protanope simulation.
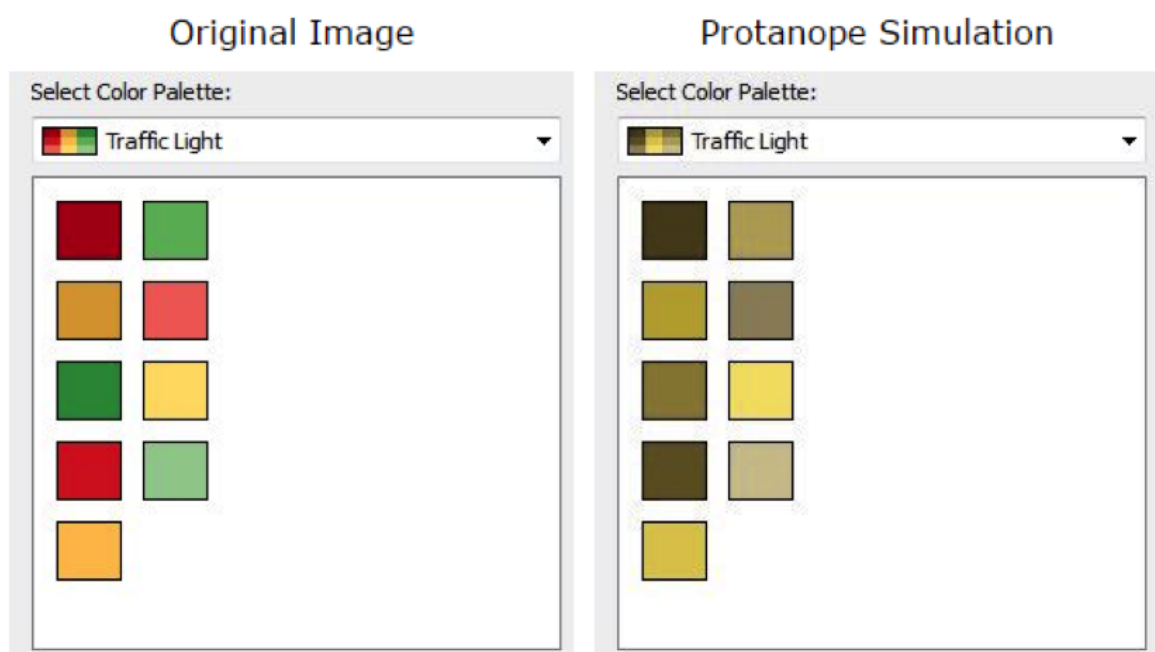
Notice that the problem here is much more complex than just simply red vs. green. Since red, green, and orange all appear to be brown for someone with strong CVD, it would be more accurate to say, "Don't use red/green/brown/orange together." However, it doesn't end there. When colors are mixed, they can also be problematic.

One color combination that is frequently overlooked is using blue and purple together. In an RGB color model, purple is achieved by using blue and red together. If someone has issues with red, then the person may also have issues with purple, which would appear to look like blue.

Also, pink and gray together and gray and brown together can be problematic. Below is the Tableau 10 color palette using a deuteranope simulation. Not only are red, green, and brown problematic but so are blue and purple, pink and gray, and gray and brown.
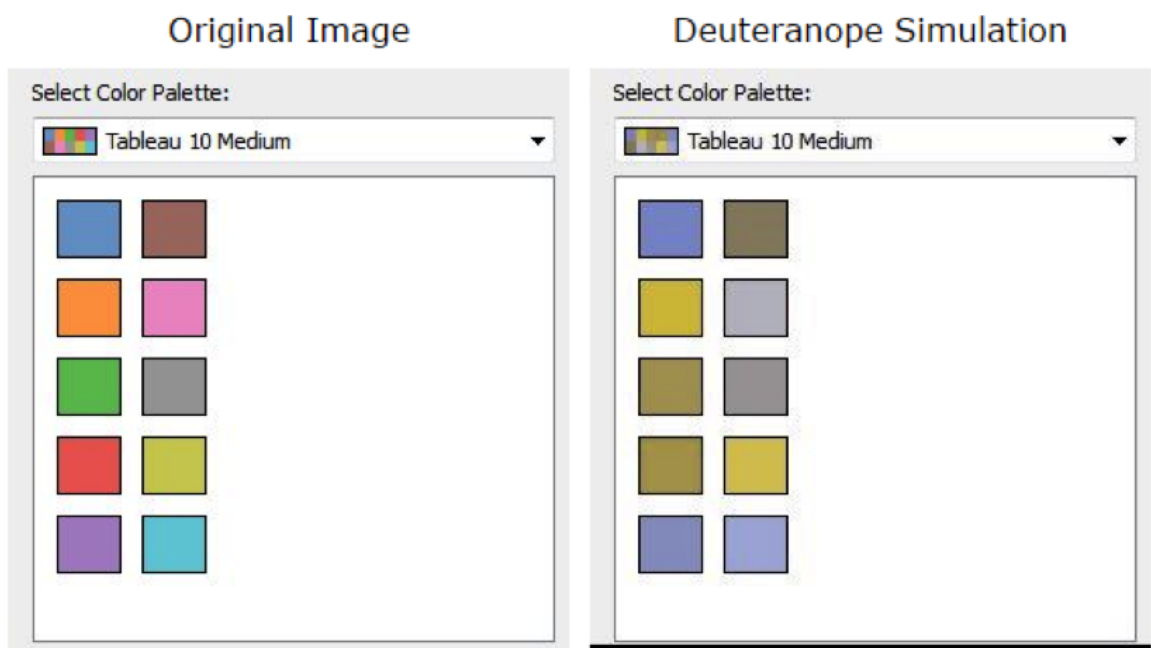
My brother-in-law has CVD, so he is frequently the guinea pig for my color experiments. Off all of the things I've tested on him, the combination of colors on the image below (left) was the hardest for him to distinguish. He seems to suffer from protanopia, which is simulated below on the right.
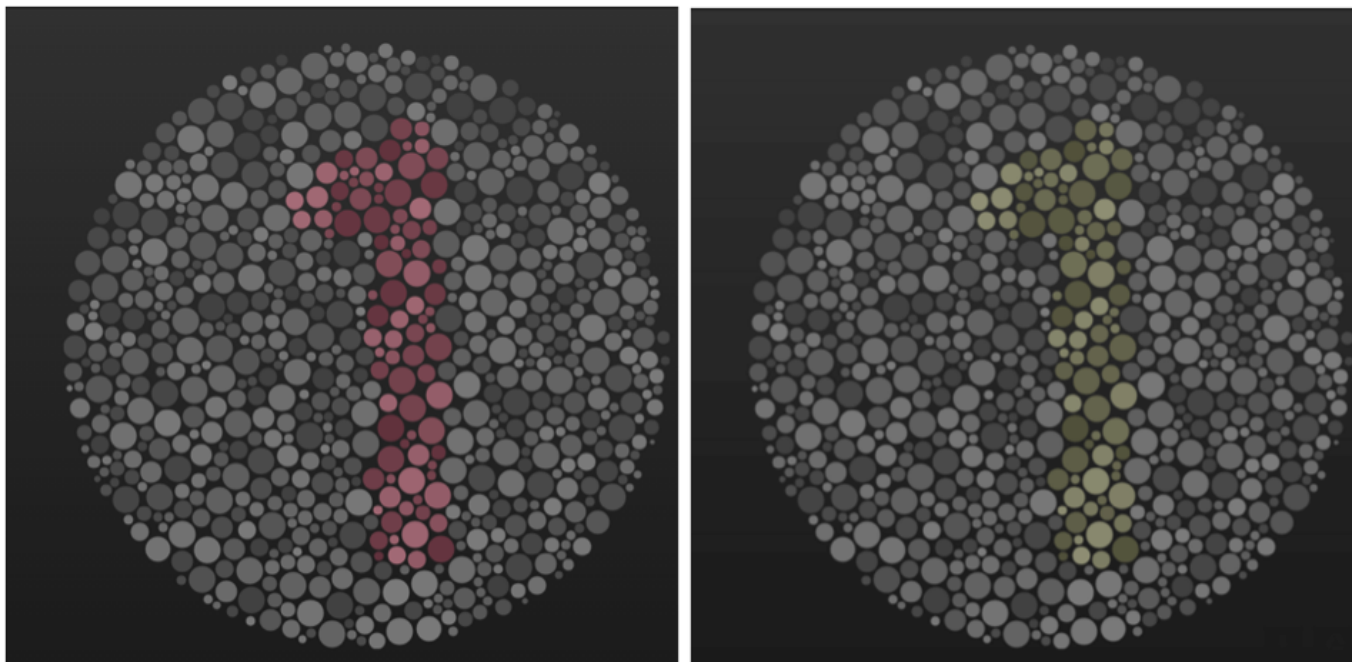
So now that we know there are many more combinations of color that can be problematic, what should we do?

## 3. Use a colorblind-friendly palette when appropriate

One color used together in combination with another color is generally fine when one of them is not usually associated with CVD. For example, blue/orange is a common colorblind-friendly palette. Blue/red or blue/brown would also work. For the most common conditions of CVD, all of these work well, since blue would generally look blue to someone with CVD.

Tableau has a built-in colorblind-friendly palette designed by Maureen Stone. This palette works very well for the common cases of CVD. Below is the Tableau colorblind-friendly palette under both deuteranope and protanope simulation. Notice how well this color palette works for the various comparisons of color.

Your Results:

Original Image   Deuteranope Simulation

Your Results:

Original Image   Protanope Simulation
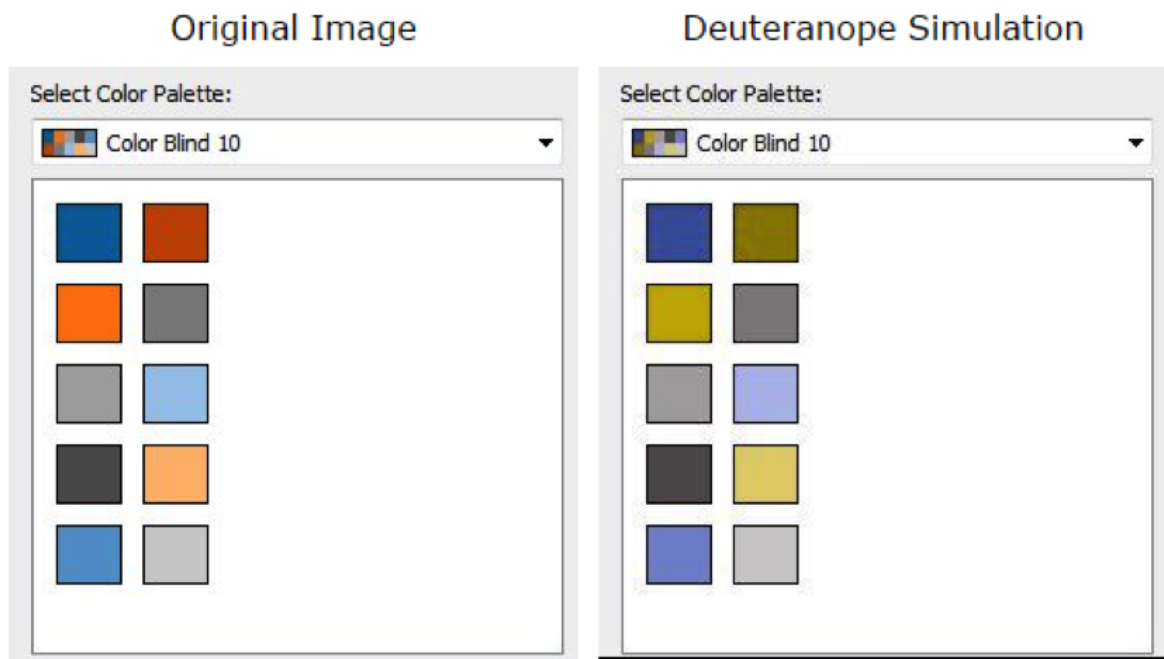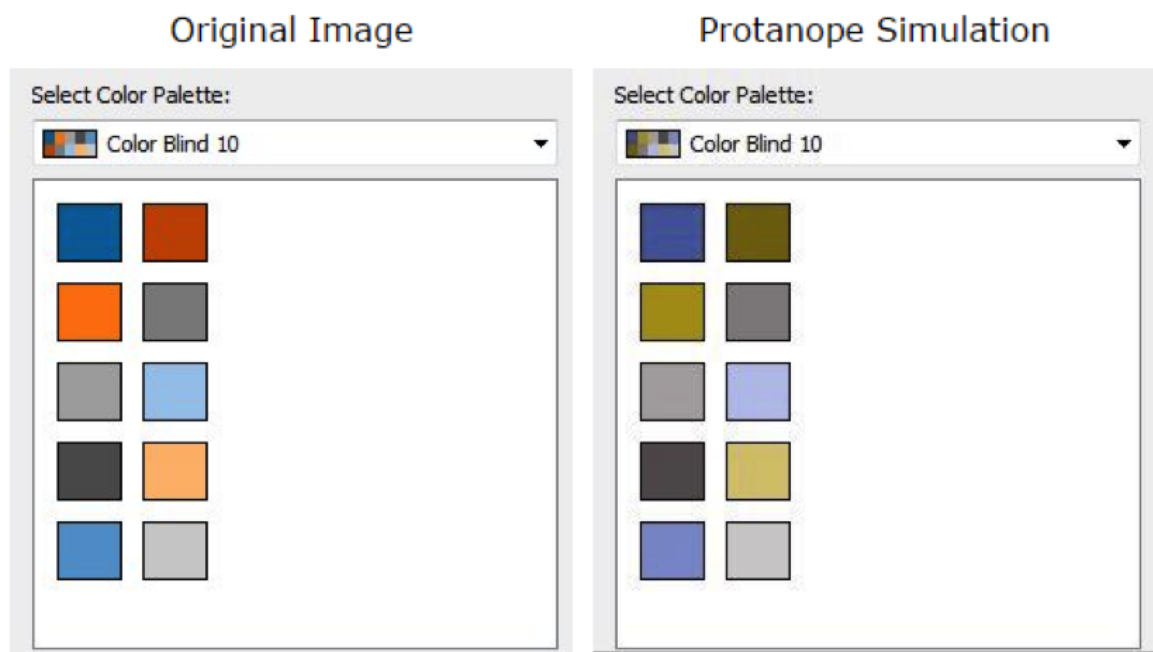
Maybe it's the boss, the client, or even the company colors or style guide that requires you to use red and green. So now what can we do?

4. If you must use red and green together, leverage light vs. dark

For someone with CVD, the problem is primarily with color hue (e.g. red vs. green) and not with the color value (light vs. dark).

Almost anyone can tell the difference between a very light color and a very dark color, so another option when using red and green together is to use a really light green, a medium yellow, and a very dark red. This would appear to be more of a sequential color scheme to someone who has strong CVD, but the person would at least be able to distinguish red from green based on light vs. dark.

5. If you must use red and green together, offer alternate methods of distinguishing data

Along those same lines, if using red and green, you can also add icons, directional arrows, labels, annotations, or other indicators that would allow a person with CVD to see that something is bad (red) vs. good (green).

Another option might be a checkbox for a user to switch the color palette for the entire viz to a colorblind-friendly palette. This allows for the red/green pairing for the majority of the audience while offering a way for someone with CVD to change the palette entirely.

Unfortunately, there isn't an easy way to do this in Tableau. However, it can certainly be done. Below are two examples, one using a parameter to change the color palette (using both a sequential and categorical color scheme with transparency) and the other using a dashboard action, similar to what Tableau Zen Master Robert Rouse used in his hidden-menu technique.

Color Swap

Profit
▾

Want to make sure the viz you designed is colorblind-friendly? In addition to a number of online colorblind simulators, there's also a plug-in for that. The Chrome plug-in "NoCoffee" will simulate all types of CVD right in your browser, including your visualizations hosted on Tableau Public or Tableau Server.

Try using the NoCoffee browser plug-in for an entire day, and you'll be amazed at what the world looks like to someone with CVD. For images of your visualization without a browser, try this chromatic vision simulator.

I would like to thank Maureen Stone for the valuable review, input, and suggestions for this post.

For more tips, ideas, and vizzes by Jeffrey Shaffer, check out his Tableau Public page and his blog. You can also connect with him on Twitter @HighVizAbility.

Comments

Submitted by priyatamil (not verified) on April 21, 2016 – 12:27am

Such as very good information,
Thank goodness someone is promoting quality content.these information was more
effective content. Keep update more information..

Android Training in Chennai

Reply

Submitted by dhiya (not verified) on April 21, 2016 – 3:47am

Superb i really enjoyed very much with this article here. Really its a amazing article i
had ever read. I hope it will help a lot for all. Thank you so much for this amazing
posts and please keep update like this excellent article.

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Reply

Submitted by Diego Garcia on April 21, 2016 – 10:03am

Hi thank you for the useful tools like the chromatic vision simulator, please keep
adding articles like this one.

Modux Co, Bogota D.C. – Colombia

Reply

Submitted by Mithileshwar Sharma (not verified) on April 23, 2016 – 8:27am

Good and useful tips. Thanks keep posting!

Noida, India

Reply

Submitted by sathya g (not verified) on April 25, 2016 – 3:44am

the blog is very interesting and will be much useful for us. thank you for sharing the blog with us. please keep on updating.

Reply

Submitted by Annie (not verified) on May 25, 2016 – 7:54am

This is a beautifully written article giving guidance on color options in Tableau.

However, what I was hoping to find was instructions to fill colored space with symbols in order to help a color blind person distinguish. For example, using Red and Green is a very desirable color scheme for non–blind people because it already has a global "stop/go" definition. So if those colors could be used, but optionally enhanced with fill of symbols (Circle with a line through it for Red, Checkmark for Green...for example), then color can be used as desired and the symbols would keep the chart valuable to colorblind users as well.

If there is a trick that allows you to do that in Tableau, I do not yet know how to unlock it.

Examples:
When a bubble chart is used, display a unique symbol in the center of the bubble. When a map is displayed, include hatch marks that vary by color.

It would be nice to have the option for an end user to "Turn ON Color Blind Features" so that the extra objects only are displayed when needed.

My husband is colorblind, and the problem is that they don't KNOW when they are not seeing things correctly. Even when "colorblind friendly" colors are used, if there is nothing other than color to go on, it is easy to misinterpret data.

Reply

Submitted by Phillip Browning on July 14, 2016 – 4:51pm

I love Annie's comments. This should be a top priority for Tableau.

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