B. I. Photo Club Digital Study Group Nov. 30, 2001
Color Management

1. Different physical devices (scanners, digital cameras, monitors, printers, etc.) render color differently. Color Management is an automated attempt to compensate and produce more uniform color across devices. It does not attempt to correct color problems in the original images.

2. There is no universal standard for what RGB (or CMYK) numbers represent. The same numbers will yield different colors on different devices, so you may need to use different numbers on different devices in order to produce similar colors.

3. Human color vision has been studied scientifically, and an international standard has been established to describe colors as perceived by the average person. This is the CIE L*a*b model. Two objects with the same L*a*b numbers will appear to be the same color to the average human observer.

4. An ICC Color Profile is a computer file which describes how a particular device renders color. The heart of the profile is a two-way look-up table for converting between RGB (or CMYK) settings for the device and the actual L*a*b color.

5. A Color Profile can be stored with an image file ("embedded" or "tagged") to indicate how the RGB (or CMYK) numbers in the image should be interpreted.

6. Profiles are always used in pairs, to convert from RGB (or CMYK) numbers for one device to L*a*b, and then to RGB (or CMYK) numbers for another device. Then the two devices should produce similar colors.

7. All devices have physical limits, and none can render all the colors that the human eye and brain can perceive. So what do you do if some of the colors in an image fall outside the gamut of the target device? There are four choices ("Rendering Intent"):

Absolute Colormetric: match colors exactly if possible, and use the closest possible match for colors outside the gamut. May cause photos to lose detail and texture in areas that fall outside the gamut, because a range of colors are collapsed into one. Good for corporate logos, paint chips.

Relative Colormetric: As above, but map colors relative to the "white point" of the profile. Good for images printed on a white background, because the eye tends to compensate for this. OK for photos if all important parts of the image are inside the target gamut; otherwise has same problem as above.

Saturation: maintain color saturation, even if you have to compromise the hue and lightness. Good for charts and graphs.

Perceptual: maintain relative relationships of colors, while desaturating just enough to fit inside the target gamut. Generally recommended for photos.

8. Especially with multiple devices and/or multiple people involved, you could end up with many serial color conversions, producing cumulative errors and limiting the gamut to the lowest common denominator of all the devices. To avoid this, choose one profile as a common ground and convert everything to and from it. This Working Space profile need not correspond to any physical device, but can be the profile of a hypothetical device with a nice wide gamut and neutral characteristics. Some choices for Working Spaces:

sRGB: represents an average PC monitor. Good for web publishing, but gamut too limited for printing photos.

Adobe RGB (1998): a good wide-gamut choice for photos.

9. The normal use of Color Profiles in Photoshop or other programs supporting Color Management is to convert input from scanners, etc. into the Working Space RGB numbers. These are the RGB numbers you would see in the Info Palette while editing the image. Behind the scenes, these Working Space numbers are converted into RGB settings for your monitor using its profile. When ready to print, they are converted into RGB (or CMYK) settings for the printer.

10. You can also use profiles for Proofing – making a preview, either on screen ("soft proof") or on a desktop printer ("hard proof") of what the image will look like when printed in another medium (newspaper, billboard, T-shirt, etc.). This is useful if the ultimate target medium is expensive or inconvenient to use for a test print, or has unusual color characteristics.

11. Where to get profiles:

From the device manufacturer – with printer driver, from web site, etc. Note: cannot compensate for individual unit variation, aging, third party ink or paper, etc.

From public databases – with your OS, profilecentral.com, etc.

From service bureaus – photo labs, commercial printers, publishers, etc.; for their own services.

Substitute the profile of another device – a monitor profile or working space profile might produce decent results for a scanner or digital camera for example. (You can also create new profiles by changing the numerical values in an existing profile using the Custom RGB or Custom CMYK choices under Color Settings.)

Software calibration of your monitor – Adobe Gamma control panel, Apple Monitor control panel for Colorsync calibration, etc. generate a monitor profile.

Hardware calibration of your monitor – Spyder, etc.; $300 and up.

Commercial services to calibrate your printer or scanner – chromix.com, etc.; $50 and up.

Suggested Homework:

Calibrate your monitor using the Adobe Gamma control panel. Open Color Preferences (under the Edit menu in Photoshop) and choose your Working Space, Rendering Intent, and other preferences. Open an image in Photoshop. Open Print Options (under the File menu), select More Options and Color Management, and select the profile for your printer. Open Assign Profile and Convert to Profile (under the Image/Mode menu) and preview the options. Open the Adobe Help menu, or for cookbook directions and some suggested settings, see: http://www.popphoto.com/HowTo/ArticleDisplay.asp?ArticleID=24&page=2

Possible topics for next meeting:
Modifying selections (grow, expand, contract, smooth, feather, color range, etc.)
Adjusting color (color balance, hue/saturation, variations, fade, etc.)

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