

Display profiling and Color Management

gretagmacbeth
YOUR COLOR. PRECISELY.



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Most of the definitions found throughout this presentation are taken from my book "Color Management for Photographers, Hands on Techniques for Photoshop Users" published by Focal Press. A table of content and sample chapter can be downloaded from the web site above. Or go to:http://www.amazon.com/exec/obidos/ASIN/0240806492/digitaldog-20/104-1213564-0901541?creative=327641&camp=14573&link_code=as1

Why Color Management ?

Device Dependent Color

- Digital images are big piles of numbers. Computers (and applications like Photoshop) are just calculators
- Device dependent color is a recipe for color. What color is 233R/45G/89B? What does it look like?
- RGB & CMYK describe an ingredient for color, NOT how it that color appears!
- RGB to RGB and CMYK to CMYK conversions are necessary
- You need ICC device profiles to define the right numbers to send to your printer to produce the expected color!

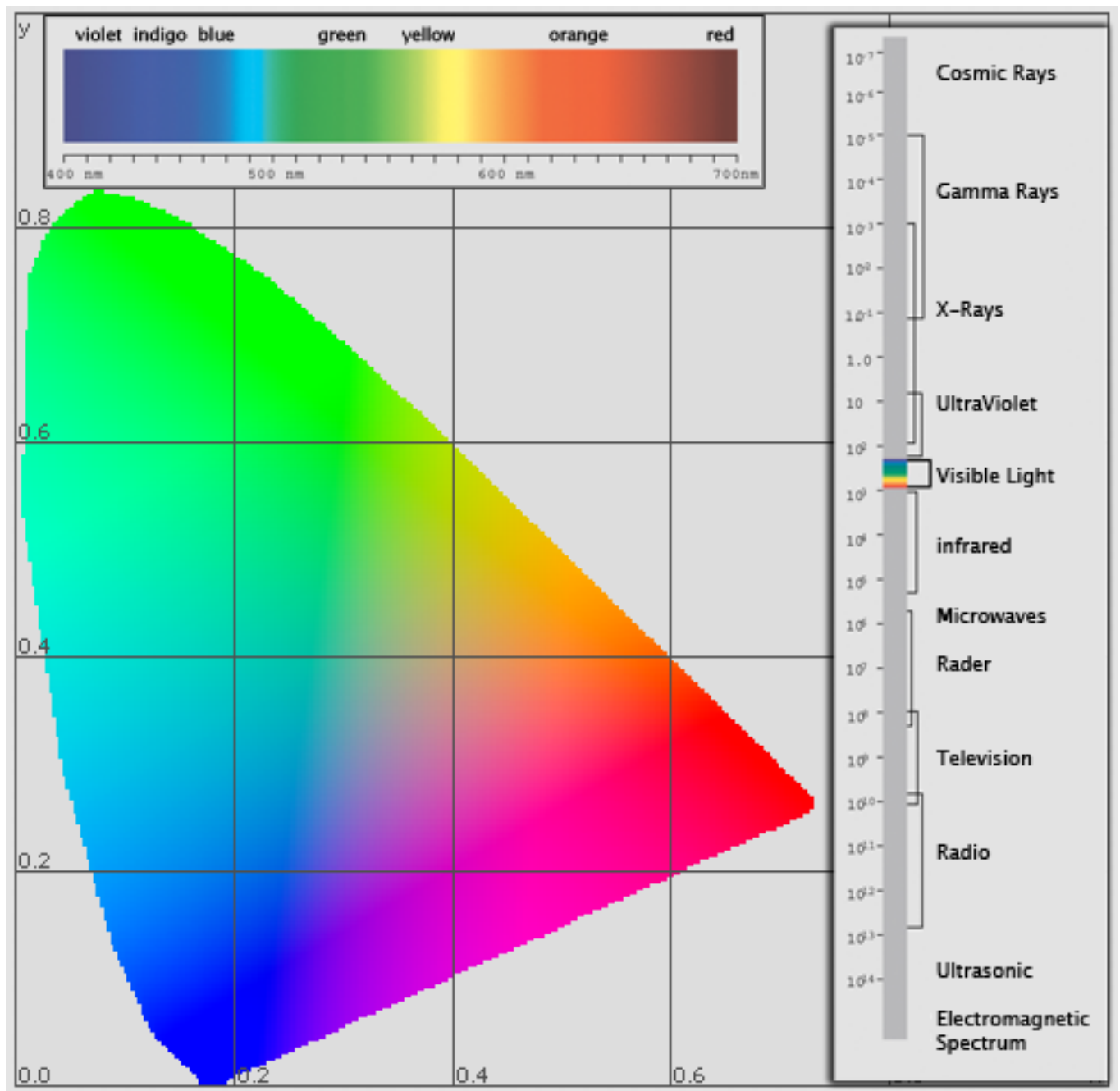
Device Dependent: Used to define a color space that is tied to a specific device behavior such as a specific printer, scanner, camera or display. Each device produces it's own unique behavior and the color space that describes this behavior is device dependent. The device itself influences the color produced

Color Model: Color Model - A method of mapping color using a set of defined dimensions. Some scientific color models such as x,y,Y or L*a*b* encompass all of human vision and have a defined scale such that a particular color will always have the same set of values. Other color models such as RGB or CMYK have no standard defined reference or scale. In order to understand a color in these models you must have a color space definition that provides a scale and reference.

Color Space: A color space is a scientifically defined portion of human vision. A color space may be defined with any color model. The RGB values R10,G100,B10 have no meaning by themselves other than the color is mostly some kind of green. By using a color space definition the same set of values can be translated into one of the scientific color models, giving the values exact meaning. Having a set of RGB values associated with a color space allow for the exact reproduction of the color.

Color spaces and color numbers.

The gamut (range of colors visible) of human vision Plotted 2 dimensionally produces this horseshoe shaped plot.



Here's a metaphor for a color space: suppose I supply a recipe for chocolate chip cookies but do not provide the unit for each ingredient in the recipe. The recipe provides each ingredient followed by a number. Without units you can't make the cookies. The numbers alone are not enough information to describe how the cookies will be produced. Likewise, R78/G103/B23 or C23/M98/M123/K6 is not enough information to reproduce that color.

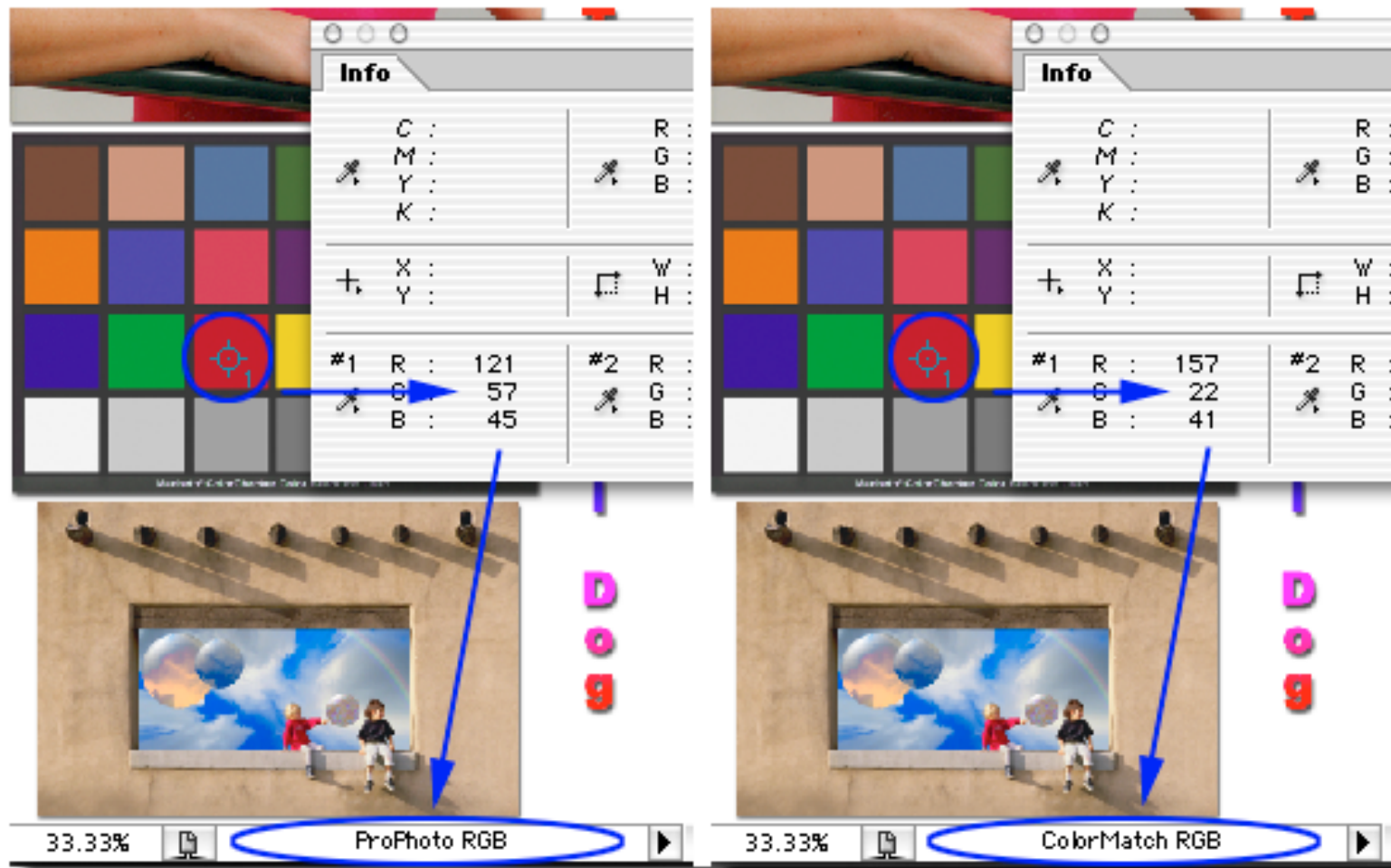
Using a chocolate chip cookie recipe analogy, suppose a color model is a cookie recipe with only three ingredients. I give you this recipe, which simply calls for 1-flour, 8-butter and 2-chocolate chips. You don't have enough information to make the cookies. However if I provide you the recipe with a specific scale—1 cup of flour, 8 tablespoons of butter, and 2 cups of chocolate chips—I've provided the necessary information, the scale, to make a dozen chocolate chip cookies. I can give you the cookie recipe in the metric scale such as liters and grams and you can still makes the same cookies even though the numbers are different. A color space is a color model that has a known reference and scale, in this case primaries (the ingredients, in this case R, G, and B) and scale (specific quantities of these ingredients).

Suppose I specify a color as R10/G130/B50 and specify a color reference by saying the color space is Adobe RGB (1998), which defines the scale of the RGB primaries; the color coordinates of this color space. The R10/G130/B50 set of numbers can now reproduce a color by anyone with the proper tools since the reference and scale have been defined. Different RGB color spaces use a different scale of red, green, and blue primaries. Adobe RGB (1998) and sRGB are different color spaces, however both are based on the RGB color model using RGB primaries. Although each color space uses the same three primary ingredients (R, G, and B), the specific colorimetric scale of each color space is different. The maximum of red, green, and blue are more saturated in the Adobe RGB (1998) color space than the sRGB color space. Even though R0/G255/B0 is the greenest green ingredient in both Adobe RGB (1998) and sRGB, knowing that the scale is different in both color spaces explains why this green value is more saturated in Adobe RGB (1998). This also illustrates how R0/G255/B0 alone can't tell us what green.

An ICC profile simply defines this scale and gives the numbers a meaning allowing us to reproduce the color using something far more concrete than using the English word "Green" or a set of numbers which alone is far too ambiguous to produce a specific color appearance.

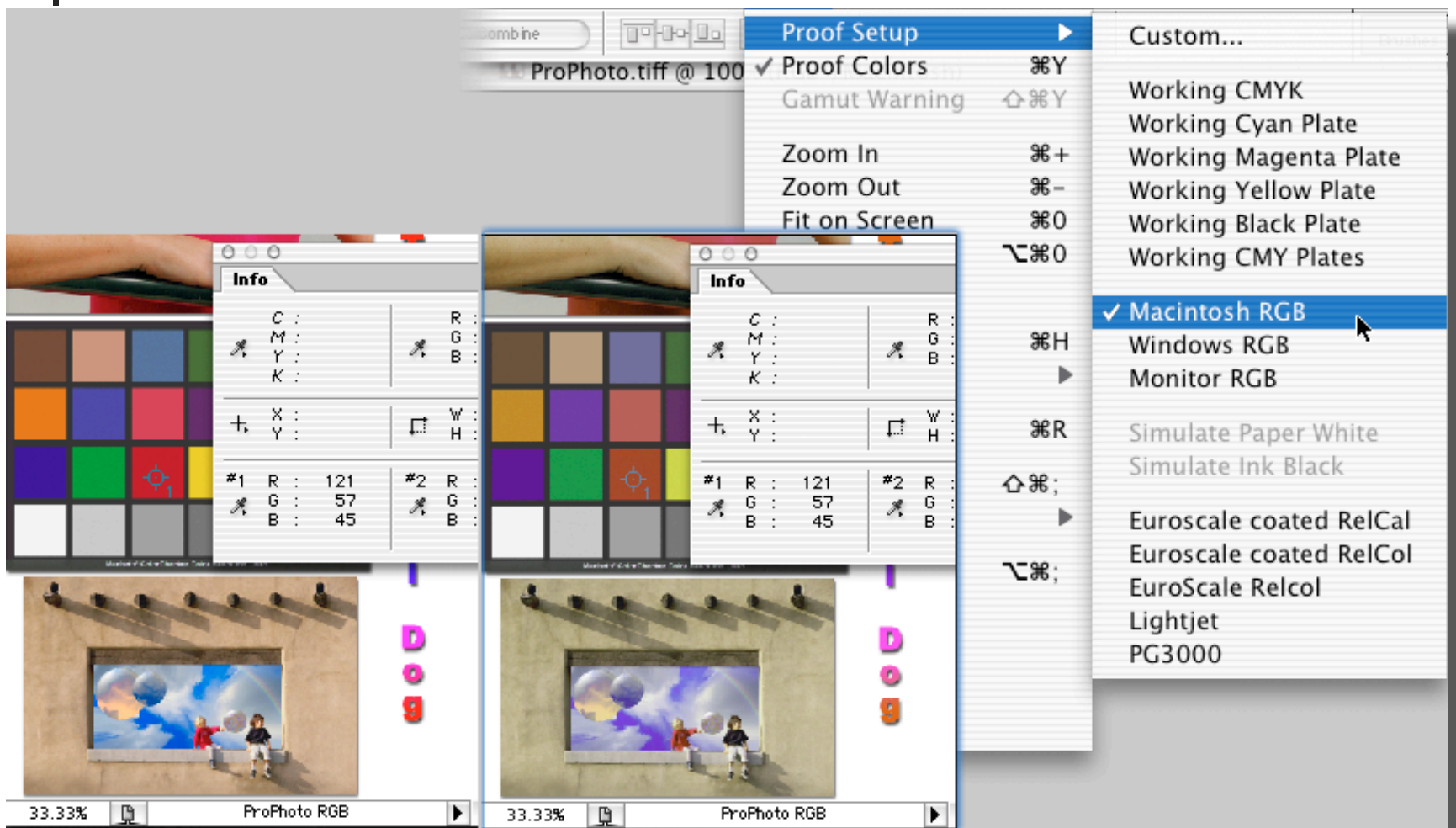
So R255 in Adobe RGB (1998) and R255 in sRGB share the same numbers but have a different scale. When you assign a color space to either number, you're telling Photoshop the scale, it's updating it's preview and showing you this (correct or not, you've defined the scale so Photoshop believes you). The number hasn't changed the color appearance has. Now you know why.

Numbers and color: Color appearance is the same but numbers are NOT



You can demo this effect yourself in Photoshop. Open a tagged file in a color working space such as ColorMatch RGB as seen above. Use the Convert to Profile command and convert to a different working space. Using the Info palette, examine the same area in both documents to see that indeed, while both preview the same color appearance, they both have different color numbers.

Numbers and color: Color appearance is different but numbers are the same! Identical numbers without color management will preview incorrectly!



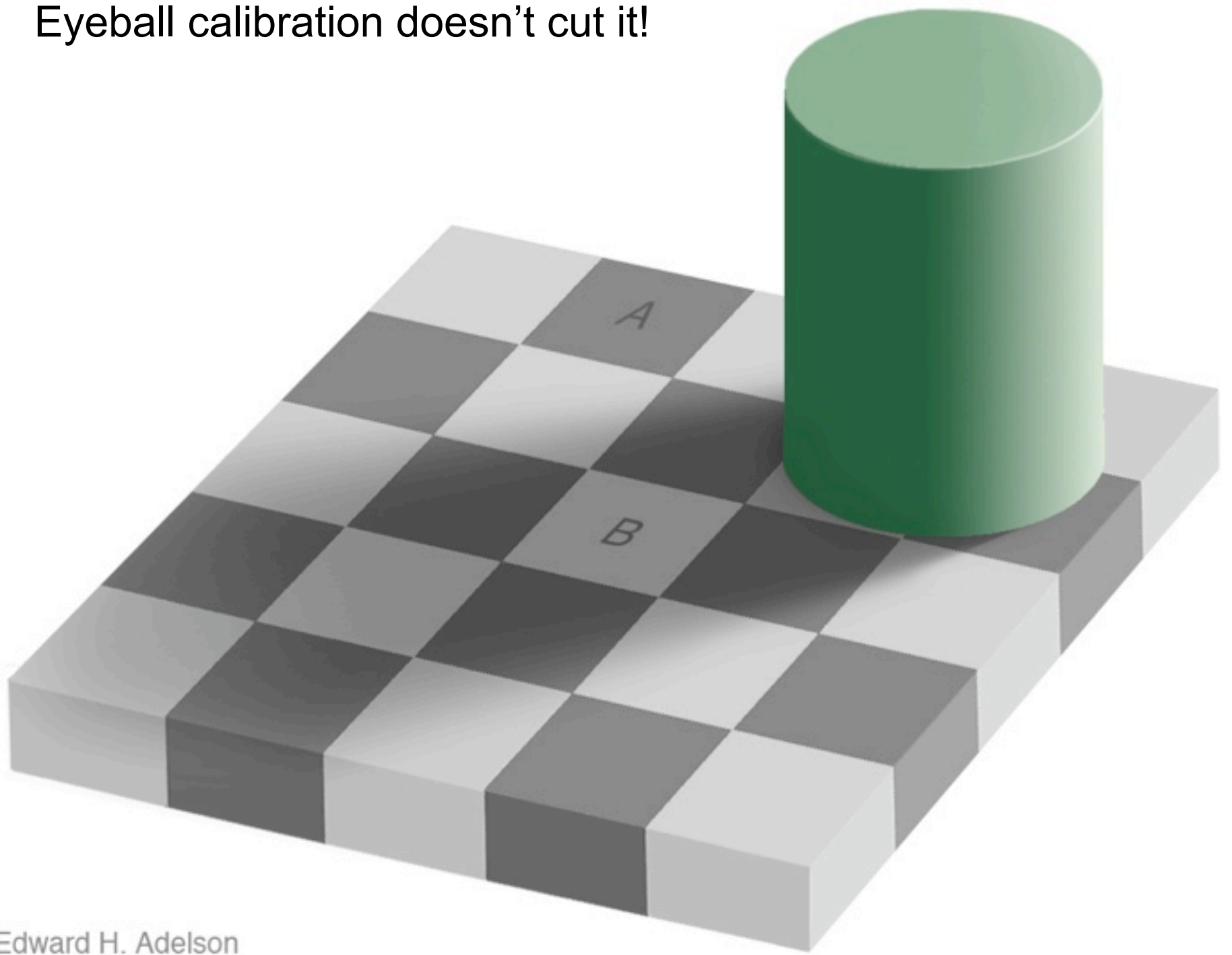
Demo this for yourself in Photoshop by using the Proof setup menu shown here. When you pick Macintosh (or Windows) RGB option, the numbers are sent directly to the screen (your display profile is being used however). Try this with a file that has a quite different color space from sRGB such as ProPhoto RGB seen here. It looks very desaturated when displayed this way since the documents embedded profile is not being used for preview purposes. Same color numbers, different color appearance. This is also the effect most users see in their web browsers. Few are ICC aware; they simply send the numbers to the screen as seen in the example to the right.

Each display receives the same signal.
Yet the color of each is different. The
device affects the color!



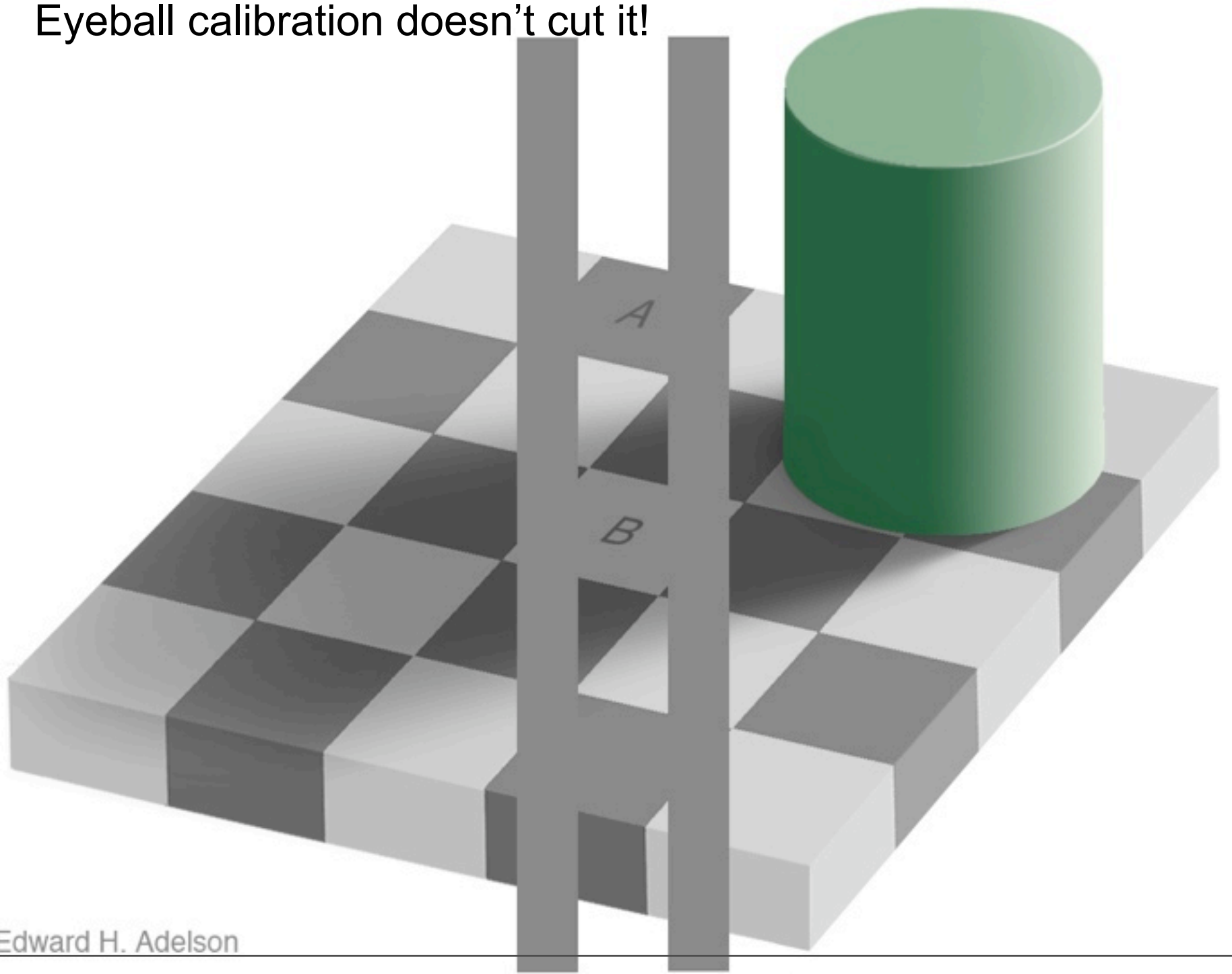
TV screens all getting same signal but showing different colors. Therefore, each device affects the colors, even when the numbers going to the devices are all identical.

Eyeball calibration doesn't cut it!



Edward H. Adelson

Eyeball calibration doesn't cut it!



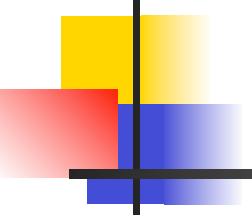
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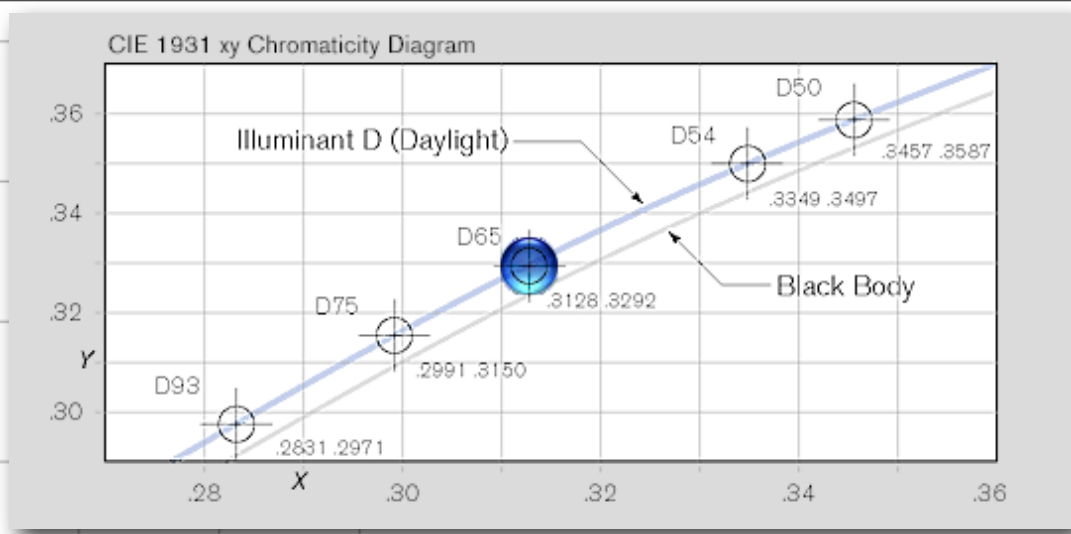
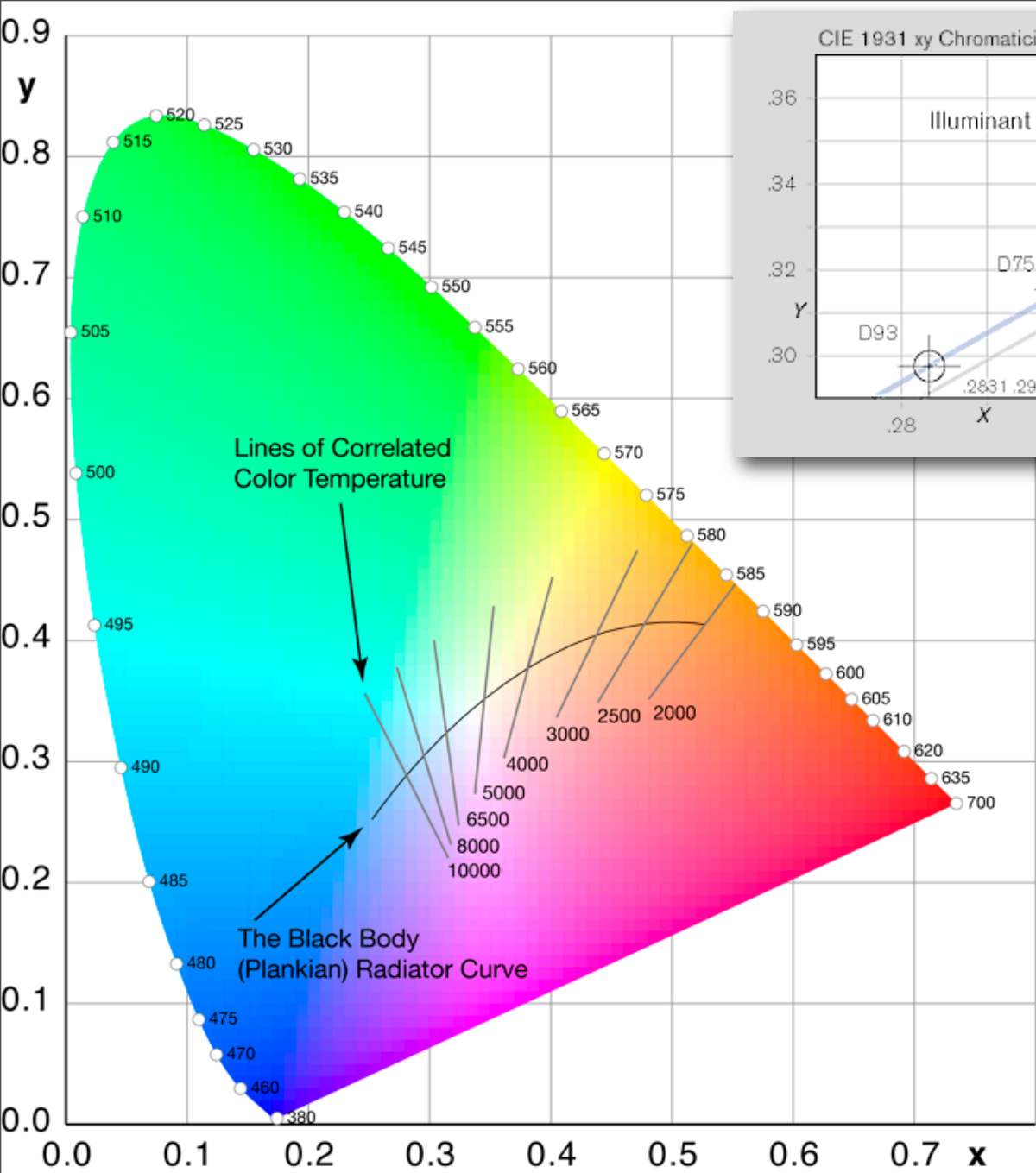
Display Calibration & Profiling

- Calibrate and profile your display using an instrument once a month or more
- Target Values for calibration:
 - White Point (color of white)
 - Gamma (TRC)
 - Luminance (brightness of white)
- After Calibration, instrument measures the display and builds an ICC device profile which Photoshop and other “ICC Aware” applications use for previews



Display calibration

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- White Point (color of white)
 - Use D illuminant not CCT (Correlated Color Temp)
 - Gamma (TRC)
 - Physical attribute of the device. Use native when possible (TRC Gamma of 2.0-2.2)
 - Luminance (brightness of white)
 - Based on ambient light levels around display and user. 85-95cd/m² based on 16-25 lux (dim!).
LCDs can produce much higher luminance hence higher ambient light to calculate...



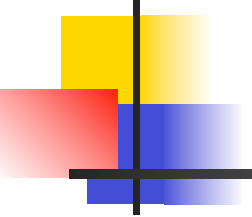
Some tips

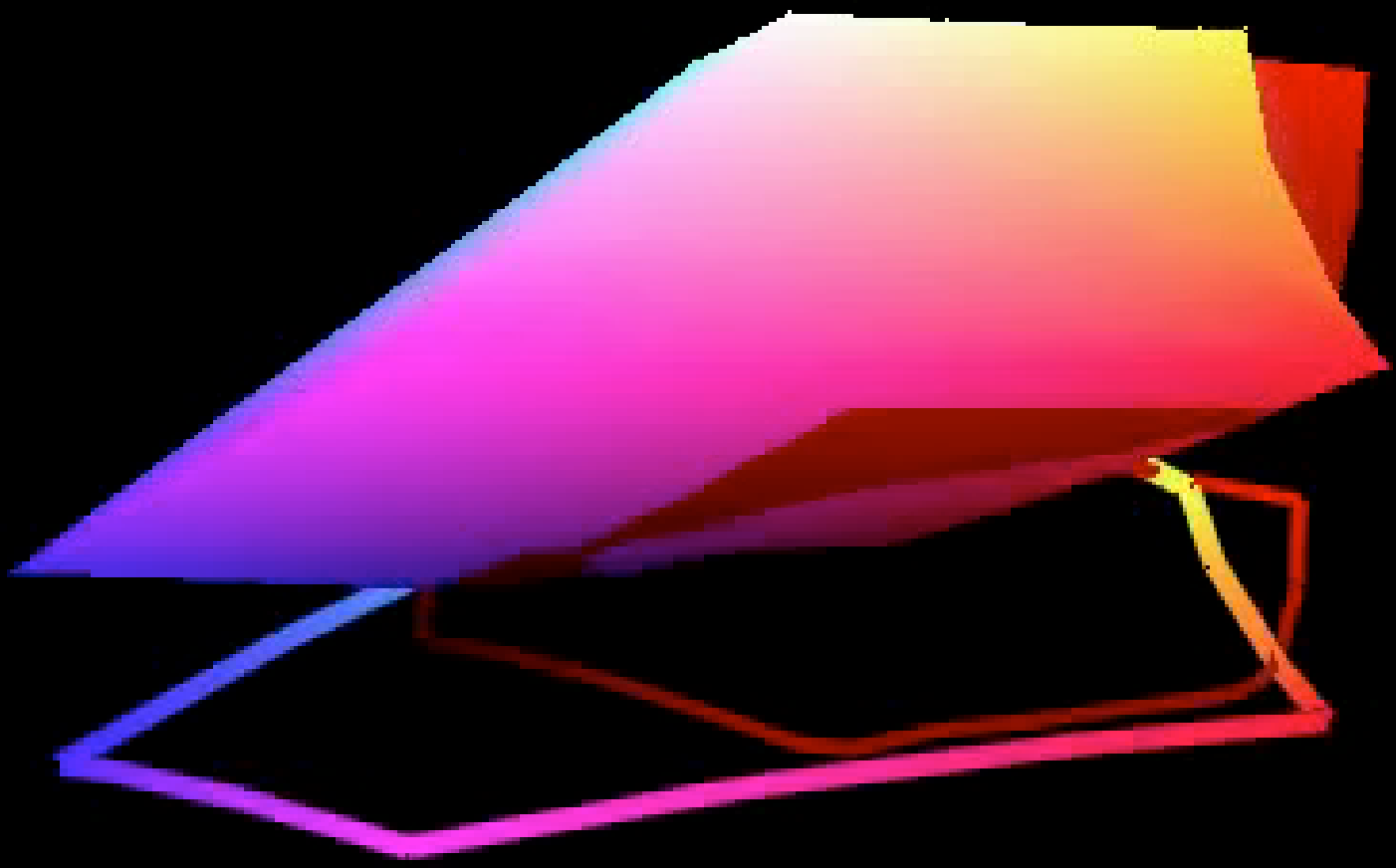
- Allow your display to warm up before calibration, profiling or color critical work. Even LCDs need 15 minutes to stabilize
- Control ambient light around the display! Use a hood to keep stray light from striking the display and control the intensity of lighting
- Most printer profiles assume you are viewing your prints under D50 lighting. The soft proof is only as accurate as how you view your prints! Do you have a reflective light booth?




graphicalite COLOR VIEWING SYSTEMS

Urban Legends

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- sRGB is all you need, no output device has a larger color gamut
 - There are colors you can reproduce on many devices that fall outside sRGB gamut. The Epson K3 ink set has colors that fall outside Adobe RGB (1998)!
 - Our printers output sRGB
 - Only one device can produce sRGB; a CRT display
 - Match your display to our reference print and your CMS is complete
 - Photoshop can't work this way. Color management cannot be turned off!!!



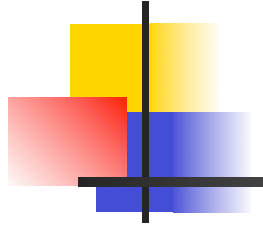
Setting up a CMS

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- You don't have to deal with all items at once. Start by calibrating and profiling the monitor using an instrument (not eye-ball calibration!)
 - Get your service provider to profile their devices and give you the profiles! This allows you to control conversions based upon the output soft proof
 - Monitor Gamma isn't Working Space Gamma; the two do not need to match
 - Keep environmental conditions in mind. Have a CCT 5000K light box, control lighting, control colors nearby for optimal screen to print matching

Try to use instrument based display calibration. Products now start at under \$100.

If you run into a service provider that asks you to match your display to a reference print they supply using on display controls, run away from them as fast as you can! This is an exercise in failure using ICC aware applications like Photoshop.

Thanks for coming...



Thank you for coming. If you were provided with evaluation forms, please fill them out.