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COLOR IN SCIENTIFIC FIGURES

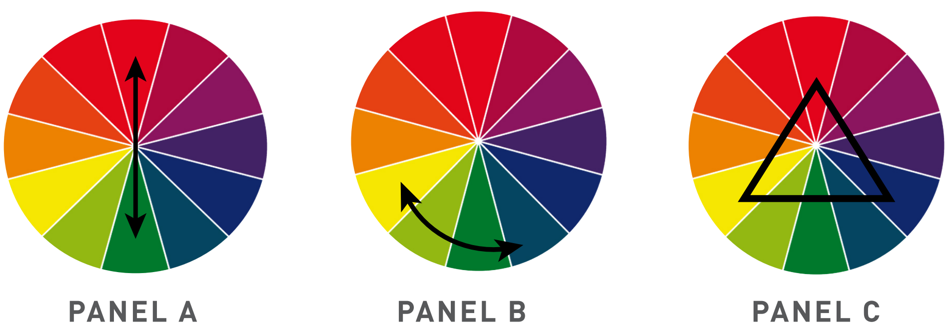
As more journals are moving toward online access, you will no longer be limited to displaying your data in grayscale due to additional charges for the use of color. When used properly, color can enhance and clarify a figure. However, when used in the wrong way, color can be confusing, obscure your data, or even distort the meaning of your data.

We understand that using color in your figures can be intimidating and confusing. Hopefully, this article will help answer some of the questions that you may have about color in figures so that you can represent your data as professionally and accurately as possible. Below are answers to some common questions that you may have about color in scientific figures.

WHAT COLORS SHOULD I USE?

The color(s) that you choose really depend on your preference. Some people like to choose a specific color pallet and use it consistently throughout a paper or even use it in all papers by that author. Others choose different shades of one color or use color to make specific points in specific figures. (See **Figure 1**.)

FIGURE 1: COLOR WHEELS DEPICTING SOME COMMON COLOR PALLETS THAT YOU CAN CHOOSE FROM



A. COMPLEMENTARY COLORS

One common pallet uses complementary colors, which are colors that are opposite from each other on the color wheel (panel A). Complementary colors are good for showing differences between data sets.

B. ANALOGOUS COLORS

Another pallet uses colors that are near each other (i.e., analogous) on the color wheel (panel B); these types of pallets are good for showing similarities in datasets.

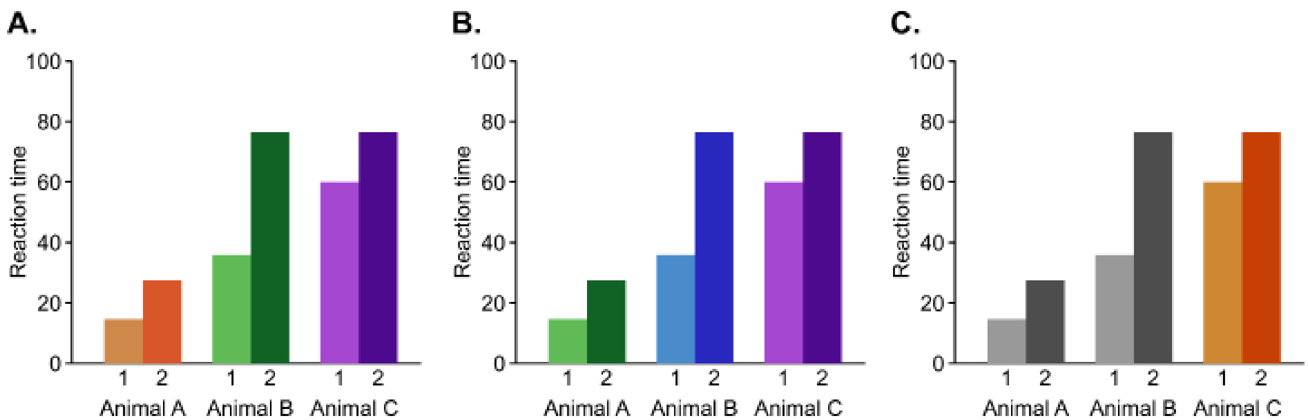
C. TRIAD COLORS

In addition, a triad scheme, which includes three colors that are equidistant from each other on the color wheel, can be used (panel C). Similar to the complementary scheme, a triad scheme can be used to show differences in color schemes but offer more variety in the colors that can be used.

HOW CAN COLOR BE USED?

Color can be used in various ways to represent your data. For example, you can use color to distinguish one element of a figure from another. Color can also be used to call attention to a specific set of data as well as to group similar types of data or separate different types of data.

FIGURE 2: THE EFFECTS OF COLOR ON HOW THE SAME DATA IS VISUALIZED

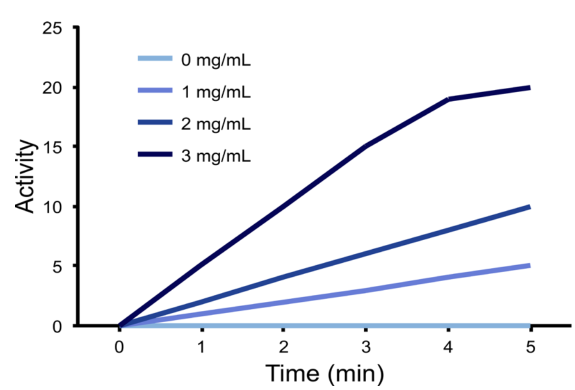


In panel A, a triad scheme (i.e., orange, green, and purple) is used to show that the three pairs of data sets are different. In panel B, the same data sets are changed to an analogous pallet (i.e., green, blue, and purple), which causes the reader to think that the three sets of data are now similar in some way. In panel C, color is only added to one data set (orange) to make that particular data set stand out from the gray data sets.

You can also use various shades of one color to display your data differently. In all three panels in **Figure 2**, a different shade of a single color was used for each individual bar in each data pair. Using different shades of the same color suggests to the viewer that these data are similar in some way.

This method can also be used to show gradients. In **Figure 3**, lighter to darker shades of blue are used to suggest increasing concentrations. In this case, using different shades of the same color indicate that something is increasing (in this case, the concentration) and that whatever is increasing in each line is similar (i.e., the material of which you are increasing the concentration).

FIGURE 3

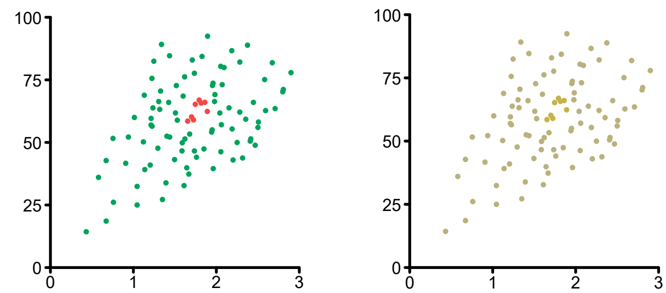


WHEN IS COLOR BAD?

Although color has the ability to enhance your figures, it can sometimes work against you. For example, too many colors can be a distraction and can mute the actual point of your figure, as seen in **Figure 4**.

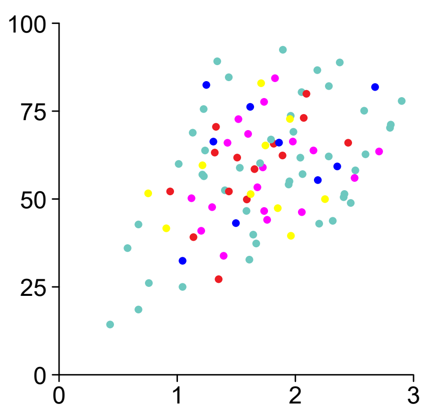
In addition, bright or neon colors, such as yellow, are often frowned upon by journal editors, as yellow backgrounds and text make things difficult to read and differentiate. Another commonly overlooked problem in using color in figures is the use of colors that are not distinguishable by people who are colorblind.

FIGURE 5



PANEL A **PANEL B**

FIGURE 4



WHY SHOULD I WORRY ABOUT COLORBLINDNESS WHEN USING COLORS?

Colorblindness (or color deficiency) occurs when an individual does not see color in a normal way. The most common form of colorblindness is deuteranomaly, a form in which individuals have reduced sensitivity to green light. This makes it difficult for those people to distinguish green and red hues.

Figure 5 shows the same data as seen by someone without (panel A) or with deuteranomaly (panel B). Globally, color deficiency is found in approximately 8% of men and 0.5% of woman and appears to be higher in people of Caucasian descent.

In addition, there is a relatively high incidence of color vision defects in countries such as India and Brazil[1]. Because of the high incidence of colorblindness and the large amount of research that is taking place in countries such as India and Brazil, there is a good chance that a reviewer/reader of your paper will have this deficiency and could potentially interpret your data incorrectly.

A few minor changes to your data can ensure that they are accurately viewed by someone with colorblindness. For example, instead of using red and green, which incidentally, are the default colors that many analysis programs use, you can use purple and green.

1 http://www.colourblindawareness.org/colour-blindness/types-of-colour-blindness/

JOURNAL REQUIREMENTS

The journal wants my figures in RGB for online but in CMYK for print. What does this mean, and why does it matter?

RGB (Red, Green, Blue) and CMYK (Cyan, Magenta, Yellow, Black) refer to the color space of your figures. Journals will ask for a specific color space depending on if your paper will be published online or in print. RGB is typically used when publishing online because computer monitors display light as a combination of red, green, and blue. In contrast, printers use cyan, magenta, yellow, and black to deposit color onto a printed page.

Because these two types of color space use different display colors, the resulting colors will be slightly different. Typically, colors in RGB will be slightly brighter than those in CMYK. Therefore, if you want to ensure that your data is displayed exactly as you want it to be displayed, it is important to choose the color space that your journal is asking for.

Hopefully, this article has helped answer some of the questions that you may have about using color in scientific figures. If you choose to use color, doing so in the correct way could present your data in a more clear and professional manner.

ABOUT THE AUTHOR

Dr. Meaux is a Scientific Animator/Illustrator at Research Square, where she has worked since 2013. She graduated from the University of Texas Health Science Center at Houston with a PhD in Molecular Genetics and Microbiology, where she studied eukaryotic gene regulation, and performed over 5 years of postdoctoral research on histone gene regulation at the University of North Carolina at Chapel Hill. In her current role at Research Square, she leads the Animation team in making Video Abstracts and is a member of the Figure Formatting team.

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