IT ALL COMES DOWN TO WHAT YOU SEE

COLOR COORDINATED

BY DAN BRILL

THE HUMAN EYE IS A REMARKABLE INSTRUMENT, capable of distinguishing as many as 12 million different colors. But it is hampered by a brain which can accurately remember barely a few hundred.

How and why we are able to visually perceive what we do is still something of a mystery, but what we *do* know is that there is no device or medium on the planet which can replicate the full visible spectrum of the eye, a color gamut which we know in the graphics world as CIELAB.

Despite the fact that colors can be mixed, measured, described and catalogued, no two people see color exactly the same way. In fact, an individual's perception of and reaction to colors can change under different conditions.

As Leonard O'Neill wrote in an article called *A View of Color* which appeared in the pages of this magazine in June, 1992, "Colors can affect one's behaviour, moods and even appetite. The way people react to color varies with sex, nationality, age, seasons, and personal characteristics. Generally speaking, women like warmer and brighter colors than men of the same age. Children like brighter colors than older people, young men buy bright ties, older men prefer the darker shades.

So when it comes to finding a way to maintain color integrity from an artist's original work to its final destination, whether it be on screen or on paper, we are immediately forced to deal with this fundamental variable: despite our attempts to formulate standards such as CIELAB for human color perception, in truth there will never be an absolute standard.

THE SHAPE OF COLOR

Color management in a print workflow is a complex issue which entails a number of different perspectives. With that in mind, I chose to invite comments and input from a variety of GRAPHIC EXCHANGE contributors and associates in the industry, whose quotes and observations are interspersed throughout this article. They included teacher/designer Lidka Schuch (studio_l@istar.ca), owner of Studio L; prepress consultant Shane Steinman (shane@archangel.net) of Archangel Media and head of

the dMACS Initiative; prepress consultant Mark Lewiecki (mark@rose.com), who is also working on the dMACS Initiative; independent prepress consultant Lerrick Starr (lstarr@ernestgreen.com), who also handles marketing for prepress distributor Ernest Green & Son; and Chris Murphy (help@colorremedies.com), president of Color Remedies, a Denver-based consulting firm specializing in customized color management workflow implementation and training.

WYSIWYG AIN'T QUITE WHAT IT WAS GONNA BE

"It doesn't look like what I saw on my monitor!!" Are these not the classic words of photographers, designers and artists everywhere?

From the wide gamut of CIELAB to the RGB environment of the monitor, there is a significant loss of color. But this is minimal in comparison to the reduction that takes place when RGB is transformed to CMYK.

Of the millions of colors that the eye can see, a press is capable of reproducing only a few thousand. Working with this inherent limitation makes the designer's task a difficult one. Working without a predictable digital color workflow makes it worse, especially since the new workflow necessitates that the content creator must assume a level of responsibility which was never there before.

As Chris Murphy points out, "[The designer's] responsibility is to provide the customer with an identity; part of that identity is accurate color reproduction. Therefore accurate color reproduction is the graphic designer's responsibility too. How they want something to look is important, and that is why they need to be able to produce soft proofs, hard proofs, and [even] specify rendering intents per image."

Color management today comes in two basic flavours: closed and open.

In an open system, color is managed from front to back (a la ColorSync), where color holds to a prescribed set of specifications within a defined color space (generally CIELAB, since this represents the largest gamut), with markers and values attached. Using these tags, color is interpreted and transformed for and by a specific device that can read the values and make them conform to its particular color mechanics. This can work well in an electronic environment (monitor to monitor), but gets trickier when applied to an analog one (monitor to press).

In a closed loop (i.e. a traditional printing environment), color management runs in the opposite direction. The press becomes the target, and a fingerprint of the final printed output is used to work backwards to the press proof and the display. Standards such as SWOP may govern the workflow, but every job must still be managed individually. This is a more controllable system than the first approach, but by definition much more limiting, too.

(above) How color spaces compare in size.

However when there is no film, and no analog press proof, such as is the case with digital printing or computer-to-plate, what then?

A new proofing target, called TR001, is gaining support in the printing community. The essence of TR001 is a kind of meeting in the middle; both printer and designer work to match this target.

But printers will probably continue to stick to their back-to-front attitude for as long as they can. Shane Steinman remarks, "The CMYK color model may be so contaminated that we have no choice but to play by its rules, i.e. cater to the device at the end of the chain and make all preceding devices match its ability to render color. The printing industry will not be convinced that it is not the Holy Grail of reproduction."

What this means for content creators looking to gain control of the color management process is that it may be an uphill battle. Or at the very least, a tug of war between front-ended idealism and back-ended skepticism.

"Color appears in three distinct "dimensions" which we call hue (determined by wavelength or shade, i.e. red, green, blue); saturation or chroma (its purity or strength); and lightness or darkness (cleanliness or dirtiness). Additive color refers to the three primary colors of red, green and blue light, which when mixed evenly produce white light. Subtractive primary colors, as found in inks, are yellow, magenta, and cyan. When mixed together, these colors correspond to the additive colors (magenta and yellow make red, cyan and yellow make green, magenta and cyan make blue)."

— Leonard O'Neill, *A View of Color* Graphic Exchange June/92

"There are three basic approaches to matching color between a proof and a press sheet: (1) Front-end forward — the press attempts to match a proof; (2) Back-end backward — the proof is produced to meet the requirements of a fingerprinted press; (3) Third party reference — both front-end (proofing) and back-end (printing) reference a common target. It is important to be clear on the differences between these three approaches. Most people use a combination of (1) & (2). But the boundary between them is often blurred in people's minds. Such fuzzy thinking can lead to poor communication and misinterpreted responsibilities. There is no room for such ambiguities in an industry-wide digital proofing strategy. All the parameters must be clear to all participants."

— Mark Lewiecki, dMACS Workflow Report: *Proofing & Color Management*, April/99

IN THE COLORSYNC SCHEME OF COLOR MANAGEMENT, ICC profiles define the particular characteristics of a specific device, which can then transform and render the color predictably and consistently, working usually from a CIELAB color description. The notion at work here is the creation of "device-independent color" — the ability to send a file to any device and have it displayed or printed exactly the same across any range of monitors and output devices.

In Apple's own words, "The intent of color management, particularly using ColorSync, is to put the color control back in the hands of the designer who is the originator of the color. That's where color management belongs…"

However let us be careful not to get too carried away with this idea of "device-independent color". Device independence is a theory — an ideal. But ultimately, color is *always* dependent on the characteristics and limitations of the "device" — up to and including the human eye. The use of ColorSync and ICC profiles is an ambitious attempt to supersede these limitations and build a model for reproducing color that overcomes the differences between devices. When it's performed correctly, it *can* work.

COMPARISON OF PROOFING METHODS

STANDARD	HAND-OFF COMBINATION	TYPE
MACS	• 1. Film + film-derived proof	Analog
Partial/ mixed	• 2. File + film-derived proof • 3. File + printed sample • 4. Film + digital proof	Hybrid
dMACS	• 5. File + digital proof • 6. File only / digital proof produced remotely at print site	Digital

Efficiency

This chart illustrates the relative efficiency (both in time and effort) of various proofing methods in a print production workflow (courtesy Mark Lewiecki).

But as Mark Lewiecki points out in his recent report on *Proofing and Color Management* (prepared for the Magazines Canada dMACS committee), there are a number of obstacles to implementing device-independent color management in the print workflow, all of which centre on the difficulty of converting the printing industry from its CMYK-based "closed loop" system to a CIELAB or RGB-based "open" system. They include:

- lack of RGB/CIELAB support in TIFF/IT-P1, PDF/X-1, or DCS (leading choices for standard file exchange formats)
- the IT8.7/3 ink value data set (the standard target for the printing industry) is specified only in CMYK
- many scanners provide only CMYK output format
- weak vendor support for ICC proofing profiles
- lack of RGB/CIELAB scanning expertise
- lack of professional CIELAB image editing tools
- lack of RGB/CIELAB color retouching expertise
- general lack of knowledge in several color management fields: device calibration, device characterization, CMS-based conversion
- complexity of integrating CMS into existing workflows
- an enormous momentum/inertia behind CMYK (history, experience, equipment)

"Device-independent color is the holy grail of a distributed digital workflow. Every device that captures or renders color information is calibrated to ensure consistency. Their characteristics are defined in ICC profiles which map the device's available gamut to a well-defined, media-neutral color space (CIELAB). A Color Management System (CMS) then uses this color space as a universal translator to convert color data between devices."

— Mark Lewiecki

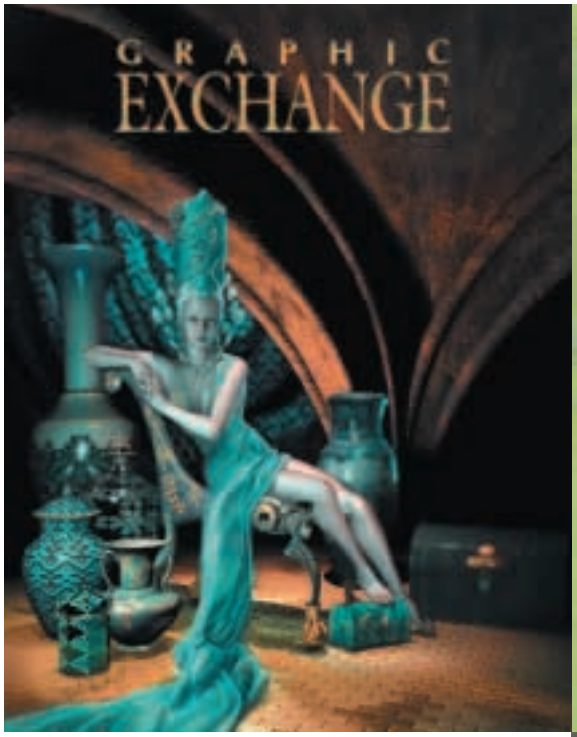
"Closed loop color refers to calibrating various devices to behave like one another. So a proofing device is calibrated (physically forced) to perform like a specific press/paper system. The problem now is that this proofing device is only an effective proofer for that ONE single press/paper combination. An open system calibrates a device to an optimum performance reference condition only — not to the behavior of another device. Then ICC profiles (or some such) are used in order to convert the data which devices receive in order for them to simulate any device for which an ICC profile exists."

— Chris Murphy

COLORSYNC SUPPORT KEEPS GROWING

Apple recently released ColorSync 2.6, which adds some powerful new AppleScripting capabilities and 18 new scripts included; support for JPEG and GIF file formats for Internet compatibility; a new Control Panel design for easier setup; a gray space profile for grayscale workflows; and updated *Photoshop* plug-ins that now support 16-bit images. Version 2.6.1 fixes some problems with Adobe separation tables and promises better memory management.

ColorSync support and color management utilities are becoming standard features in most major desktop software applications. *Photoshop* 5 has now integrated comprehensive color management setups which support ICC profiles. The Adobe Gamma calibration tool has rapidly become a standard for calibrating monitors. *QuarkXPress* 4 offers a Profile Manager and built-in support for Hexachrome. And



PUSHING THE PRINTABLE COLOR GAMUT TO THE MAX

Producing this issue's 8-color front cover was a test of skill and ingenuity for the GRAPHIC EXCHANGE team of digital artist Martin Murphy and prepress consultants Shane Steinman and Lerrick Starr. Here's how the job was done:

Art. For this rendering, Martin first created a simple figure for his "Ice Queen" in *Poser*. This figure was taken into *Bryce* and used for position only to create the background drapery and parts of the chair detail. Major elements — chair, urns, arches, trunk and crown — were built in *Ray Dream Studio* where Martin also mapped textures created in *Fractal Painter* onto some of the urns. All the pieces were then assembled in *Bryce* and rendered with final lighting, saved as a PICT, and imported into *Painter*. There Martin painted the character's face, hair, makeup, gown and detailing, as well as doing final color adjustments. The final image was brought into *Photoshop* where he performed extra dodge and burn.

Prepress and Proofing. From the final RGB image Shane produced eight separations in *Photoshop* and saved them as DCS 2.0. After creating a straight CMYK version, he went back to the original RGB file and performed Calculations to extract the color gamut represented by the Hexachrome orange and green. Additional Calculations determined the orange and green replacement in the CMY plates. He also created two special stochastic plates for the metallic and graduated varnish plates, the first using a coarse 42 micron spot and defined as 100% opaque, and the second at a coarser 56 microns and defined as White and 0% opaque. Prior tests had shown us that six color proofing can be problematic, so we decided to rely on soft proofing. To retain the full color gamut, Shane converted the 8-plate set to RGB and then merged that with the special channels. The final 63 MB job was reduced down to a 500K JPEG proof file.

Film and Printing. Film was output by veteran ripper Lerrick at the Ernest Green & Son Tech Lab in Toronto on an Agfa Avantra 30E. This imagesetter is not normally designed to run CristalRaster; film output for this project was made possible only with the invaluable technical assistance of Agfa Canada's support staff. Agfa provides a choice of three different CristalRaster dot gain compensation curves — light, medium and heavy. We decided to use medium. Printing was performed at Image Plus on a Heidelberg 8-color press, with many thanks to president David Smith for guiding the job through smoothly.

Summing Up. With the combination of six colors and CristalRaster stochastic screening, we expected the final printing to show a wider color gamut and improved detail. Indeed, the extra colors yielded a green-cyan more vivid than anything possible in CMYK, and CristalRaster screening contributed much sharper image detail that surpassed the capabilities of traditional screening.

PROVING THE POINT

Heidelberg Color Publishing Solutions' *LinoColor* 6, due to be released in June, will finally include full ColorSync and ICC profile support.

Calibration of devices to manufacturers' specifications is a prerequisite for successful color management, but even more important is the *characterization* of the specific device through custom profiling. Not very long ago, an investment in custom profiling software could run into the thousands of dollars. However ICC profile editing software for the desktop is now available at desktop prices. Color Partnership (www.colorpartnership.com) recently began shipping its *Profile•Editor* software for Macintosh which sells for only $245 (US). Other affordable color management packages can be found through companies such as X-Rite (www.xrite.com), Candela (www.candelacolor.com) Monaco Systems (www.monacosys.com) and Color Savvy Systems (www.colorsavvy.com), to name but a few.

In Scandinavia, some paper manufacturers now offer ICC profiles for their papers, a sure signal that ColorSync is beginning to work its way down the graphics food chain.

And very shortly Adobe will release *PressReady*, its new software designed for proofing on low cost desktop color printers using ColorSync.

Clearly there is momentum behind the open color management initiative among vendors. But how quickly will the market adapt to the new standard?

COLOR RESOURCES

ColorSync
www.apple.com/colorsync

ColorSync Profile First Aid
asu.info.apple.com/swupdates.nsf/artnum/n11359

ColorSync CMYK Workflow
www.apple.com/colorsync/workflows/cmkworkflow.html

SWOP Calibration Kit (Cost $975 US)
www.swop.org/SWOProds.html

TR-001 Information
www.dMACS.org/SWOPCK.JPG
www.npes.org/standards/order.htm

THE END JUSTIFIES THE MEANS

OVER THE YEARS THE PRINTING INDUSTRY has developed its own standards for color reproduction. SWOP, SNAP and GRACoL are three well-known sets of specifications which have acted as guidelines for predicting color and dot gain for film and proofs.

But in the real world environments of pressrooms across the country, there are really only two standards. For color-critical jobs, the objective is to match the proof exactly. For everything else, "pleasing color" that delivers a result as close as possible to the proof is commercially acceptable. However, in either case, the "contract proof" is the final arbitrator.

As long as we lived in an analog world, there were workable standards for proofing on which printers could rely. But standards for digital contract proofing have yet to be established, and this has printers feeling mighty nervous.

Most continuous tone digital proofs don't reflect dot gain or UCR/GCR, nor do they show potential trapping or moiré problems. Often users will output color with color gamuts which don't even match what a press is capable of printing. Dot gain alone is a huge variable that can ruin any chance of matching color on press. And this might be a good place to add a note of caution concerning dialogues with printers on this subject. A printer may say his gain on press is, for example, only four to six per cent, but he's not talking about the same dot gain that a *Photoshop* user thinks of; he's referring to the difference between a traditional film-based proof (with compensation for gain already built in) and the actual printed piece. Don't confuse that with the 22 or 25 per cent (or more) dot gain that must be allowed for when going from file to press.

COLOR MANAGEMENT — SOMEWHERE OVER THE RAINBOW?

As desktop color management tools evolve, and film begins to be phased out of the production workflow in favour of computer-to-plate, and remote proofing gains wider acceptance, and multi-purposing files for a variety of uses becomes the norm, the question is: what kind of contract proof will we see in the future?

In computer-to-plate circles, a great deal of discussion has centered on the potential problems that exist in a workflow that isn't completely "closed loop". When ripping to a digital proofing device, then ripping that file to plate, are all RIPs created equal? The answer is: no. Variables continue to exist. There is still no absolute 100% guarantee in a CTP workflow that the plates will match the proof. And printers and CTP vendors keep struggling to close the loop.

For content creators, meanwhile, the challenge of mastering the complexities of color management become more daunting, even as the tools get better and simpler. It's not enough to simply get it right on press; match the digital printing, match the wide format printing, match the sales presentation, match the website — and while you're at it, make it all match the hifi color on the annual report.

Ask your printer for an ICC profile for his press and see him roll his eyes. Then tell him you'll need a fresh profile every time you bring in a job. He'll love you forever.

Surely simple, reliable, cross-platform, cross-media, real world color management must be out there somewhere, Dorothy.

Maybe all we have to do is close our eyes and click our heels together three times. ✶

"I'm not in favor of designers controlling print production. I'm in favor of them actually having a reasonable workflow that isn't ad hoc and, from their point of view, color unpredictable — unless they pay for an analog proof."

— Chris Murphy

"Remember that CMYK is a bastardized color space which has been adopted by the industry in order to accommodate the vagaries of rendering images in the subtractive color model. . . The very nature of black plate generation from a three-component color space automatically subverts the purity and accuracy of the imaging process by adding 'clean muck' (black ink) to achieve the four-component color space we've come to know as 'process color'."

— Shane Steinman