

COLOR SPACE CADETS:

Why color doesn't match

One of Five

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For many of you, this article will explain why color doesn't match between monitors and printers. For others, it will make you want to check into a mental hospital. But don't fret! There are easily understood reasons why the same image does not look the same on different monitors and printers. Once you understand the reasons for color matching problems, it will be much easier to see how color management can solve the problem for you, leaving more time for you to do what you do best.

First, some terminology: Saturation is purity of color. Printing inks such as cyan, magenta and yellow, and monitor phosphors such as red, green, and blue are difficult to make perfectly pure. It is also difficult to make them the same from monitor to monitor, or printer to printer. It's all a compromise between cost and perfection.

What is gamut? Gamut is a range of colors. Think of it as you would a balloon. Balloons come in all different shapes and sizes. The bigger the balloon, the more air it contains. The bigger the gamut, the more saturated colors it contains, possibly the greater the number of colors it contains as well. The further from the center of the balloon you go, the greater the saturation. The rubber balloon skin itself is the boundary and it represents the most saturated colors.

RGB is a color model defined by red, green, and blue primary colors. CMYK is a color model defined by cyan, magenta, and yellow primary colors. (We'll talk about black (or K) in a bit, it's special.) Some printers can print more colors than others because they have a larger gamut than others.

The purity of the primaries is what determines the size of the gamut. Colors outside of a balloon cannot be reproduced. This is what we mean by "in gamut" and "out of gamut" in regards to a specific color and monitors or printers. If the color can be printed or displayed,

we say it is in gamut. If it cannot be reproduced, then we say it is out of gamut.

When you are plugging in RGB or CMYK values in your applications to specify a color, these values are device specific. This is why you see different color with the same values on different printers and monitors. It's like asking John to draw a blue sky with only a blue crayon, and asking Jill to draw a blue sky with only a blue marker. You gave John and Jill the same instructions like you do your monitor and printer, but because they are using different "inks" you will see two different blues. You don't expect John and Jill to show you identical blue skies because they are using different "inks."

The primary reason why printers output differently are ink and paper. Both affect the purity of the primary colors. Just like a high quality glossy paper is more expensive and performs better than plain copier paper, the same holds true for ink. Perfectly pure ink is difficult and expensive to produce, and each manufacturer has their own ideas about how to solve the problem.

In theory, pure cyan, magenta, and yellow combined will make black. Because inks are not pure, this doesn't happen. Instead, we see a muddy brown-black on printing presses, and perhaps very green-blacks on ink jets. This impurity of inks is why we add K, or black ink, to most CMY printing processes.

If you were to print out a 100% cyan patch on two printers using the same paper, you will very likely end up with what appears to be two different shades of cyan. One may be "darker" or the other one may appear "brighter and cleaner." This is a problem if a single CMYK file is sent to these two devices and we expect the same image out of both. The reason is that the inks are different, and possibly, the printing method is different as well. This is just like John and Jill's problem.

It is very common for printers to be dealing with the same press and ink system, but with different paper stocks. Therefore, if you print a 100% cyan patch on two different kinds of paper but with the same device, the cyan patches still appear different! Different paper will react with ink in different ways. This could be due to one paper being whiter than the other, ink absorption differences, or issues that are more complex. Thus the paper will affect hue, saturation, and/or brightness of the primaries, and thus all other colors produced by them. The paper can affect the size and shape of the balloon, so to speak.

“Well, my monitor is consistent at least,” you are thinking. There are no inks, and no paper, in a monitor. Well, you are right, but it’s still not the same as the monitor next to it, or down at the service bureau. They may be the same age, the same model, the same whatever, but they are not necessarily the same.

Monitor phosphors are what make up the red, green and blue components of light we see emitting from our monitors. The phosphors are a complex mixture of earth minerals. It is complex enough that from one batch of this mixture to the next, it is not exactly the same, just like inks. Foiled again!

You can see an illustration of the effect of different phosphors if you have ever gone to an electronics or department store with a large number of television sets for sale. Many of them will have the exact same channel selected, yet most of them look quite a bit different from each other, and it’s not just the brightness and contrast setting. While monitors are more high-end than the average television set, they too differ in the color you see, even when the monitors receive the same RGB values. Just like the printers, and just like John and Jill’s crayon vs. the marker saga.

Now you understand that each device, even the same model, can be very different from the next device. This applies to monitors, presses, printers, and even scanners and digital cameras. What does this mean? It means there is no such thing as one kind of RGB, or one kind of CMYK. However, nearly all of us expect a single RGB or CMYK file to look the same on all of our devices.

For example, if a designer duplicates, then color corrects an image such that it will look the same on two devices, taking into account the difference of inks and substrates, he will end up with two images with com-

pletely different numeric values in them! How do you know you are fixing real color problems with the image, and not issues with your devices when you are color-correcting images? You may be color correcting for phantom problems.

There are other reasons why monitors and printers are so different, but we’ll keep it “simple” today. I wouldn’t want to be responsible for a nationwide increase in health insurance premiums.

Just by reading this article, you are much more capable of tackling the color-matching problem. Now that they’re out of the way, you can look forward to each additional article in this series showing you how color management can help. It’s all downhill from here, so to speak.

The next article, I will discuss device independent color spaces, and why they are important in dealing with the many different flavors of RGB and CMYK. Imagine the benefit of one value for a specific color. We don’t get that with RGB or CMYK! In yet another issue, I will discuss why calibration of devices isn’t enough to fix the differences between devices, and what you really need.

The remaining four articles in this series can be found at www.colorremedies.com. They are free!

The author, Chris Murphy is President of Color Remedies™, a Boulder, CO national consulting firm specializing in customized color management workflow implementation and training. He is co-author of Real World Color Management by Peachpit Press, ISBN 0-201-77340-6, and can be reached at: help@colorremedies.com www.colorremedies.com



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