

### **To order the book**

Adobe Photoshop CS3 for Photographers is published by Focal Press, an imprint of Harcourt Education.

ISBN: 0-240-52028-9 (old style ISBN)

ISBN: 978-0-240-52028-5

The title is stocked in most major bookstores throughout the world. It is available to purchase from:  
www.focalpress.com and also through the on-line bookstores: www.amazon.com and www.amazon.co.uk.

### **Adobe™ Photoshop™ CS3 for Photographers**

This PDF on color management is an extract from Martin Evening's book: Adobe Photoshop CS3 for Photographers, which will go on sale from early June 2007. This latest update in the Adobe Photoshop for Photographers series will contain 704 pages in full color, plus a CD containing 110 minutes of video tutorials and a 32 page PDF document of shortcuts in Adobe Photoshop and Adobe Bridge. The book layout has been further improved to make navigation easier and contains updated advice on everything you need to know about using Photoshop, from digital capture to print output, as well as all that is new in Adobe Photoshop CS3.

### **A note about the chapter structure**

The importance of calibrating the monitor is covered early on in Chapter 3 and the remaining color management information is then discussed later in Chapter 12. So for this reason, you will find that the pages from chapter 3 on monitor display calibration have been inserted midway in the following extract. And this also explains the change in color for the header, along with the interim changes to the chapter 3 figure references. I did this in order to provide a self-contained guide on Photoshop color management.

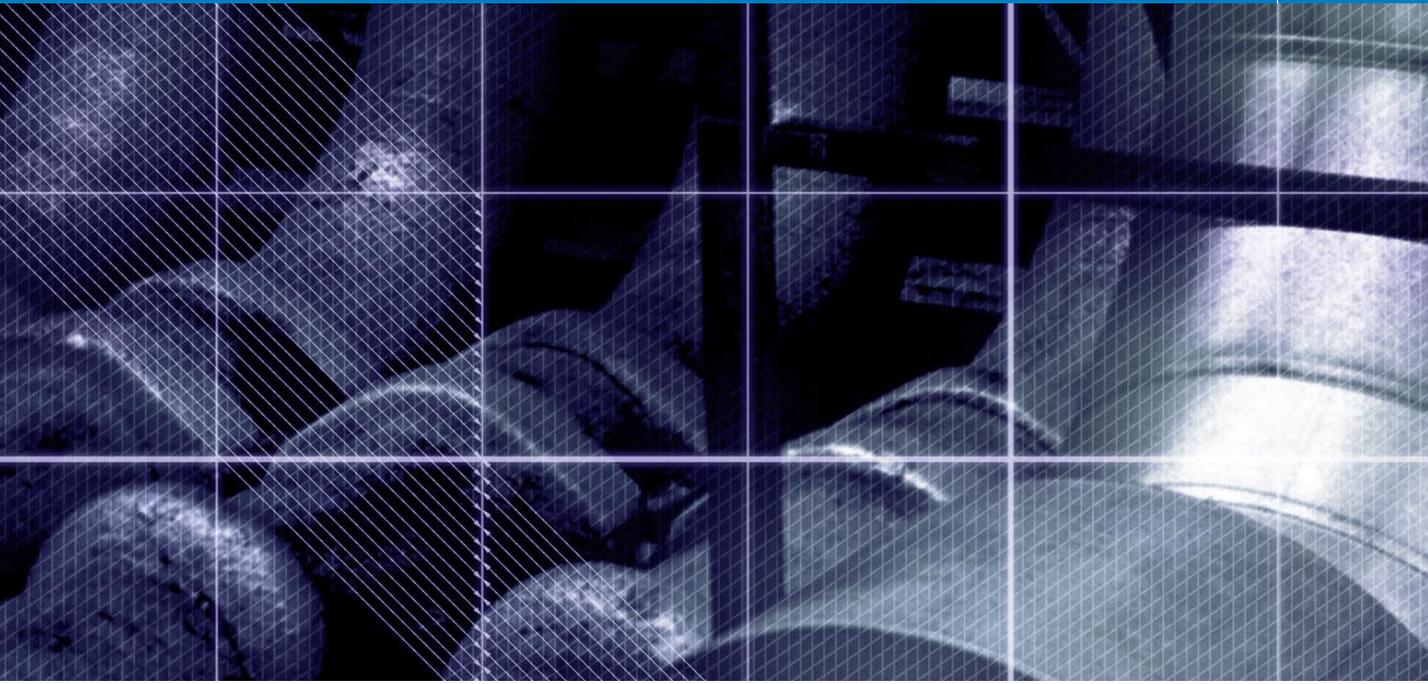
### **PDF usage**

This PDF extract is available to view only and it is print disabled. You may share this PDF file or the link to the PDF file with others, but the copyright of the material and images remain the property of myself. The contents may not be modified in any way, or used commercially without express permission from the author.

### **Website**

There is a website for the book from where you can find more information about the book and download more PDF sample pages as well as images from the book.

**[www.photoshopforphotographers.com](http://www.photoshopforphotographers.com)**



## Chapter 12

# Color Management

**P**hotoshop 5.0 was justifiably praised as a ground-breaking upgrade when it was released in the summer of 1998. The changes made to the color management setup were less well received in some quarters. This was because the revised system was perceived to be extremely complex and unnecessary. Some color professionals felt we already had reliable methods of matching color and you did not need ICC profiles and the whole kaboodle of Photoshop ICC color management to achieve this. The aim of this chapter is to start off by introducing the basic concepts of color management. The first part will help you to understand the principles of why color management is necessary. And then we shall be looking at the color management interface in Photoshop and the various color management settings.

## **The need for color management**

An advertising agency art buyer was once invited to address a meeting of photographers. The chair, Mike Laye, suggested we could ask him anything we wanted, except ‘Would you like to see my book?’ And if he had already seen your book, we couldn’t ask him why he hadn’t called it back in again. And if he had called it in again we were not allowed to ask why we didn’t get the job. And finally, if we did get the job we were absolutely forbidden to ask him why the color in the printed ad looked nothing like our original photograph!

That in a nutshell is a problem which has bugged us all our working lives. And it is one which will be familiar to anyone who has ever experienced the difficulty of matching colors on a computer system with the original or a printed output. Figure 12.1 has two versions of the same photograph. One shows how the Photoshop image is previewed on the monitor and the other is an example of how a printer might interpret and reproduce those same colors when no attempt is made to color manage the image.

So why is there sometimes such a marked difference between what is seen on the screen and the actual printed result? Digital images are nothing more than just bunches of numbers and good color management is all about making sense of those numbers and translating them into meaningful colors at the various stages of the image making process.

## **The way things were**

Fifteen years ago, most photographers only used their computers to do basic administration work and there were absolutely no digital imaging devices to be found in a photographer’s studio (unless you counted the photocopier). If you needed a color print made from a chrome transparency, you gave the original to the printer at a photographic lab and they matched the print visually to your original. Professional photographers would also supply chrome transparencies or prints to the client and the photographs then went to the printer to be digitized



using a high-end drum scanner to produce a CMYK file. The scanner would be configured to produce a CMYK file ready to insert in a specific publication. And that was the limit of the photographer's responsibilities. If color corrections were required, the scanner operators would carry this out themselves on the output file.

These days a significant number of photographers, illustrators and artists are now originating their own files from digital cameras, desktop scanners or directly within Photoshop. This effectively removes the repro expert who previously did all the scanning and matching of the colors on the press. Therefore, there is no getting away from the fact that if you supply digital images to a printer, you will be deemed responsible should any problems occur in the printing. This may seem like a daunting task, but with Photoshop it is not hard to color manage your images with confidence.

**Figure 12.1** The picture on the left shows how you would see the Photoshop image on your screen and the one on the right represents how that same image might print if sent directly to a printer without applying any form of color management. This is an actual simulation of what happens when raw RGB data is sent without any form of compensation being applied to balance the output to what is seen on the screen. You might think it is merely a matter of making the output color less blue in order to successfully match the original. Yes, that would get the colors closer, but when trying to match color between different digital devices, the story is actually a lot more complex than that. The color management system that was first introduced in Photoshop 5.0 will enable you to make use of ICC profiles and match these colors from the scanner to the screen and to the printer with extreme accuracy.

Client: Russell Eaton. Model: Lidia @ M&P.

### Why not all RGB spaces are the same

Go into any TV showroom and you will probably see rows of televisions all tuned to the same broadcast source but each displaying the picture quite differently. This is a known problem that affects all digital imaging devices, be they digital cameras, scanners, monitors or printers. Each digital imaging device has its own unique characteristics. And unless you are able to quantify what those individual device characteristics are, you won't be able to communicate effectively with other device components and programs in your own computer setup, let alone anyone working outside your system color loop.

Some computer monitors will have manual controls that allow you to adjust the brightness and contrast (and in some cases the RGB color as well), so we have some element of basic control there. And the desktop printer driver software will also probably allow you to make color balance adjustments, but is this really enough though? And if you are able to get the monitor and your printer to match, will the colors you are seeing in the image appear the same on another person's monitor?

### RGB devices

Successful color management relies on the use of profiles to describe the characteristics of each device such as a scanner or a printer and using a color management system to successfully translate the profile data between each device in the chain. Consider for a moment the scale of the color management task. We wish to capture a full color original subject, digitize it with a scanner or digital camera, examine the resulting image via a computer screen and finally reproduce it in print. It is possible with today's technology to simulate the expected print output of a digitized image on the display with remarkable accuracy. Nevertheless, one should not underestimate the huge difference between the mechanics of all the various bits of equipment used in the above production process. Most devices are RGB devices and just like musical instruments, they all possess unique color tonal properties, such that no two devices are always identical or will be able to reproduce color exactly the same way as another device can. Nor is it always possible to match in print all the colors which are visible to the human eye. Converting light into electrical signals via a device such as a CCD chip is not the same as projecting pixels onto a computer screen or reproducing a photograph with colored ink on paper.



**Figure 12.2** All digital devices have individual output characteristics, even if they look identical on the outside. In a TV showroom you will typically notice each television displaying a different colored image.

### **The versatility of RGB**

A major advantage of working in RGB is that you can access all the bells and whistles of Photoshop which would otherwise be hidden or grayed out in CMYK mode. And these days there is also no telling how many ways a final image may end up being reproduced. A photograph may get used in a variety of ways, with multiple CMYK separations made to suit several types of publications, each requiring a slightly different CMYK conversion because CMYK is not a 'one size fits all' color space. High-end retouching for advertising usage is usually done in RGB mode and a large format transparency output produced. That transparency can be used as an original to be scanned again and converted to CMYK but the usual practice is to use the transparency output for client approval only. The CMYK conversions and film separations are produced working directly from the digital file to suit the various media usages.

Photographers are mainly involved in the RGB capture end of the business. The proliferation of Photoshop, plus the advent of high quality desktop scanner and digital cameras, means that more images than ever before are starting out in and staying in RGB color. This is an important factor that makes color management so necessary and also one of the reasons why I devote so much attention to the managing of RGB color, here and elsewhere in the book. But if professional photographers are more likely to supply a digital file at the end of a job, how will this fit in with existing repro press workflows that are based on the use of CMYK color? Although digital capture has clearly taken off, the RGB to CMYK issue has to be resolved. If the work you create is intended for print, the conversion of RGB to CMYK must be addressed at some point and so for this important reason, we shall also be looking at CMYK color conversions later on in this chapter.

### **Color management references**

If your main area of business revolves around the preparation of CMYK separations for print, then I do recommend you invest in a training course or book that deals with CMYK repro issues. I highly recommend the following books: *Real World Color Management* by Bruce Fraser, Chris Murphy and Fred Bunting. *Color Management for Photographers* by Andrew Rodney and *Getting Colour Right, The Complete Guide to Digital Colour Correction* by Neil Barstow and Michael Walker.

### **Color vision trickery**

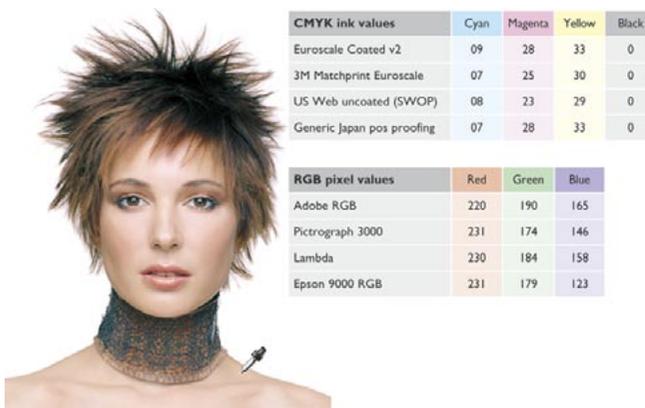
They say that seeing is believing, but nothing could be further from the truth, since there are many interesting quirks and surprises in the way we humans perceive vision. There is an interesting book on this subject titled *Why We See What We Do*, by Dale Purves and R. Beau Lotto (Sinauer Associates, Inc). And also a website at [www.purveslab.net](http://www.purveslab.net), where you can have a lot of fun playing with the interactive visual tests, to discover how easily our eyes can be deceived. What you learn from studies like this is that color can never be properly described in absolute mathematical terms. How we perceive a color can also be greatly influenced by the other colors that surround it. This is a factor that designers use when designing a product or a page layout. You do it too every time you evaluate a photograph, probably without even being aware of it.

### Beyond CMYK

There are other types of output to consider, not just CMYK. Hexachrome is a six-color ink printing process that extends the range of color depth attainable beyond conventional limitations of CMYK. This advanced printing process is currently available only through specialist print shops and is suitable for high quality design print jobs. Millions have been invested in the four-color presses currently used to print magazines and brochures, so expect four-color printing to still be around for a long time to come, but Hexachrome will open the way for improved color reproduction from RGB originals. Photoshop supports six-color channel output conversions from RGB, but you will need to buy a separate plug-in utility like HexWrench. Spot color channels can be added and previewed on screen: spot color files can be saved in DCS 2.0 or TIFF format. Multimedia publishing is able to take advantage of the full depth of the RGB color range. If you are working in a screen-based environment for CD, DVD and web publishing, RGB is ideal. And with today's web browsers, color management can sometimes be turned on to take full advantage of the enhanced color control these programs can now offer.

### Output-centric color management

Printers who work in the repro industry naturally tend to have an 'output-centric' view of color management. Their main concern is getting the CMYK color to look right on a CMYK press. But the printer can color correct a CMYK image 'by the numbers' if they wish. Take a look at the photograph of the young model in Figure 12.3. Her Caucasian flesh tones should at least contain equal amounts of magenta and yellow ink, with maybe a slightly greater amount of yellow, while the cyan ink should be a quarter to a third of the magenta. This rule will hold true for most CMYK press conditions. The accompanying table compares the CMYK and RGB space measurements of a flesh tone color. However, you will notice there are no similar formulae that can be used to describe the RGB pixel values of a flesh tone. If you were to write down the flesh tone numbers for every RGB device color space, you could in theory build an RGB color space reference table. And from this you could feasibly construct a system that would assign meaning to these RGB numbers for any given RGB space. This is basically what an ICC profile does except an ICC profile may contain several hundred color reference points. These can then be read and interpreted automatically by the Photoshop software and give meaning to the color numbers.



**Figure 12.3** The tables shown here record the color readings in RGB and CMYK color spaces of a typical Caucasian flesh tone. As is explained in the text, while the CMYK readings are all fairly consistent, this is not the case when you try to compare the RGB values.

## Profiled color management

The objective of profiled color management is to use the measured characteristics of everything involved in the image editing workflow from capture to print and to reliably translate the color at every stage. In a normal Photoshop workflow, the color management process begins with reading the profiled RGB color data from the incoming file and if necessary converting it to the current Photoshop RGB work space. While the image is being edited in Photoshop the RGB work space image data is sent to the computer display and converted on-the-fly to the profiled monitor space so that the colors are viewed correctly. When the image is finally output as a print, the RGB work space data is converted to the profile space of the printer. Or, you might carry out an RGB to CMYK conversion to the CMYK profile of a known proof printer.

A profile is therefore a useful piece of information that can be embedded in an image file. When a profile is read by Photoshop and color management is switched on, Photoshop is automatically able to find out everything it needs to know in order to manage the color correctly from there on. Note that this will also be dependent on you calibrating your monitor, but essentially all you have to do apart from that is to open the Photoshop Color Settings from the Edit menu and select a suitable preset such as the US Prepress Default setting. Do this and you are all set to start working in an ICC color managed workflow.

Think of a profile as being like a postcode (or ZIP code) for images. For example, the address label shown in Figure 12.4 was rather optimistically sent to me at 'Flat 14, London', but thanks to the postcode it arrived safely! Some labs and printers have been known to argue that profiles cause color management problems. This I am afraid is like a courier company explaining that the late delivery of your package was due to you including a ZIP code in the delivery address. A profile can be read or it can be ignored. What is harmful in these circumstances is an operator who refuses to use an ICC workflow. If you feel you are getting the runaround treatment, it may be time to change labs.



**Figure 12.4** Even if you have never been to London before, you know it's a fairly big place and 'Flat 14, London' was not going to help the postman much to locate my proper address. However, the all-important ZIP code or postcode was able to help identify exactly where the letter should have been delivered. An image profile is just like a ZIP code – it can tell Photoshop everything it needs to know about a file's provenance.

### Translating the color data

One way to comprehend the importance of giving meaning to the numbers in a digital file is to make a comparison with what happens when language loses its meaning. There is an excellent book by Lynne Truss called *Eats, Shoots & Leaves: The Zero Tolerance Approach to Punctuation*. It is partly a rant against poor punctuation, but also stresses the importance of using punctuation to assign exact meaning to the words we read. Remove the punctuation and words will easily lose their true intended meaning. Another good example is the way words can have different meanings in other languages. So a word viewed out of context can be meaningless unless you know the language that it belongs to. For example, the word 'cane' in English means 'dog' in Italian.

### Color Management Modules

The International Color Consortium (ICC) is an industry body that represents the leading manufacturers of imaging hardware and software. The ICC grew out of the original Color Consortium that was established in 1993 and has been responsible for extending and developing the original ColorSync architecture to produce the standardized ICC format which enables profiles created by different vendors to work together. All ICC systems are basically able to translate the color gamut of a source space via a reference space (the Profile Connection Space) and accurately convert these colors to the gamut of the destination space. At the heart of any ICC system is the Color Management Module, or CMM, which carries out all the profile conversion software processing. Although the ICC format specification is standardized, this is one area where there are some subtle differences in the way each CMM will handle the data. In Photoshop you have a choice of three CMMs: Adobe Color Engine (ACE), Apple ColorSync or Apple CMM. And there are other brands of CMM that you can use as well. But this really need not concern most Photoshop users. The default CMM used in Photoshop is Adobe (ACE) and I recommend that you leave this as set.

### The Profile Connection Space

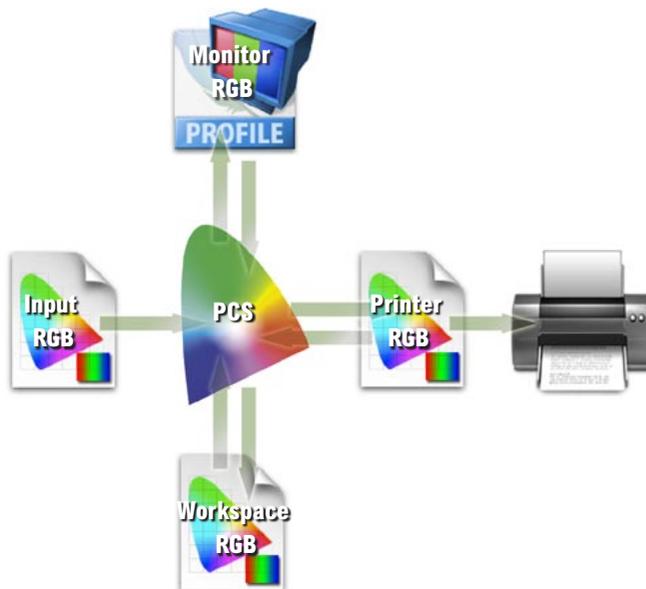
If the CMM is the engine that drives color management, then the Profile Connection Space, or PCS, is at the hub of any color management system. The PCS is the translator that can interpret the colors from a profiled space and define them using either a CIE XYZ or CIE LAB color space. The Profile Connection Space is an interim space. It uses unambiguous numerical values to describe color values using a color model that matches the way we humans observe color. You can think of the PCS as being like the color management equivalent of a multilingual dictionary that can translate a language into any other language.

If an ICC profile is embedded in the file, Photoshop will recognize this and know how to correctly interpret the color data. The same thing applies to profiled CMYK

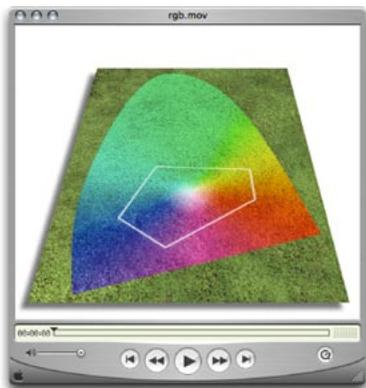
files as well. Photoshop uses the monitor display profile information to render a color correct preview on the monitor screen. It helps to understand here that in an ICC color managed workflow in Photoshop, what you see on the monitor is always a color corrected preview and you are not viewing the actual file data. So when the RGB image you are editing is in an RGB work space, such as Adobe RGB, and color management is switched on, what you see on the screen is an RGB preview that has been converted from Adobe RGB to your profiled monitor RGB via the PCS. The same thing happens when Photoshop previews CMYK data on the screen. The Photoshop color management system calculates a conversion from the file CMYK space to the monitor space. Photoshop therefore carries out all its color calculations in a virtual color space. So in a sense, it does not really matter which RGB work space you edit with. It does not have to be exactly the same as the work space set on another user's Photoshop system. If you are both viewing the same file, and your displays are correctly calibrated and profiled, a color image should look near enough the same on both monitors.



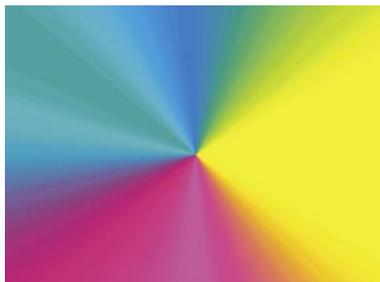
**Figure 12.5** A color management system is able to read the profile information from an incoming RGB file and behind the scenes it will build a table that correlates the source RGB information with the Profile Connecting Space values.



**Figure 12.6** Photoshop can read or make use of the profile information of an incoming RGB file and translate the data via the Profile Connecting Space and make an RGB to RGB conversion to the current RGB work space in Photoshop. As you work in RGB mode, the image data is converted via the PCS using the monitor profile to send a profile-corrected signal to the monitor display. When you make a print the image data is then converted from the work space RGB to the printer RGB via the PCS.



**Figure 12.7** The DVD accompanying this book contains a short movie which helps to explain the RGB space issue by graphically comparing some of the main RGB spaces.



**Figure 12.8** A CMYK color space is mostly smaller than the monitor RGB color space. Not all CMYK colors can be displayed accurately due to the physical display limitations of the average computer monitor. This screen shot shows a continuous spectrum going through shades of cyan, magenta and yellow. The image was then deliberately posterized in Photoshop. Notice how the posterized steps grow wider in the Yellow and Cyan portions of the spectrum. This sample gradient pinpoints the areas of the CMYK spectrum which fall outside the gamut of a typical CRT monitor.

## Choosing an RGB work space

Although I highly recommended that you switch on the color management settings in Photoshop, you cannot assume that everyone else will. There are many other Photoshop users and color labs from the Jurassic era who are running outputs from files with Photoshop color management switched off and are not bothering to calibrate their displays properly.

If you are using Photoshop 6.0 or later it matters less individually which RGB color space you choose in the RGB setup, as long as you stick to using the same space for all your work. RGB to RGB conversions are not as destructive as RGB to CMYK conversions, but the space you plump for does matter. Once chosen you should not really change it. And whichever color work space you select in the RGB color settings, you will have to be conscious of how your profiled Photoshop RGB files may appear on a non-ICC savvy Photoshop system. What follows is a guide to the listed RGB choices.

### Apple RGB

This is the old Apple 13" monitor standard. In the early days of Photoshop this was used as the default RGB editing space where the editing space was the same as the monitor space. If you have legacy images created in Photoshop on a Macintosh computer using a gamma of 1.8, you can assume Apple RGB to be the missing profile space.

### sRGB IEC-61966-2.1

sRGB was conceived as a multipurpose color space standard that consumer digital devices could all standardize to. It is essentially a compromise color space that provides a uniform color space which all digital cameras and inkjet printers and monitors are able to match. sRGB aims to match the color gamut of a typical 2.2 gamma PC monitor. Therefore if you are opening a file from a consumer digital camera or scanner and there is no profile embedded, you can assume that the missing profile should be sRGB. It is an ideal color space for web design but unsuitable for

photography or serious print work. This is mainly because the sRGB space clips the CMYK gamut quite severely and you will never achieve more than 75–85% cyan in your CMYK separations.

### **ColorMatch RGB**

ColorMatch is an open standard monitor RGB space that was implemented by Radius. ColorMatch has a gamma of 1.8 and is favored by some Macintosh users as their preferred RGB working space. Although not much larger than the gamut of a typical monitor space, it is at least a known standard and more compatible with legacy, 1.8 gamma Macintosh files.

### **ProPhoto RGB**

This is a large gamut RGB space that has the advantage of preserving the full gamut of raw capture files when converting the raw data to RGB. It is also suited for image editing that is intended for output to photographic materials such as transparency emulsion or a photo quality inkjet printer. This is because the gamut of ProPhoto RGB extends more into the shadow areas compared to most other RGB spaces, meaning better tonal separation in the shadow tones.

### **Adobe RGB (1998)**

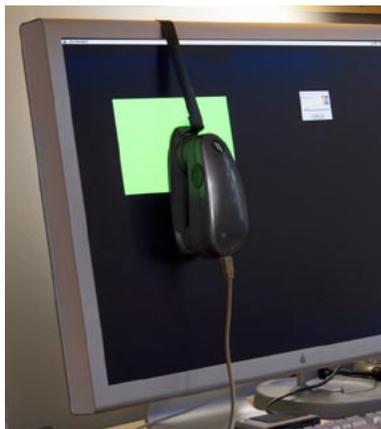
Adobe RGB (1998) has become established as the recommended RGB editing space for RGB files that are destined to be converted to CMYK. For example, the Photoshop prepress color settings all use Adobe RGB as the RGB working space. Adobe RGB was initially labeled as SMPTE-240M which was a color gamut proposed for HDTV production. As it happens, the coordinates Adobe used did not exactly match the actual SMPTE-240M specification. Nevertheless, it proved popular as an editing space for repro work and soon became known as Adobe RGB (1998). I have in the past used Adobe RGB as my preferred RGB working space, since it is well suited for RGB to CMYK color conversions.

### **The ideal RGB working space**

If you select an RGB work space that is the same size as the monitor space, you are not using Photoshop to its full potential and more importantly you are probably clipping parts of the CMYK gamut. For many years I would have advised you to choose Adobe RGB as your work space, because it appeared to offer the best compromise between encompassing most of the CMYK gamut but without being so large as to be unwieldy. However, a few years ago I was in conversation with the late Bruce Fraser and he convinced me that cautionary warnings against ProPhoto RGB were perhaps a little overstated, even if you are going to end up converting a file from 16-bit to 8-bit RGB. So following Bruce's advice I mostly now use ProPhoto RGB as my principal RGB work space, although I would still strongly advise making the big tone edits in 16-bit before converting to 8-bit. The only other thing I would caution you on here is to never supply clients with ProPhoto RGB master files. If I ever send out RGB files, I make sure that I only release Adobe RGB or sRGB converted versions. If I am sending a file to someone who I believe is ICC color management savvy, I send them a profiled Adobe RGB version. If I am sending a file by email or to someone who may not understand color management, I always play safe and send them an sRGB version.

### Eyeball calibration

If you don't have a monitor calibration device, you can always build a profile for your monitor using a visual calibration method. You could, for example, use the Display Calibration Assistant that comes with the Mac OS X system. But the problem with relying on visual calibration is that because our eyes are so good at adapting to light, our eyes are poor instruments to use when calibrating a device like a monitor display



**Figure 12.9** Good color management is very much dependent on having your display calibrated and profiled. This should ideally be done using a hardware calibration device like the Gretag MacBeth Eye-One system.

### Profiling the display

The first step to making color management work in Photoshop is to calibrate and profile the screen display. This is by far the most important and essential first link in the color management chain. You can live without scanner profiling and it is not the end of the world if you can't profile every printer/paper combination. But you simply must have a well-calibrated and profiled display. It is after all the instrument you most use to make color editing decisions with.

In Chapter 3 I mentioned some of the equipment and software options that you can buy these days and showed a quick run through of how to calibrate a computer screen using a calibration device. I would strongly urge you to purchase a proper measuring instrument and use this to calibrate the display on a regular basis. A hardware calibration device combined with a dedicated software utility is the only way that you can guarantee getting good color from your system. This will enable you to precisely calibrate your display and build an accurate monitor profile. At the time of writing, I found four basic monitor profiling packages, which include a colorimeter and basic software program, all for under \$300. Highly recommended is the *basIColor Display and Squid* combination. Then there is the Gretag MacBeth Eye-One Display 2 that comes with Eye-One Match 2 software, the Monaco Optix XR system and lastly the ColorVision Monitor Spyder and Spyder2Pro Studio. Of these I would probably recommend the Gretag MacBeth Eye-One Display 2, since I am very familiar with the (more expensive) Eye-One spectrophotometer system, which I use to calibrate and profile the display in my office. It is also an emissive spectrophotometer so I can also use it to build custom printer profiles. The units I have listed here (apart from the Eye-One) are all colorimeters so these can only be used for building monitor profiles. But they are usually regarded as being just as good as more expensive spectrophotometers for this type of task.

### **Calibration and profiling**

Profiling devices are attached to the screen via rubber suckers to a CRT, or hung over the edge of an LCD display using a counter weight that gently rests the calibrator against the surface. Don't use a calibrating device with suckers on an LCD as this will easily damage the delicate surface.

The software packages used will vary in appearance but they essentially all do the same thing. If you are using a CRT monitor it must be switched on for at least half an hour before you attempt to calibrate and profile it. The first stage is to calibrate the display to optimize the contrast and brightness. You should end up with a display luminance of around 85–110 cd/m<sup>2</sup>. Most CRT monitors will allow you to manually adjust the individual color guns to help neutralize the screen. But on an LCD display all you can adjust is usually the brightness. Once this has been done you will want to lock down the hardware controls so they cannot be accidentally adjusted. This should be done before performing the calibration in which a series of colors will be sent to the screen and the measurements used to adjust the video card settings which will fine-tune the display to achieve optimum neutralization.

The second part is the profiling process. Once the screen has been calibrated a longer sequence of color patches will be sent to the screen and measured to build a profile describing how the neutralized screen displays these known colors. This data is collected together to build the profile. At the end you will be asked to name the profile and it should be automatically saved to the correct folder location and assigned as the new default monitor profile.

Some CRT monitor displays such as the Sony Artisan or Barco have built-in internal calibration mechanisms. You literally just switch them on and they self-calibrate to provide optimized performance. This takes a lot of the guesswork out of the calibration process.

Do remember that the performance of the display will fluctuate over time (especially a CRT display). It is therefore important to check and calibrate the monitor at regular intervals.

### **Locating the display profile**

On the Macintosh, the profile should automatically be saved in the Library/ColorSync/Profiles/Displays folder. On a PC, save to the Windows/System32/Spool/Drivers/Color folder.

### **Monitor profile creation settings**

Before you build a profile there are several option settings you have to decide upon. First there is the gamma space which I recommend should always be 2.2, even if it says somewhere that Macintosh users should use 1.8. The white point should be set to 6500 K. You may see 5000 K as the recommended setting, but your display will perform much better at 6500 K and is also closer to the native white point of most LCD displays (where possible select the native white point of your LCD). Select a small profile size for CRT profiles and large profile size for LCD profiles.

### **LCD hardware calibration**

Some high-end LCD displays are beginning to feature hardware-level calibration such as Eizo Coloredge and Mitsubishi Spectraview.



## The ideal computer setup

Your computer working environment is important. Even if space is limited there is much you can do to make your work area an efficient place to work in. Figure 3.1 shows a general view of the office area from where I run the business and do all my Photoshop work and, as you can see, it allows two operators to work simultaneously. The desk unit was custom built to provide a large continuous worktop area with good cable management in order to minimize the number of stray leads hanging all over the place. The walls are painted neutral gray with paint I was able to get from a local hardware store, and when measured with a spectrophotometer is almost a perfect neutral color. The under shelf lighting uses cool fluorescent strips that bounce off behind the displays to avoid any light hitting

## Chip acceleration

Upgrading the processor chip is the most dramatic way you can boost a computer's performance. But not all computers will allow you to do this. If you have either a daughter card slot or some other processor upgrade slot then you will be able to upgrade your old computer and give it a new lease of life. The upgrade card may also include an increase of backside cache memory to further enhance performance. The cache memory stores frequently used system commands and thereby takes the strain away from the processor chip allowing faster performance on application tasks.



**Figure 3.1** This is the office area where I carry out all my Photoshop work. It has been custom built so that the desk area remains as clear as possible. The walls are painted neutral gray to absorb light and reduce the risk of color casts affecting what you see on the monitor screens. The lighting comes from daylight balanced tubes which backlights the monitor screens. I usually have the light level turned down quite low, in order to maximize the monitor viewing contrast. And yes, it really did used to look this tidy once!

**Chip speed**

Microchip processing speed is expressed in megahertz, but performance speed also depends on the chip type. A 2 GHz Pentium class 4 chip is not as fast as a 2 GHz Intel Duo Core processor. Speed comparisons in terms of the number of megahertz are only valid between chips of the same series. Many of the latest computers are also enabled with twin processing. And another crucial factor is the bus speed. This refers to the speed of data transfer from RAM memory to the CPU (the central processing unit, i.e. the chip). CPU performance can be restricted by slow system bus speeds so faster is better, especially for Photoshop work where large chunks of data are always being processed.

the screens directly. The window is north facing, so I never have any problems with direct sunlight entering the room and what daylight does enter the office can be controlled with the venetian blind. It is also important to choose a chair that is comfortable, ideally one with arm rests and adjustable seating positions so that your wrists can rest comfortably on the table top. The monitor should be level with your line of view or slightly lower.

Once you start building an imaging workstation, you will soon end up with lots of electrical devices. While these in themselves may not consume a huge amount of power, do take precautions against too many power leads trailing off from a single power point. Cathode ray tube monitors are vulnerable to damage from the magnets in an unshielded speaker or the electrical motor in an inkjet printer. Just try not to position any item other than the computer too close to a CRT monitor screen. Interference from other electrical items can cause problems too. To prevent damage or loss of data from a sudden power cut, place an uninterruptible power supply unit between your computer and the mains source. These devices will also smooth out any voltage spikes or surges in the electricity supply.

**Choosing a display**

The display is one of the most important components in your entire kit. It is what you will spend all your time looking at as you work in Photoshop. You really do not want to economize by buying a cheap screen that is unsuited for graphics use. There are two types of display that you can buy: cathode ray tube (CRT) monitors and liquid crystal displays (LCDs). A cathode ray tube fires electrons from its red, green and blue guns to produce a color image as the electrons strike the colored phosphor screen. CRTs have been around a long time and they remain popular with high-end graphics users. This is because most CRT displays make it possible to manually adjust the calibration of the display (see page 103) so that you can achieve a nice, neutral-looking output and

there is less further adjustment required with the monitor profile. So ideally, the monitor profile will simply fine-tune the image to appear correctly on the calibrated CRT. But because CRT displays are analog devices, they are prone to fluctuate in performance and output. This is why you must always calibrate a CRT monitor regularly. The hardware controls of a CRT will typically allow you to adjust the contrast, brightness and color balance of the display output. The more expensive CRT monitors such as the Barco Calibrator have built-in self-calibrating tools. These continually monitor and regulate the output from the moment you switch the device on. A 22" CRT display is a big and bulky piece of equipment, whereas the light, slim-line design of a flat panel LCD screen will occupy less desk space. LCDs range in size from the screens used on a laptop computer to big 30" desktop displays. An LCD contains a translucent film of fixed-size liquid crystal elements that individually filter the color of a backlit, fluorescent light source. Therefore, the only hardware adjustment you can usually make is to adjust the brightness of the backlit screen. You can calibrate the brightness of the LCD hardware but that is about all you can do. The contrast is fixed, but it is usually more contrasty than a typical CRT monitor, which is not a bad thing when doing Photoshop work for print output.

Because LCDs are digital devices they tend to produce a more consistent color output. They still need to be calibrated and profiled, but the display's performance will remain fairly consistent over longer periods of time. On the other hand, there will be some variance in the image appearance depending on the angle from which you view the screen. The brightness and color output of an LCD will only appear to be correct when the screen is viewed front on. And this very much depends on the design of the LCD display. The worst examples of this can be seen on ultra-thin laptop display screens. But the evenness of the output from a 23" Apple Cinema display and other desktop LCD screens is certainly a lot more consistent.

### Using a second display

If you are able to run two displays from your computer, then you might want to invest in a second, smaller screen and have this located beside the main display and use it to show the Photoshop palette windows and keep the main screen area clear of palette clutter. To run a second display you may need to buy an additional PCI card that provides a second video port.

### Floating windows

In the past, PC users were restricted by the limits of the Photoshop application window. This is now resolved in two ways. Firstly, because Bridge is now a separate application, it is no longer constrained to working in Photoshop, as we were with the File Browser. And secondly, Photoshop has a floating windows feature in the PC version which lets you move document windows outside the bounds of the application window.

### Video cards

The graphics card in your computer is what drives the display. It processes all the pixel information and converts it to draw a color image on the screen. An accelerated graphics card will enable your screen to do several things. It will allow you to run your screen display at higher screen resolutions, hold more image screen view data in memory and it will use the monitor profile information to finely adjust the color appearance. When more of the off-screen image data remains in memory the image scrolling is enhanced and this provides generally faster screen refreshes. In the old days, computers were sold with a limited amount of video memory. If you were lucky you could just about manage to run a small screen in millions of colors. If you buy a computer today the chances are that it will already be equipped with a good, high performance graphics card, easily capable of doing all of the above. These cards will contain 128 MB (or more) of dedicated memory. There is probably not much advantage to be gained in fitting anything other than this (unless you have a very large LCD screen) because the top of the range graphics cards are mostly optimized to provide faster 3D games performance rather than providing a better 2D display.

It is interesting to speculate what displays will look like in the future. BrightSide Technologies ([www.brightsidetech.com](http://www.brightsidetech.com)) has developed an LCD display which uses a matrix of LED lights instead of a fluorescent light source to pass light through the LCD film. These displays have an incredible dynamic range and are capable of displaying a 16-bit per channel image with an illumination range that makes an ordinary 8-bit display look dull and flat by comparison. We may one day have display technologies that are able to get closer to simulating the dynamic range of natural light. These will be great for viewing computer games and video, but for Photoshop print work we will mostly want to have the display we are looking at match our expectations of what can be reproduced on a print.

### Display calibration and profiling

We now need to focus on what is the most important aspect of any Photoshop system: getting the monitor to correctly display your images in Photoshop at the right brightness and neutralized to avoid introducing color casts. This basic setup advice should be self-evident, because we all want our images in Photoshop to be consistent from session to session and match in appearance when they are viewed on another user's system. There are several ways that you can go about this. At a bare minimum you will want to calibrate the monitor display so that the contrast is turned up to maximum, that the brightness is consistent with what everyone else would be using and that neutral grays really do display as gray on the screen. As I mentioned earlier, CRT displays will fluctuate in performance all the time. So before you calibrate a CRT monitor, it should be left switched on for at least half an hour to give it a chance to warm up properly and stabilize. A decent CRT monitor will have hardware controls that allow you to adjust the brightness and the color output from the individual color guns so that you can easily correct for color shifts and reset the gray balance of the output. However, the life-span of a CRT is about three years and as these devices get older they will lose their brightness and contrast to the point where

they can no longer be successfully calibrated or be reliable enough for Photoshop image editing.

The initial calibration process should get your display close to an idealized state. From there, you can build a monitor profile which at a minimum describes the black point, white point and chosen gamma. The black point describes the darkest black that can be displayed so that the next lightest tone of dark gray is just visible. The white point information tells the video card how to display a pure white on the screen that matches the specified color temperature. For a CRT displays I suggest you use D65/6500. For LCD displays I suggest you select the native white point. And lastly the gamma. This tells the video card how much to adjust the midtone levels compensation. Note that the gamma you choose when creating a monitor profile does not affect how light or dark an image will be displayed in Photoshop. The monitor profile gamma only affects how the midtone levels are distributed. Whether you use a Mac or PC computer, you should always choose a gamma of 2.2 when building a monitor profile. If you use a measuring instrument (see Figure 3.3) to accurately calibrate and profile the display, you can build a monitor profile that will contain a lot more detailed information about how the screen is able to display a broad range of colors.

Basically, the calibration process should reset your hardware to a standardized output. Next, you build a monitor profile that describes how well the display actually performs after it has been calibrated. A good CRT monitor will let you manually adjust the color output of the individual guns (smart monitors like the Sony Artisan and Barco Calibrator do this automatically). If the screen is more or less neutral after calibration there is less further adjustment required to get a perfectly profiled display. The monitor profile sends instructions to the video card to fine-tune the display. If these adjustments are relatively minor, you are making full use of the video card to describe a full range of colors on the screen. If you rely on video card adjustments to calibrate the display as well, then the

### Prolonging the life of a CRT display

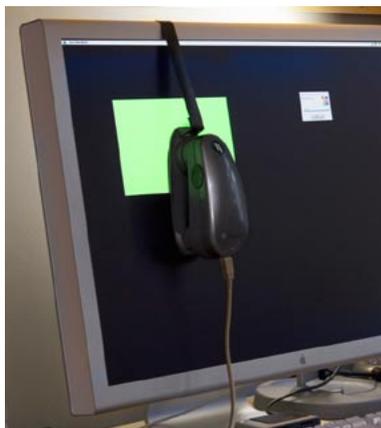
A CRT display will typically provide three years of good use before the tube starts to fade and calibration becomes difficult, although using a screen saver will help prolong the life of a CRT. A CRT monitor display will usually have hardware controls that allow you to configure the alignment of the image. It is suggested that you carefully configure the alignment so that you don't have the display image filling the entire area of the CRT screen. Use the hardware controls to reduce the width and height slightly so that you have, say, a quarter inch unused border around the display viewing area.



**Figure 3.2** This is a screen shot showing the hardware monitor controls for the LaCie Electron Blue III CRT display. The hardware controls enable me to adjust the output of the individual guns that control the red, green and blue color of the display. I adjust these settings as part of the display calibration process to make the screen neutral before building the monitor profile.

### Eizo ColorEdge

Eizo have established themselves as offering the finest quality LCD displays for graphics use. The ColorEdge CG221 is the flagship model in the range. Capable of providing uniform screen display from edge to edge, it encompasses the Adobe RGB gamut and comes with ColorNavigator calibration software that can be used with Gretag MacBeth calibration devices. This display is more expensive than most, but is highly prized for its color fidelity.



**Figure 3.3** The Gretag Macbeth Eye-One is a popular spectrophotometer that can be used to accurately measure the output from the monitor display to both calibrate the output and, using the accompanying Eye-One software, measure color patches and build an ICC profile for your display.

video card is having to make bigger adjustments and the color output may suffer as a result. For example, with a CRT display you can use the monitor hardware controls to regulate and neutralize the color output via the video card. Not all CRT monitors are capable of doing this and LCD displays certainly don't. The only adjustment you can make on an LCD monitor is to adjust the brightness. This is not to say that all LCD screens are unsuitable devices for graphics work. The lower grade LCD displays such as those used on laptop computers are not really good enough for Photoshop color work. But the higher grade LCD screens will feature relatively good viewing angle consistency, are not too far off from providing a neutral color and D65 white balance and won't fluctuate much in performance. As with everything else in life, you get what you pay for. If you are not going to invest in a calibration/measuring device, your best option with an LCD is to load a canned profile for your monitor and keep your fingers crossed. It will sort of work and is better than doing nothing. But I do urge you to consider buying a monitor and calibration device as a complete package.

### Calibration hardware

Let's now look at the practical steps for calibrating and profiling the display. First, get rid of any distracting background colors or patterns on the computer desktop. And consider choosing a neutral color theme for your operating system. The Mac OS X system has a graphite appearance setting especially there for Photoshop users! If you are using a PC, try going to Control Panels ⇒ Appearance ⇒ Themes, choose Display and click the Appearance tab. Click on the active and inactive window samples and choose a gray color for both. If you are using Windows XP, try choosing the silver color scheme. This is all very subjective of course, but personally I think these adjustments improve the system appearances.

The only reliable way to calibrate and profile your display is by using a hardware calibration system. Some displays, such as the LaCie range can be bought with a



**1** An uncalibrated and unprofiled monitor cannot be relied on to provide an accurate indication of how colors should look.



**2** The calibration process simply aims to optimize the display for gray balance, contrast and brightness.



**3** The profiling process records at a minimum the black point, white point, and gamma. With the right software, the profiling process will also measure how a broad range of colors is displayed. Recording this extra color information is the only way you can truly produce an accurate profile.



**4** To create a profile of this kind you need a colorimeter device. A calibrator such as the Gretag Macth Eye-One Display 2 or Eye-One Photo with the Eye-One Match 3.0 or Profile Maker 5 Professional software will produce the most accurate results.

**Color managing the print output**

This leaves the question of how to profile the print output. Well, getting custom profiles built for your printer is a good idea, and this topic is covered in some detail in Chapter 12. However, calibrating and building a profile for your display is by far the most important step in the whole color management process. Get this right and the canned profiles that came with your printer should work just fine. You should already be seeing a much closer match between what you see on the display and what you see coming out of your printer. But without doubt, a custom print profile will help you get even better results.

bundled hardware calibrator, but there are many other types of stand-alone calibration packages to consider. The ColorVision Monitor Spyder and Spyder2Pro Studio are affordable, and are sold either with PhotoCal or the more advanced OptiCal software. The Monitor Spydery are colorimeter devices and can be used to measure the output from a CRT or LCD monitor display. The X-Rite is also a good system and comes with the easy-to-use Monaco OPTIX software.

CRT measuring devices generally use rubber suckers to attach to the screen, but to measure an LCD display, a weighted strap is used to counterbalance the instrument so it just rests against the LCD screen. Whatever you do, don't try attaching anything with rubber suckers to an LCD screen, as you will completely ruin the surface of the display! My personal preference is the Gretag Macbeth Eye-One system, which is available in several different packages. The Eye-One Photo measuring device is an emissive spectrophotometer that can measure all types of displays and build printer profiles as well when used in conjunction with the ProfileMaker 5 or Eye-One Match 3.0 software. The Eye-One Display 2 device is a low cost colorimeter device and is designed for measuring both CRT and LCD displays. If all you are interested in is calibrating and profiling a computer display, there is no great advantage in choosing a spectrophotometer over the more economically priced colorimeter devices. But whatever you do, I do advise you to include a calibrator/software package with any display purchase.

***Do you want good color or just OK color?***

Let me summarize in a few paragraphs why you should pay special attention to how your images are displayed in Photoshop and why good color management is essential.

The choice of an LCD or CRT display can be a matter of individual choice. Although Sony, Eizo, Viewsonic, Phillips and NEC still appear to be selling CRTs, I have a personal preference for using LCDs. Once you have chosen a good display you need to consider how you are

going to calibrate and fine-tune it. This is crucial and if it is done right it will mean you can trust the colors you see on the screen. You are going to be spending a lot of time looking at the display as you work in Photoshop and you will naturally want to see print results that match what you saw on the screen. In the long run you are going to save yourself an awful lot of time and frustration if you calibrate and profile the screen properly from the start. Not so long ago, the cost of a large screen, plus a decent video card, would have cost a small fortune and monitor display calibrators were specialist items. These days, a basic monitor calibration and profiling device can cost about the same as an external hard drive, so I would urge anyone setting up a computer system for Photoshop to put a monitor display calibrator high on their spending list. A standard colorimeter like the Eye-One Display 2 from Gretag MacBeth is easy to set up and use and all the necessary software will be supplied to enable you to calibrate and build a profile for your monitor.

All the monitor display calibrator products I have tested will automatically place a profile for your monitor in the correct folder in your system and you are then ready to start working straight away in Photoshop with a properly calibrated display. Once you are in Photoshop you need to make sure you are using the right color settings for your workflow: see page 110 for instructions on how to check if you are using the right settings for a photography setup. Once that is done, the Color Settings will remain set until you change them. And after that, all you need to worry about is making sure that the calibration and profiling for your display is kept up to date. If you are using a CRT type display, this should probably be done about once a week. If you are using an LCD type display, the profiling is just as important, but regular calibration will not be quite so critical. Checking once a month will probably be enough.

Color management does not have to be intimidatingly complex and nor does it have to be expensive. So the question is, do you want good color or simply OK color? Or, to put it another way, can you afford not to?

### Gamma setup

When you utilize a calibration device the calibrating software will want to ask you which gamma you will be using. Now quite often you are told that PC users should use a 2.2 gamma and Macintosh users should use a 1.8 gamma. But a 2.2 gamma is the ideal gamma setting to use regardless of whether you are on a Mac or a PC. You can build a correct monitor profile using a 1.8 gamma option, but 2.2 is closer to the native gamma of most displays. I once asked an engineer why they still included it as an option in their software and he replied that it's only there to comfort Mac users who have traditionally been taught to use 1.8. So now you know.

### Display luminance

The target luminance will vary according which type of display you are using. A typical modern LCD display will have a luminance of 200 candelas M<sup>2</sup> or more at the maximum luminance setting, which is way too bright for image editing work in subdued office lighting conditions. And with older CRT monitors you may be lucky to reach the desired target of 100 candelas M<sup>2</sup> (a sure sign that the display is due for retirement). A target of around 140 candelas M<sup>2</sup> is ideal for a desktop LCD monitor display.

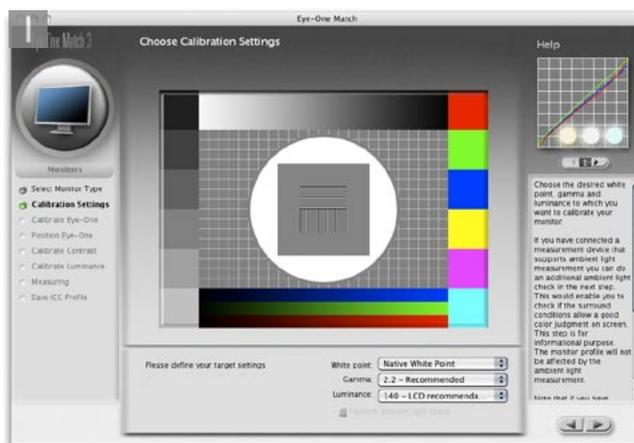
### White point setup

The other puzzling question concerns the white point. You will sometimes be urged to choose a 5000 K whitepoint for print work. My advice is to always use 6500 K instead. Most displays run naturally at a white point of 6500 K. Some people regard 5000 K as being the correct value to use for CMYK proofing work. But in reality, the whites on your display will appear too yellow at this setting. 6500 K may be cooler than the assumed 5000 K standard, but 6500 K will give much better contrast on your display and your eyes always adjust naturally to the colors on the display, the same way as your eyes adjust normally to fluctuations in everyday lighting conditions. The apparent disparity of using one white point for the lightbox and another for the display is not something you should worry about.

With LCD displays it is not possible to physically adjust the whitepoint, so it is better to select the native white point option when calibrating an LCD display. Again, remember that colors are perceived relative to the white point and the eye will compensate naturally from the white point seen on the display to the white point used by an alternative viewing light source.

### Calibration using a third-party calibrator

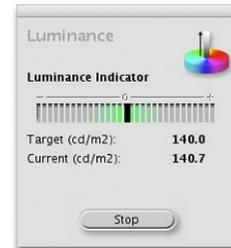
The following steps show an example of how to use the Eye-One Match 3.0 software with a Gretag MacBeth monitor calibration device.



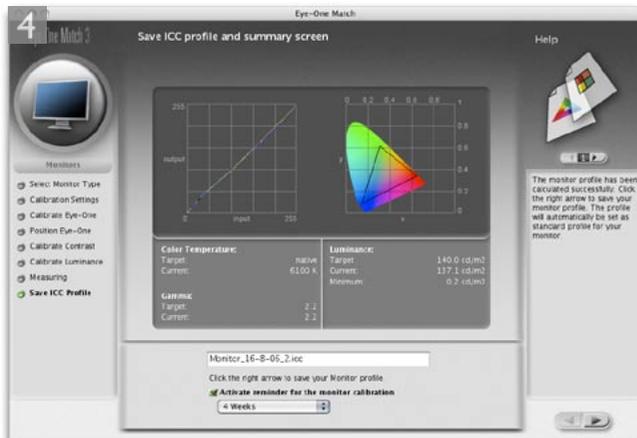
1 I like using Eye-One Match 3 because it is easy to set up and use. The initial screens will ask what type of device you wish to profile. In this case, I wanted to calibrate and profile an LCD display. I set the white point to Native, the Gamma to 2.2 and the luminance to 140 candelas  $M^2$ , the recommended target setting for desktop LCD displays.



2 Eye-One Match will then ask you to calibrate the device (placing it on the base unit to measure the white tile) before hanging the device onto the screen.



3 You will then be asked to set the contrast to maximum (skip this step if calibrating an LCD) and then adjust the brightness, by starting with the brightness controls dimmed right down. Eye-One Match will measure the display as you gradually increase the brightness and indicate when you have reached the target luminance setting you set at the beginning.



4 When you proceed to the next step, Eye-One Match will automatically sense the placement position of the calibration device and start measuring a sequence of colors from the display and, once it has completed doing this, generate a monitor profile named with today's date. All you have to do is click OK to establish this as the new monitor profile to use, replacing any previous monitor profile. You might also want to set a reminder for when the next monitor profile should be made. If you are using an LCD, once every 4 weeks should be just fine.

### Old monitor profiles

Do you really need to hang on to old monitor profiles? I recommend that you purge the ColorSync Profiles folder on your system of older monitor profiles to avoid confusion. All you really need is one good up-to-date profile for your display.

### Camera Raw profiling

As was explained in Chapter 5, the Camera Raw plug-in uses data accumulated from two sets of profiles which have been produced using daylight balanced and tungsten balanced lighting. This method of profiling works surprisingly well with most normal color temperature settings, but the data gathered is based on a small sample of cameras (sometimes just one!) and so cannot be regarded as offering absolute accuracy. It may be helpful to follow the calibrate procedure (described in the same chapter) to obtain improved color.



Figure 12.10 ProfileMaker Pro™ interface.

### Profiling the input

Input profiling is possible but it is easier to do with a scanner than it is with a digital camera. To profile a scanner you need to scan a film or print target and use profile creation software such as Gretag MacBeth's ProfileMaker Pro™ program to read the data and build a custom profile based on readings taken from the scanned target. The target measurements are then used to build a profile that describes the characteristics of the scanner. This profile should be saved to the Macintosh Library/ColorSync/Profiles folder. Or on a PC, save to the Windows/System32/Spool/Drivers/Color folder. It can then be incorporated into your color managed workflow to describe the image data coming into Photoshop (refer back to Figure 12.6). This can be done by selecting the profile in the scanner software or by assigning the profile in Photoshop as the file is opened.

Camera profiling is a lot trickier to do and few photographers feel it is something worth bothering with. This is because the camera sensor will respond differently under different lighting conditions and you would therefore need to build a new profile every time the light changed. This is not necessarily a problem if you are using a digital camera in a studio setup with a consistent strobe lighting setup. In these circumstances it is probably very desirable that you photograph a color checker and take measurements that can be used to create a custom input profile for the camera. The Gretag MacBeth Eye-One Photo system will offer camera profiling.

Overall, I would not stress too much about input profiles unless it is critical to your workflow that you have absolute color control from start to finish. For example, a museum photographer who is charged with photographing important works of art would absolutely want to profile their camera. But is it always necessary or desirable? The most important thing is to trust what you see on your monitor display and obtain good color management between the image displayed on the screen and what you see in the print.

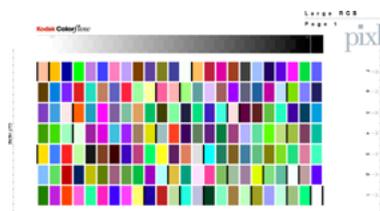


**Figure 12.11** Here are three photographs taken on and around the London Eye wheel. These pictures have each been processed using an incorrect white balance setting. In these examples, input color management becomes irrelevant. But it matters more how consistent the appearance is between the computer display and the print output.

### Profiling the output

Successful color management also relies on having accurate profiles for each type of media paper used with your printer. The printer you buy will come with a driver on a CD (or you can download one) and the installation procedure should install a set of canned profiles that will work when using the proprietary inks designed to be used in this device and with a limited range of branded papers. These tend to be OK in quality and will be enough to get you started. To get the best quality results I will use a test target like the one shown in Figure 12.12 and make a test print without color managing it. Once the test print has been allowed to stabilize, the target is measured the following day using the Gretag MacBeth Eye-One spectrophotometer (see Figure 12.13). The patch measurement results are then used to build a color profile for the printer. The other alternative is to take advantage of Neil Barstow's remote profiling service special offer which is available to readers of this book (see the Appendix).

If using custom printer profiles, you need one to be built for each printer/media combination. I believe it is well worth the expense since it is possible to achieve really excellent results. If you read through to the next chapter on print output, you will see that you can use a profiled printer to achieve good CMYK proofing even from a modestly priced printer, which comes close to matching the quality of a recognized contract proof printer.



**Figure 12.12** This Kodak™ color target can be used to construct a color ICC profile. Neil Barstow of [www.colourmanagement.net](http://www.colourmanagement.net) is offering a special discount rate to readers of this book (see Appendix for more details). A profile service company will normally supply you with instructions on how to print it out. When they receive your prints, they can measure these and email the custom ICC profile back to you. For more information on printing a profile test target, refer to Chapter 14.



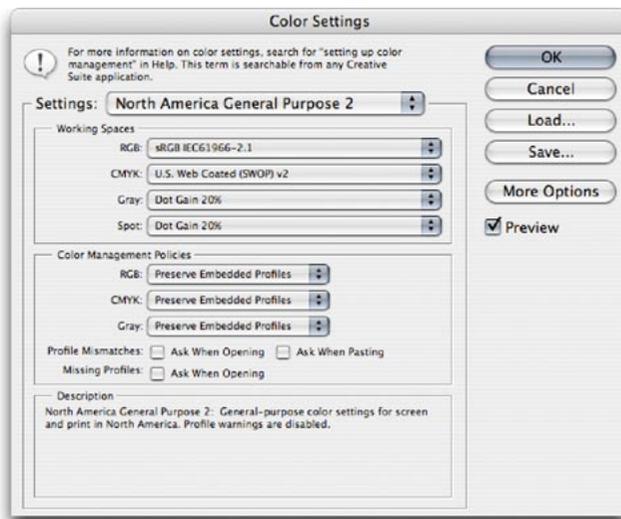
**Figure 12.13** Once a print profile has been printed out, the color patches can be read using a spectrophotometer and the measurements are used to build an ICC profile.



**Figure 12.14** Here we are reexamining the problem encountered at the beginning of this chapter where the skin tones in the original image printed too blue. In the upper workflow no printer profile is used and the image data is sent directly to the printer with no adjustment made to the image data. In the lower example we show how a profile managed workflow works. The profile created for this particular printer is used to convert the image data to that of the printer's color space before being sent to the printer. The (normally hidden) color shifting which occurs during the profile conversion process will compensate by making the skin tone colors more red, but apply less color compensation to other colors. The result is an output that more closely matches the original. This is a simple illustration of the ICC-based color management system at work. All color can be managed this way in Photoshop from capture source to the monitor display and the final proof.

## Photoshop color management interface

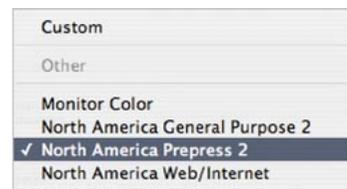
By now you should be acquainted with the basic principles of Photoshop ICC color management. It has become relatively easy to configure the Photoshop system. At the simplest level all you have to do is calibrate and profile your display and then go to the Photoshop Color Settings and select an appropriate prepress setting. This will switch on the Photoshop color management policies and be enough to get you up and running without the need to read any further. But if you are ready to discover more, then do read on.



### The Color Settings

The Color Settings are located in the Edit menu. Figure 12.15 shows the basic dialog controls and options. The first item you will come across is the Settings pop-up menu. Photoshop provides a range of preset configurations for the color management system and these can be edited to meet your own specific requirements. In Basic mode, the default setting will be some sort of General Purpose setting and the exact naming and subsequent settings list will vary depending on the region where you live.

**Figure 12.15** All the Photoshop color settings can be managed from within the Photoshop Color Settings dialog. Photoshop conveniently ships with various preset settings that are suited to different Photoshop workflows. As you move the cursor pointer around the Color Settings dialog, help messages are provided in the Description box area below – these provide useful information which will help you learn more about the Photoshop color management settings and the different color space options.



**Figure 12.16** The default settings are just defaults. I advise changing the setting to one of the prepress settings as this will configure Photoshop to use Adobe RGB as your RGB work space and switch on the Profile Mismatch and Missing Profiles alert warnings.



**Figure 12.17** Here is a full list of the prepress settings (as seen when the More Options is selected). The General Purpose presets will preserve RGB profiles, but use sRGB as the RGB work space instead of Adobe RGB, and CMYK color management will be switched off. This is a little better than the previous Web Graphics default yet may help avoid confusion among novice users. In the basic Fewer Options mode, the choice will be restricted so that all you see will be the color settings for your geographical area.



**Figure 12.18** The Color Management Policies, with the Profile Mismatch and Missing Profile checkboxes checked.

I would recommend that you follow the advice in Figure 12.16 and change this default to one of the prepress settings. So if Photoshop was installed on a European computer, you would select the Europe Prepress Default setting from this list. If a preset color setting says ‘prepress’, this will be the ideal starting point for any type of color managed workflow, especially if you are a photographer. That is all you need to concern yourself with initially, but if you wish to make customized adjustments, then you can select custom settings in the Working Spaces section below. For help selecting an ideal RGB work space, refer back to the section on RGB spaces on pages 552–553. The CMYK and Grayscale settings will be covered later.

### **Color management policies**

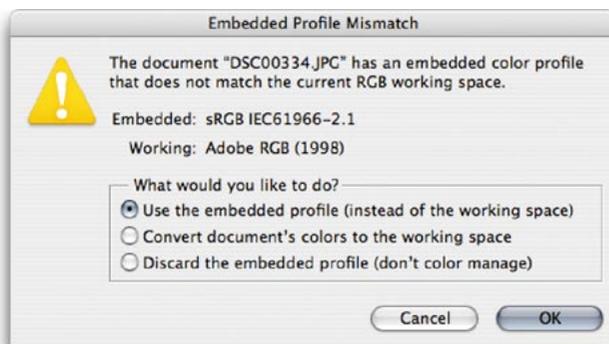
The first thing Photoshop does when a document is opened is check to see if an ICC profile is present. The default policy is to preserve the embedded profile information. So whether the document has originated in sRGB, Adobe RGB or ColorMatch RGB, it will open in that RGB color space and after editing be saved as such. This means you can have several files open at once and each can be in an entirely different color space. A good tip here is to set the Status box to show ‘Document profile’ (on the Mac this is at the bottom left of the image window; on a PC it is at the bottom of the system screen). Or, you can configure the Info palette to provide such information. This will allow you to see each individual document’s color space profile.

### **Profile mismatches and missing profiles**

When there is a profile mismatch, Photoshop will warn you using one of the dialogs shown in Figure 12.19. Which of these you see will depend on the Color Settings. If you have a prepress setting selected, the Profile Mismatch and Missing Profile boxes will automatically be checked and the dialog that is shown when there is a profile mismatch will offer you a chance to convert the document colors to the current work space or discard the profile.

### Preserve embedded profiles

The default policy of Preserve Embedded Profiles allows you to use the ICC color management system straight away, without too much difficulty. So long as there is a profile tag embedded in any file you open, Photoshop will give you the option to open that file without converting it. So if you are given an Apple RGB file to open, the default option is to open it in Apple RGB and save using the same Apple RGB color space. This is despite the fact that your default RGB work space might be Adobe RGB or some other RGB color space. The same policy rules apply to CMYK and grayscale files. Whenever Preserve Embedded Profiles is selected, Photoshop will read the CMYK or Grayscale profile, preserve the numeric data and not convert the colors. And the image will remain in the tagged color space. This is always going to be the preferred option when editing incoming CMYK files because a CMYK file may already be targeted for a specific press output and you don't really want to alter those numeric color values.



### Making color management easier

A newcomer does not necessarily have to fully understand how Photoshop color management works in order to use it successfully. When Preserve Embedded Profiles is selected this will make the Photoshop color management system quite foolproof. The color management system is adaptable enough to suit the needs of all Photoshop users, regardless of their skill levels. Whichever option you select – convert or don't convert – the saved file will always be correctly tagged.

**Figure 12.19** If the Preserve Embedded Profiles color management policy is selected, this dialog will appear whenever there is a profile mismatch between the image you are opening and the current working space. When you see this dialog, click OK to open the image in its embedded color space. Click Don't show again if you don't wish to be reminded each time this occurs.

**Figure 12.20** If the Ask When Opening box is checked in the Profile Mismatches section (see Figure 12.18) then you will see a slightly different dialog like the lower one shown here. If the Ask When Opening option is checked, you can make a choice on opening to use the embedded profile, or override the policy and convert to the working space or discard the embedded profile.

Whatever you do, select one of these options and click OK, because if you click Cancel you will cancel opening the file completely.

**Include a 'Read Me' file**

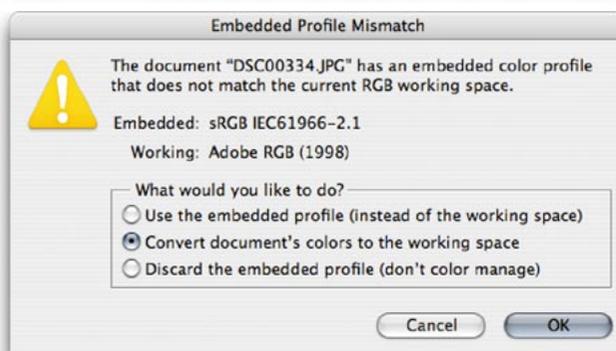
When you save a profiled RGB file, you might want to enclose a Read Me file on the disk to remind the person who receives the image that they must not ignore the profile information.

**Convert to Working space**

If you select the Convert to Working space policy, Photoshop will automatically convert everything to your current RGB or CMYK work space. If the incoming profile does not match the work space, then the default option will be to carry out a profile conversion from the embedded profile space to the current work space. And when the incoming profile matches the current RGB, CMYK or grayscale work space, there is of course no need to convert the colors. Preserve Embedded Profiles is usually the safer option because you can't go wrong if you just click OK to everything. Convert to Working space can be a useful option for RGB mode because you may wish to convert all RGB images to your working space, but not for CMYK. For batch processing work I sometimes prefer to temporarily use a Convert to Working space RGB setting because this will allow me to apply a batch operation to a mixture of files in which all the images end up in the current RGB work space.

**Figure 12.21** If the Convert to Working RGB color management policy is selected, this dialog will appear whenever there is a profile mismatch between the image you are opening and the current working space. When you see this dialog, click OK to convert the document colors to the current color working space. Click Don't show again if you don't wish to be reminded each time this occurs.

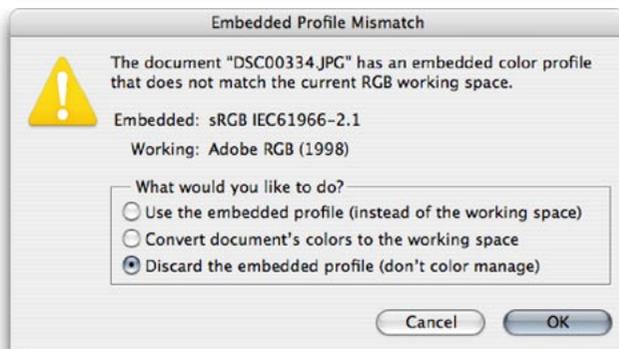
**Figure 12.22** If the Ask When Opening box is checked in the Profile Mismatches section you will see the dialog shown here. You can make a choice on opening to convert to the working space, use the embedded profile, or override the policy and discard the embedded profile.



### Color Management Off

The other option is to choose Color Management: Off. When this option is selected Photoshop will appear not to color manage incoming documents. It will assume the default RGB or CMYK work space to be the source. If there is no profile embedded, then the document will stay that way. If there is a profile mismatch between the source and work space, the profile will be removed (with an alert warning pointing out that the embedded profile information is about to be deleted). But if the source profile matches the work space, there is no need to remove the profile, so in this instance the profile tag will not be removed (even so, you can still remove the ICC profile at the saving stage). So in this instance, Photoshop will still be color managing certain files and strictly speaking is not completely 'off'.

Turning the color management off is not recommended for general Photoshop work. So check the Color Settings to make sure you are not using one of the Web/Internet preset settings that will disable Photoshop's color management.



### When it is good to 'turn off'

Sometimes it is desirable to discard a profile. For example, you may be aware that the image you are about to open has an incorrect profile and it is therefore a good thing to discard it and assign the correct profile later in Photoshop. I would not recommend choosing Off as the default setting though. Just make sure you have the Color Management Policies set to Ask When Opening and you can easily intervene manually to discard the profile when using either of the other color management policy settings.

**Figure 12.23** If the Color Management Off policy is selected, this dialog will appear whenever there is a profile mismatch between the image you are opening and the current working space. When you see this dialog, click OK to discard the embedded profile. Click Don't show again if you don't wish to be reminded each time this occurs.

**Figure 12.24** If the Ask When Opening box is checked in the Profile Mismatches section you will see the dialog shown here. You can make a choice on opening to discard the embedded profile, use the embedded profile or convert to the working space.

**RGB to RGB conversion warning**

A Convert to Profile is just like any other image mode change in Photoshop, such as converting from RGB to Grayscale mode, and it is much safer to use than the old Profile to Profile command in Photoshop 5.0. However, be careful if you use Convert to Profile to produce targeted RGB outputs that overwrite the original RGB master. Any version of Photoshop since version 6.0 will have no problem reading the embedded profiles and displaying the image correctly; and will recognize any profile mismatch (and know how to convert back to the original work space). But as always, customized RGB files such as this may easily confuse other non-ICC savvy Photoshop users. Not everyone is using Photoshop, nor does everyone have their color management configured correctly. Some RGB to RGB conversions can produce RGB images that look fine on a correctly configured system, but look very odd on one that is not (see page 570).

**Profile conversions**

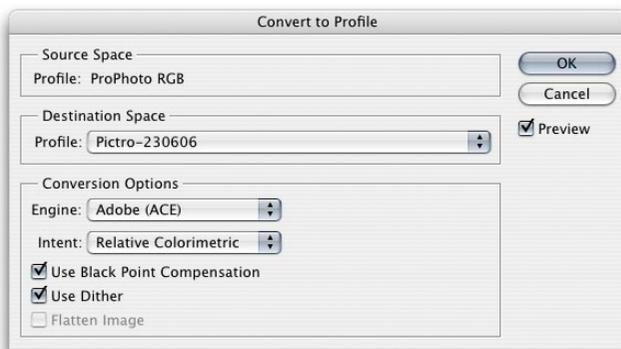
As you gain more experience you will soon be able to customize and create your own color settings. The minimum you need to know is which of these listed color settings will be appropriate for the work you are doing. And to help in this decision making, you can read the text descriptions that appear in the Description box at the bottom of the Color Settings dialog. For example, you might want to start by loading one of the presets present in the Color Settings menu and customize the CMYK settings to match the conditions of your repro output.

**Convert to Profile**

Even if you choose to preserve the embedded profile on opening, it is useful to have the means to convert non-work space files to your current work space after opening. This is where the Convert to Profile command comes in, because you don't have to worry about remembering to convert the image on opening. The profile conversion can take place at any time, such as at the end of a retouch session, just before saving. Let's suppose we want to open an RGB image that is in Adobe RGB and the current working space is sRGB. If the Preserve Embedded Profile option is selected then the default behavior would be to open the file and keep it in Adobe RGB without converting. We could carry on editing the image in the Adobe RGB color space up until the point where it is desirable to carry out a conversion to another color space. To make a profile conversion, go to the Edit menu and choose Convert to Profile... This will open the dialog box shown in Figure 12.25. The Source space shows the current profile space and the Destination Space will most likely default to 'Working RGB', which in this case would be sRGB. But it will also contain a pop-up menu that will list all of the profiles available on your computer system (depending on how many profiles you have installed). The list of available profiles will be divided into several sections that are separated by dividers (see Figure 12.26). The first section starts with the default RGB, CMYK and Grayscale profiles. Below that are all the other available RGB profiles followed by the CMYK and lastly the Grayscale spaces.

The Convert to Profile command is also useful when you wish to create an output file to send to a printer for which you have a custom-built profile but the print driver does not recognize ICC profiles. For example, one of the printers I use is the Fuji Pictograph. I have built a custom profile for this printer, but unfortunately there is no facility within the File Export driver to utilize the output profile. Therefore, I use the Convert to Profile command to convert the color data to match the space of the output device just prior to sending the image data to the printer to make a print.

Whenever you make a profile conversion the image data will end up in a different color space and you might see a slight change in the on-screen color appearance. This is because the profile space you are converting to has a smaller gamut than the one you are converting from. Whether an image is imported that is not in the working colour space or has been converted to one that is not, Photoshop appends a warning asterisk (\*) to the color mode in the title bar (Mac) or status bar (PC).



**Figure 12.25** Convert to Profile is located in the Edit menu and is similar to the old Profile to Profile command in Photoshop 5.0. The color management system in Photoshop 6.0 or later is different in that you don't need to carry out a profile conversion in order to correctly preview a file in Photoshop. It is nevertheless an essential command for when you wish to convert color data from one profile color space to another profile space, such as when you want to convert a file to the profiled color space of a specific output device. In this example, I am using Convert to Profile to convert the RGB data from the source space to the profiled space of my Fuji printer.



**Figure 12.26** The profile list will display all the profiles that are available on your computer.

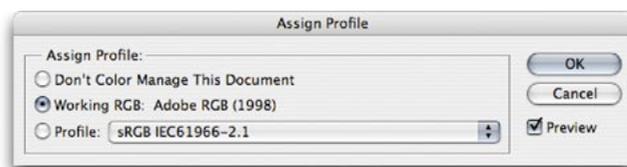
### Incorrect sRGB profile tags

Some digital cameras won't embed a profile in the JPEG capture files or, worse still, embed a wrong profile, yet the EXIF metadata will misleadingly say the file is in sRGB color mode. The danger here is that while you may select Adobe RGB as the RGB space for your camera, when shooting in JPEG mode, the camera may inadvertently omit to alter the EXIF tag which stubbornly reads sRGB.

This can be resolved by going to the Photoshop menu and choosing: Preferences ⇒ File Handling... If you check the Ignore EXIF Profile tag, Photoshop will always ignore the specified camera profile in the EXIF metadata and only rely on the actual profile (where present) when determining the color space the data should be in.

### Assign Profile

The Assign Profile command can be used to correct mistakes by assigning a profile to an image if one is missing, or removing an incorrect profile. When an image is missing its profile or has the wrong profile information embedded then the numbers are meaningless. The Assign Profile command allows you to assign correct meaning to what the colors in the image should be. So, for example, if you know the profile of an opened file to be wrong, then you can use the Edit ⇒ Assign Profile command to rectify the situation. Let's suppose you have opened an untagged RGB file and for some reason decided not to color manage the file when opening. The colors don't look right and you have reason to believe that the file had originated from the sRGB color space. Yet, it is being edited in your current Adobe RGB work space as if it were an Adobe RGB image. By assigning an sRGB profile, we can tell Photoshop that this is not an Adobe RGB image and that these colors should be considered as being in the sRGB color space. You can also use Assign Profile to remove a profile by clicking on the Don't Color Manage This Document button, which will allow you to strip a file of its profile. But you can also do this by choosing File ⇒ Save As... and deselecting the Embed Profile checkbox in the Save options.



**Figure 12.27** The Assign Profile command is available from the Edit menu in Photoshop. Edit ⇒ Assign Profile can be used to assign a new correct profile to an image or remove an existing profile.

### Profile mismatches

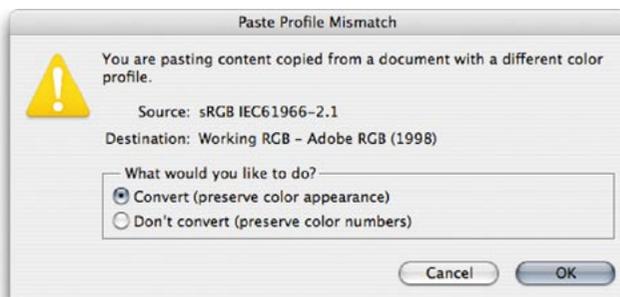
One problem with having images with multiple color spaces open at once concerns the copying and pasting of color data from one file to another. Whenever you copy and paste image data, or drag copy an image with the move tool, it is possible that a profile mismatch may occur; although this will very much depend on how you have the Color Management policy settings configured in the Color Settings (see Figure 12.28). If the Profile Mismatches: Ask When Pasting box is unchecked in the Color Settings and a profile mismatch happens, you will see the dialog shown in Figure 12.29. This will ask if you wish to convert the color data to preserve the color appearance when it is pasted into the new destination document. If the Profile Mismatches: Ask When Pasting box is checked in the Color Settings, then you will see instead the dialog box shown in Figure 12.30. This dialog offers you the choice to convert or not convert the data. If you select Convert, the appearance of the colors will be maintained when you paste the data. If you choose Don't Convert the color appearance will change but the numbers will be preserved.



**Figure 12.28** The Profile Mismatches settings in the Color Management section of the Color Settings dialog will influence Profile Mismatch behavior.



**Figure 12.29** If you attempt to paste image data from a document whose color space does not match the destination space, this dialog warning will appear, alerting you to the fact that there is a profile mismatch between the source and destination documents. If you click OK, Photoshop will convert the data and preserve the color appearance of the image data.



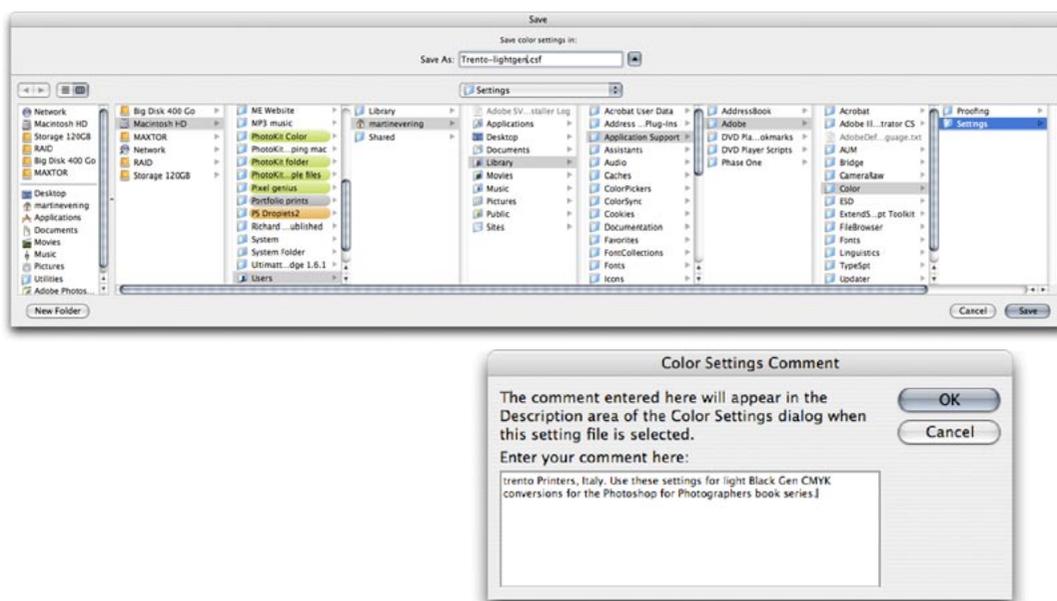
**Figure 12.30** If the Profile Mismatches: Ask When Pasting box is checked in the Color Settings dialog and you attempt to paste image data from a document whose color space does not match the destination space, this dialog warning will give you the option to Convert the colors (as in Figure 12.28 above), or Don't Convert and preserve the numbers instead.

### Color Settings save location

On Mac OS X, if Photoshop CS3 is installed for multi-users, the most likely path to save your settings to is: Users/Username/Library/Application Support/Adobe/Color/Settings folder. On a PC, save your settings to: Program Files/Common Files/Adobe/Color/Settings folder. The file will be appended with a .csf suffix.

### Saving a Color Setting

If you have configured the settings to suit a particular workflow, you can click on the Save... button to save these as a custom setting that will appear in the Color Settings menu the next time you visit the Color Settings dialog. When you save a setting you can enter any relevant comments or notes about the setting you are saving in the text box (see Figure 12.31). This information will then appear in the Color Settings dialog text box at the bottom. You might name the setting something like 'Client annual report settings' and so you might want to write a short descriptive note to accompany the setting.



**Figure 12.31** Custom color settings can be loaded or saved via the Color Settings dialog. The relevant folder will be located in the Username Library/Application Support/Adobe/Color/Settings folder (Mac OS X) or Program Files/Common Files/Adobe/Color/Settings folder (PC). When you save a custom setting it must be saved to this location and will automatically be appended with the '.csf' suffix. When you save a color setting you have the opportunity to include a brief text description in the accompanying dialog. A Color Settings file can be shared between some Adobe applications and with other Photoshop users. The Mac OS X location of the settings file is user-specific, so the route is: Users/Username/Library/Application Support/Adobe/Color/Settings folder.

### Reducing the opportunities for error

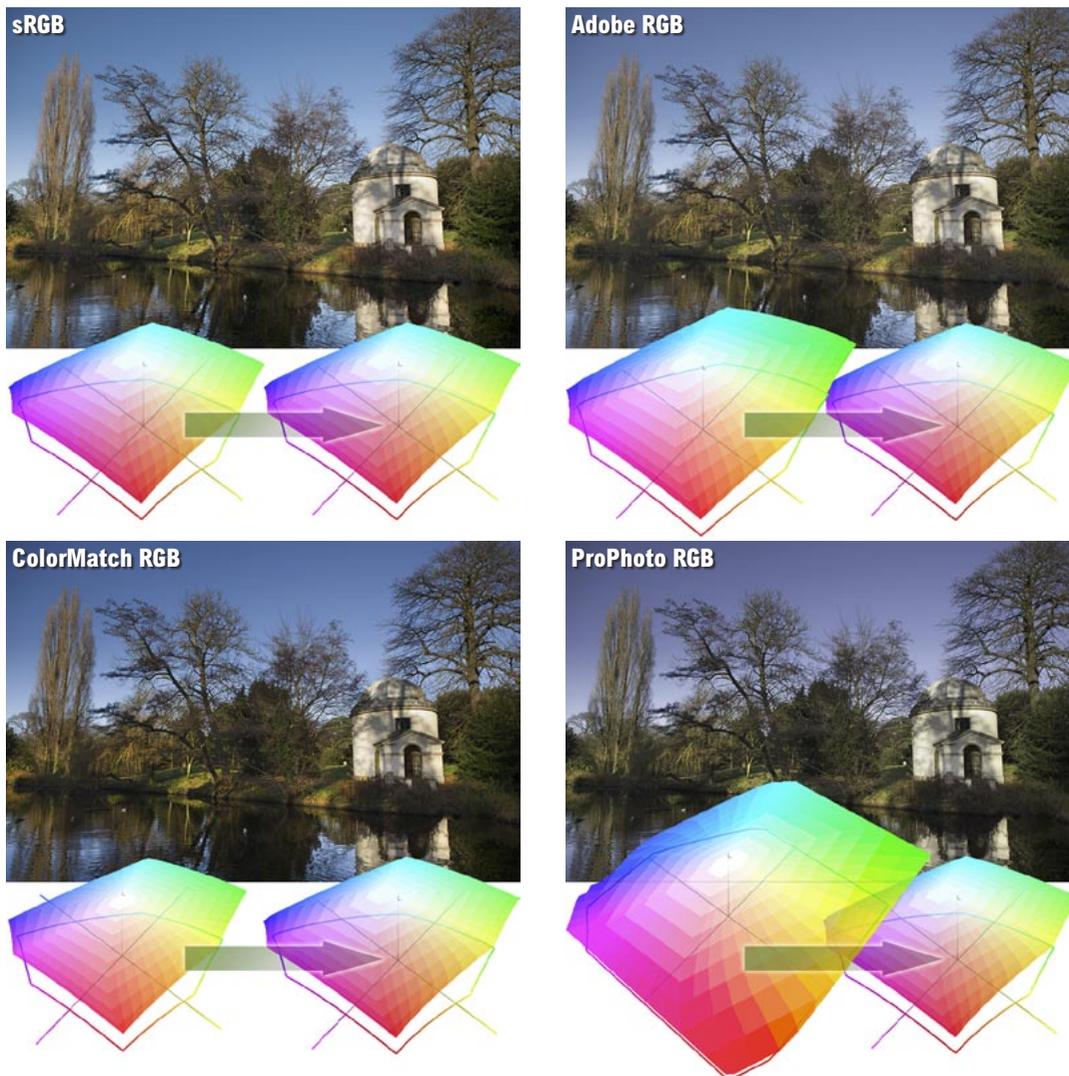
When you adopt an RGB space such as Adobe RGB as the preferred work space for all your image editing, you have to take into account that this might cause confusion when exchanging RGB files between your machine operating in a color managed workflow and that of someone who is using Photoshop with the color management switched off. When sending image files to other Photoshop users, the presence of a profile will help them to read the image data correctly. So as long as they have the Photoshop color settings configured to preserve embedded profiles (or convert to the working space) and their monitor display is calibrated correctly, they will see your photographs on their system almost exactly the way you intended them to be seen. The only variables will be the accuracy of their display calibration and profile, the color gamut limitations of the display and the environment it is being viewed in. Configuring the Color Settings correctly is not difficult to do, but the recipient does have to be as conscientious as you are about ensuring their monitor display is set up correctly. The situation has not been helped either by the way the default color settings have shifted about over the last seven versions of the program. The default settings in Photoshop CS3 use Preserve Embedded Profiles, but prior to that we had settings like 'Web Graphics' in which color management was switched off. Consequently, there are a lot of Photoshop users out there who have unwittingly been using sRGB as their default RGB work space and with color management switched off. And even when people do have the color management switched on, the monitors they are using may not have been profiled in months or are being viewed in a brightly lit room!

It is important to be aware of these potential problems because it is all too easy for the color management to fail once an image file has left your hands and been passed on to another Photoshop user. With this in mind, here are some useful tips to help avoid misunderstandings over color. The most obvious way to communicate what the colors are supposed to look like is to supply a printed output that

### Playing detective

How you deliver your files will very much depend on who you are supplying them to. I often get emails from readers who have been given the runaround by their color lab. One typically finds that the lab may be using a photo printer such as the Fuji Frontier which does not read incoming profiles and is simply calibrated to expect sRGB files. So far so good. As long as you send an sRGB file, you shouldn't have any problems. But if the color lab operator has Photoshop color management switched off, they will not know how to handle anything other than an incoming file that is in sRGB. If you were to supply them with an Adobe RGB file they won't read the profile and the colors will end up looking different in the final print. And then they blame the customer!

It helps to do a little detective work to ascertain the skill level of the recipient. The first thing you need to know is the color settings they are using. That will help you determine which RGB space they are using and whether the color management is switched on or off. The other thing to ask is 'do you have your monitor display calibrated and profiled?' And if the answer is yes, then ask how often they calibrate and profile their display. The answers to these questions will tell you quite a bit about the other person's system, how you should supply your files and also how accurately they should be able to judge the color on their monitor display. Basically, if you have any doubts, the safest option is to convert to sRGB.



**Figure 12.32** The purpose of this illustration is to show what would happen if you submitted an RGB file to a Photoshop user who had their Photoshop system configured using sRGB as their RGB work space and with the color management policies set to ignore incoming profiles. The top left picture is the correct version and shows how the image would look if I supplied the image converted to the sRGB color space, anticipating that the other user was using this as their default RGB space. The remaining examples show how the same picture would look if I had supplied the same picture using different RGB spaces and the person receiving the file ignored the embedded profile. If the picture was delivered as an Adobe RGB file, the gamma would match but because Adobe RGB has a larger gamut than sRGB the colors would appear slightly desaturated. If I supplied a ColorMatch RGB file, sRGB would interpret this as a darker image because ColorMatch has a lower gamma of 1.8. And lastly, ProPhoto RGB has a much larger color gamut than Adobe RGB so the colors would appear even more muted when brought into sRGB without any color management.

shows what the photograph should look like. In fact this is considered routine when supplying images to a printer. If you are sending a file for CMYK repro printing then the file should be targeted to the CMYK output. Don't worry too much about what that means just yet, we will be covering this topic in the following chapter. But supplying a print is an unambiguous visual reference, which if done properly can form the basis of a contract between yourself, the client and the printer.

If the person you are supplying the file to is in the same building or you are in regular contact with them, then you probably have a clear idea of how their system is set up. If they have Photoshop color management switched on, they can read any file you send them in any color space and it will be color managed successfully. But you cannot always make too many assumptions about the people you are sending image files to and so you should sometimes adopt a more cautious approach. I am often asked to supply RGB files as large JPEGs for initial approval by the client before making a finished print. In these situations I find it safer to supply a profiled sRGB image. I do this by choosing Edit ⇒ Convert to Profile... and selecting sRGB as the destination space. If the recipient is color management savvy, then Photoshop will read the sRGB profile and handle the colors correctly. If the recipient has not bothered to configure their color management settings then one can be almost certain that they are using sRGB as their default RGB work space. So in these instances, targeting the RGB colors to sRGB is probably the safer option. Figure 12.32 shows a comparison of how a single image that was edited using different RGB work spaces would look on a Photoshop system configured using a (non-color managed) Web Graphics default setting. In this example, the version that was converted to sRGB was the only one that stood a chance of being displayed correctly. I am certainly not advocating you use sRGB as your standard RGB work space, because it is still a poor space to use for photographic work. But it can be a useful 'dumbed down' space to use when communicating with unknown users.

### Supplying a color proof

To find out more about how to produce a proof print that is targeted to simulate a specific print output, you will find this topic is covered in the following chapter on pages 614–616.

### Grayscale for screen display

If you intend creating grayscale images to be seen on the Internet or in multimedia presentations, choose the Default Web Graphics color setting. The Grayscale work space will then be set to a 2.2 gamma space, which is the same gamma used by the majority of PC computer screens. The truth is, you can never be 100% sure how anybody who views your work will have their monitor calibrated, but you can at least assume that the majority of Internet users will have a PC monitor set to a 2.2 gamma.

### Macintosh gamma

The Macintosh 1.8 gamma setting should really be relegated to ancient history. The reason it exists at all is because in the very early days of the Macintosh computer and before ICC color management, a 1.8 gamma monitor space most closely matched the dot gain of the Apple monochrome laser printer.

### Custom Gray space settings

Figure 12.40 shows a range of dot gain values that can be used as a guide for different types of press settings. This is a rough guide as to which dot gain setting you should use on any given job. When the Advanced color settings option is checked you can enter a custom gamma value or dot gain curve setting (see 'Dot gain' on pages 579–580).

### Working with Grayscale

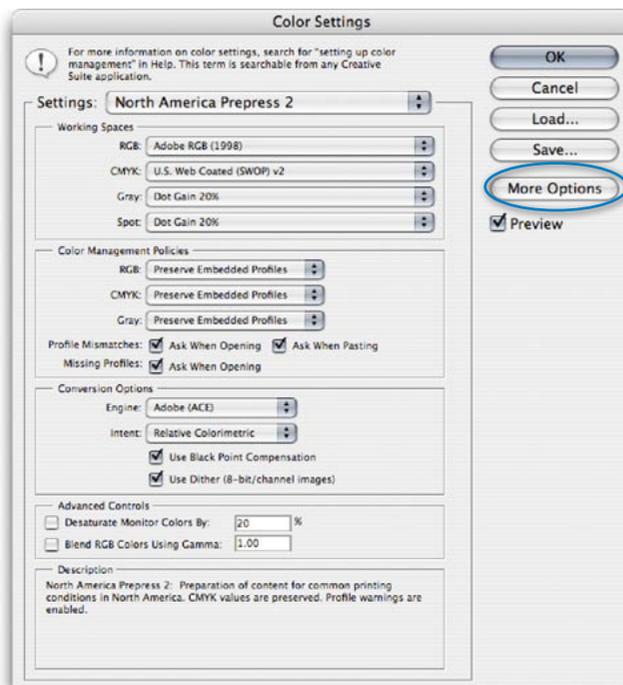
Grayscale image files can also be managed via the Color Settings dialog. The color management policy can be set to either Preserve Embedded Profiles or Convert to Grayscale work space and again the Ask When Opening box should be checked. If the profile of the incoming grayscale file does not match the current Gray work space, you will be asked whether you wish to use the tagged grayscale space profile, or convert to the current grayscale work space. If there is no profile embedded, you will be asked to either: 'Leave as is' (don't color manage), assign the current Gray work space or choose a Gray work space to assign to the file (and, if you wish, convert to the Gray work space).

If you examine the Gray work space options, you will see a list of dot gain percentages and monitor gamma values. If you are preparing grayscale images for display on a monitor such as on a website or in a multimedia presentation then you will want to select an appropriate monitor space setting such as Gamma 2.2 (see the sidebar: Grayscale for screen display). If you want to know how any existing prepress grayscale image will look like on the Web as a grayscale image, select the View ⇨ Proof Setup and choose Windows RGB or Macintosh RGB. You can then select Image ⇨ Adjust ⇨ Levels and adjust the Gamma slider accordingly to obtain the right brightness for a typical Windows or Macintosh display.

For prepress work you should select the dot gain percentage that most closely matches the anticipated dot gain of the press. It is important to note that the Gray work space setting is independent of the CMYK work space. If you want the Gray work space dot gain value to match the black plate of the current CMYK setting, then mouse down on the Gray setting and choose Load Gray... Now go to the Profiles folder which will be in the Library/Application Support/Adobe/Color/Settings folder on a Mac and in the Program Files/Common Files/Adobe/Color/Settings folder on a PC. Select the same CMYK space as you are using for the CMYK color separations and click the Load button.

## Advanced Color Settings

The advanced settings will normally remain hidden. If you click on the More Options button, you will be able to see the expanded Color Settings dialog shown in Figure 12.33. These advanced settings unleash full control over the Photoshop color management system. But do not attempt to adjust any of these expert settings until you have fully understood the intricacies of customizing the RGB, CMYK, Gray and Spot color spaces. I would suggest that you read through the remaining section of this chapter first before you consider customizing any of these settings.



**Figure 12.33** The Photoshop Advanced Color Settings dialog. Clicking on the More Options button will unleash full control over all the Photoshop settings. The following sections of this chapter show how you can customize the color management settings in this advanced mode. Note that the button in this Color Settings dialog view will normally say 'Fewer Options'; I edited the screen shot to say 'More Options', simply to make it more obvious where to click.

**Black Point and Proof printing**

You will want to use Black Point Compensation when separating an RGB image to a press CMYK color space. However, in the case of a conversion from a CMYK proofing space to an inkjet profile space, we must preserve the (grayish) black of the press and not scale the image (because this would improve the blacks). It is for these reasons that the Black Point Compensation is disabled in the Print with Preview dialog when making a proof print to simulate the black ink.

**Conversion options**

You have a choice of three Color Management Modules (CMMs): Adobe Color Engine (ACE), Apple ColorSync or Apple CMM. The Adobe color engine is reckoned to be superior for all RGB to CMYK conversions because the Adobe engine uses 20-bit per channel bit-depth calculations to calculate its color space conversions.

**Black Point Compensation**

This will map the darkest neutral color of the source RGB color space to the darkest neutrals of the destination color space. Black Point Compensation plays a vital role in translating the blacks in your images so that they reproduce as black when printed. As was explained in Chapter 4, there is no need to get hung up on setting the shadow point to anything other than zero RGB. It is not necessary to apply any shadow compensation at the image editing stage, because the color management will automatically take care of this for you and apply a black point compensation obtained from the output profile used in the mode or profile conversion. If you disable Black Point Compensation you may obtain deeper blacks, but you will get truer (compensated) blacks if you leave it switched on.

**Use Dither (8-bit per channel images)**

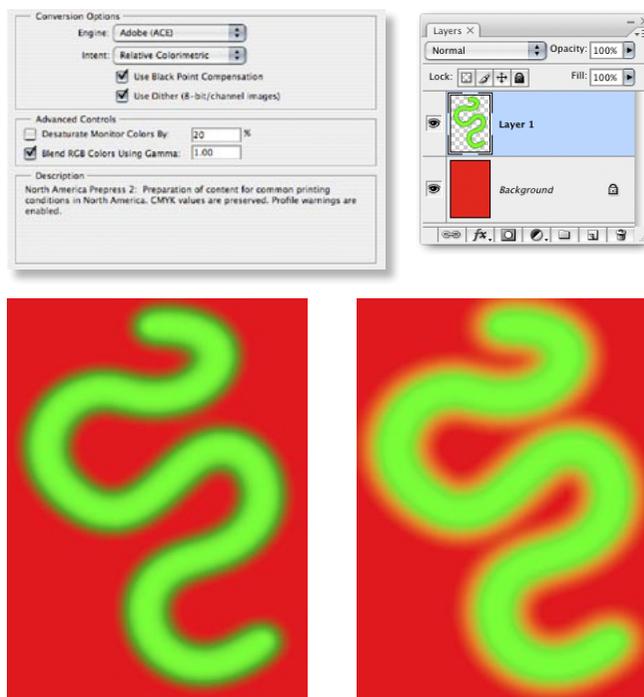
Banding may occasionally occur when you separate to CMYK, particularly where there is gentle tonal gradation in bright saturated areas. Banding which appears on screen does not necessarily always show in print and much will depend on the coarseness of the screen used in the printing process. However, the dither option will help reduce the risks of banding when converting between color spaces.

**Rendering intents**

The rendering intent will influence the way the data is translated from the source to the destination space. The rendering intent is like a rule that describes the way the translation is calculated. We will be looking at rendering intents in more detail on pages 584–587.

### Blend RGB colors using gamma

This item provides you with the potential to override the default color blending behavior. There used to be an option in Photoshop 2.5 for applying blend color gamma compensation. This allowed you to blend colors with a gamma of 1.0, which some experts argued was a purer way of doing things, because at any higher gamma value than this you would see edge darkening occur between contrasting colors. Some users found the phenomenon of these edge artifacts to be a desirable trapping effect. But Photoshop users complained that they noticed light halos appearing around objects when blending colors at a gamma of 1.0. Consequently, gamma-compensated blending was removed at the time of the version 2.5.1 update. But if you understand the implications of adjusting this particular gamma setting, you can switch it back on if you wish. Figure 12.34 illustrates the difference between blending colors at a gamma of 2.2 and 1.0.



### Desaturate monitor colors

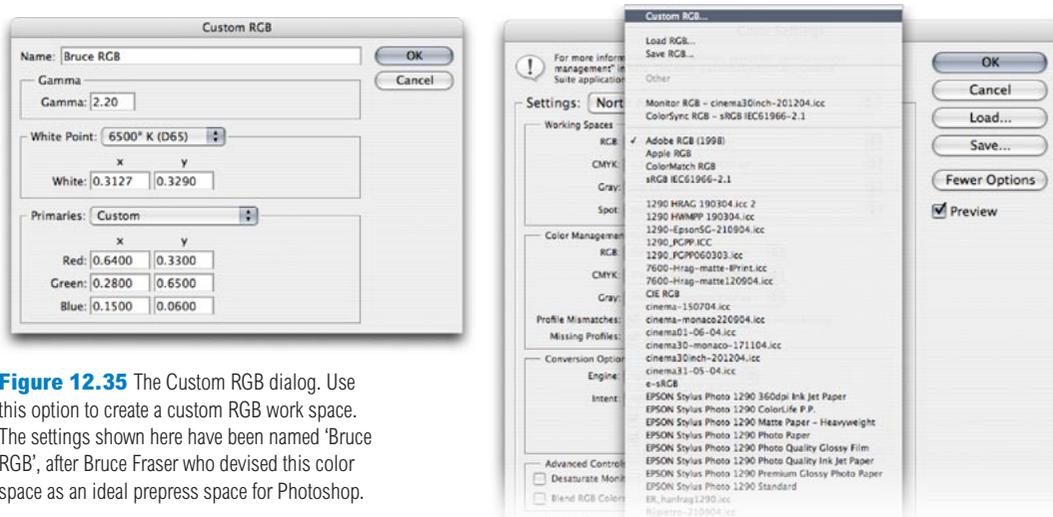
The desaturate monitor colors option enables you to visualize and make comparisons between color gamut spaces where one or more gamut space is larger than the monitor RGB space. Color spaces such as Adobe RGB and Wide Gamut RGB both have a gamut that is larger than the monitor space is able to show. So turning down the monitor colors saturation will allow you to make a comparative evaluation between these two different color spaces.

**Figure 12.34** In this test we have a pure RGB green soft edged brush stroke that is on a layer above a pure red Background layer. The version on the left shows the combined layers using the normal default blending. And the image on the right shows what happens if you check the 1.0 checkbox. The darkening around the edges where the contrasting colors meet will disappear.

### Customizing the RGB and work space gamma

Expert users may wish to use an alternative custom RGB work space instead of one of the listed RGB spaces. If you know what you are doing and wish to create a customized RGB color space, you can go to the Custom... option in the pop-up menu and enter the information for the White Point, Gamma and color primaries coordinates. My advice is to leave these expert settings well alone. And do avoid falling into the trap of thinking that the RGB work space gamma should be the same as the monitor gamma setting. The RGB work space is not a monitor space.

Adobe RGB is a good choice as an RGB work space because its 2.2 gamma provides a more balanced, even distribution of tones between the shadows and highlights. These are the important considerations for an RGB editing space and remember, you do not actually 'see' Adobe RGB. The Adobe RGB gamma has no impact on how the colors are displayed on the screen, so long as Photoshop ICC color management is switched on. In any case, these advanced custom color space settings are safely tucked away in Photoshop and you are less likely to be confused by this apparent discrepancy between monitor gamma and the RGB work space gamma.



**Figure 12.35** The Custom RGB dialog. Use this option to create a custom RGB work space. The settings shown here have been named 'Bruce RGB', after Bruce Fraser who devised this color space as an ideal prepress space for Photoshop.

## RGB to CMYK

Digital scans and captures all originate in RGB but professional images are nearly always reproduced in CMYK. Since the conversion from RGB to CMYK has to happen at some stage, the question is: at what point should this take place and who should be responsible for the conversion? If you have decided to take on this responsibility yourself then you need to know something more about the CMYK settings. Because when it comes to four-color print reproduction, it is important to know as much as possible about the intended press conditions that will be used at the printing stage and use this information to create a customized CMYK setup.

### CMYK setup

If you examine the US prepress default setting, the CMYK space says U.S. Web Coated (SWOP). This setting is by no means a precise setting for every US prepress SWOP coated print job, because there can be many flavors of SWOP, but it does at least bring you a little closer to the type of specification a printer in the US might require for printing on coated paper with a web press setup. If you mouse down on the CMYK setup pop-up list, you will see there are also US options for web uncoated and sheetfed press setups. Under the European prepress default setting, there is a choice between coated and uncoated paper stocks, plus the latest ISO coated FOGRA27 setting. And then there is Custom CMYK... where you can create and save your custom CMYK profile settings.

### Creating a custom CMYK setting

Figure 12.36 shows the Custom CMYK dialog. This is better known as the familiar 'Classic' Photoshop CMYK setup. You can enter here all the relevant CMYK separation information for your specific print job. Ideally you will want to save each purpose-built CMYK configuration as a separate color setting for future use and label it with a description of the print job it was built for.

### Photoshop CMYK myths

There are some people who will tell you that in their 'expert opinion', Photoshop does a poor job of separating to CMYK. And I bet if you ask them how they know this to be the case, they will be stumped to provide you with a coherent answer. Don't let anyone try to convince you otherwise. Professional quality CMYK separations can be achieved in Photoshop. You can avoid gamut clipping and you can customize a separation to meet the demands of any type of press output. But the fact is that Photoshop will make lousy CMYK separations if the Photoshop operator who is carrying out the conversion has a limited knowledge of how to configure the Photoshop CMYK settings. For example, a wider gamut RGB space such as Adobe RGB is better able to encompass the gamut of CMYK and yield CMYK separations that do not suffer from gamut clipping. This is one big strike in favor of the Photoshop color management system. But CMYK is not a one-size-fits-all color space. CMYK conversions do need to be tailor-made for each and every job.

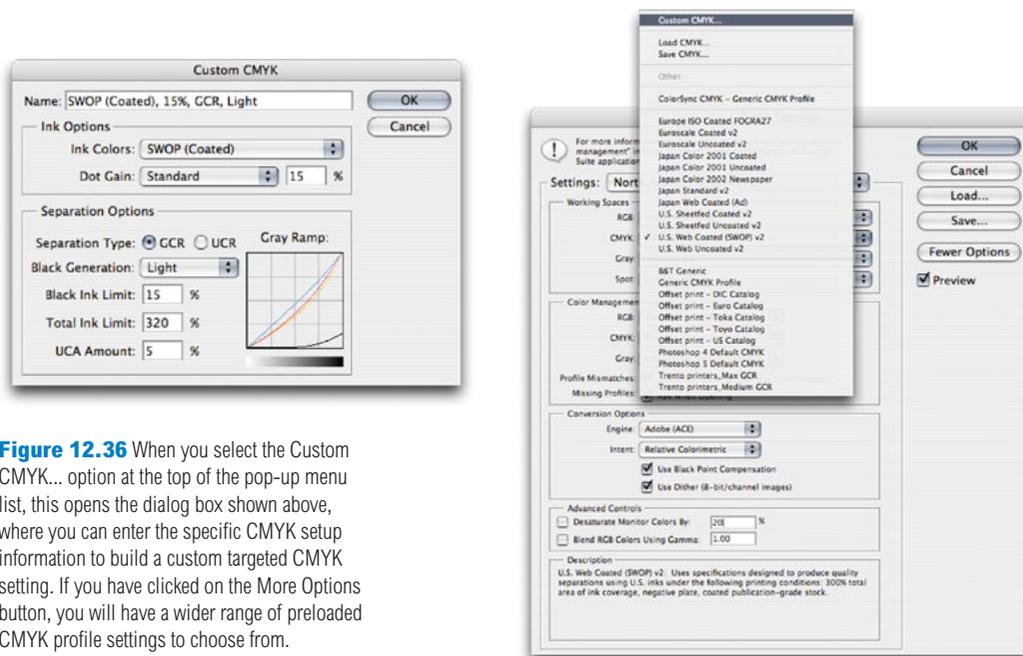
### Saving custom CMYK settings

The custom CMYK settings should be saved using the following locations: Library/ColorSync/Profiles/Recommended folder (Mac OS X). Windows/System32/Spool/Drivers/Color folder (PC).

**CMYK previews in Proof Setup**

Once the CMYK setup has been configured, you can use View ⇒ Proof Setup ⇒ Working CMYK to apply a CMYK preview of what the image will look like after converting while you are still editing the image in RGB mode.

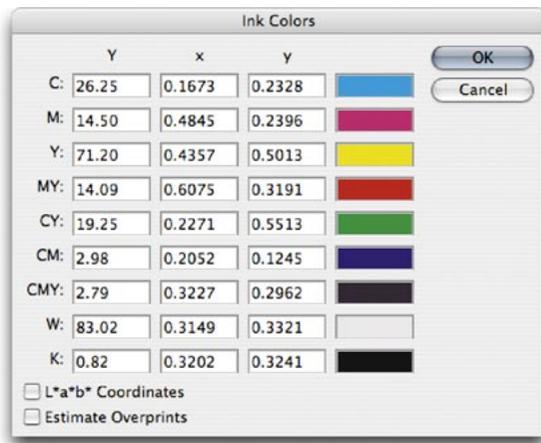
Once you have configured a new CMYK work space setting, this will become the new default CMYK work space that is used when you convert an image to CMYK mode. Altering the CMYK setup settings will have no effect on the on-screen appearance of an already-converted CMYK file (unless there is no profile embedded) because the CMYK separation setup settings must be established first before you carry out the conversion.



**Figure 12.36** When you select the Custom CMYK... option at the top of the pop-up menu list, this opens the dialog box shown above, where you can enter the specific CMYK setup information to build a custom targeted CMYK setting. If you have clicked on the More Options button, you will have a wider range of preloaded CMYK profile settings to choose from.

**Ink Colors**

If you click on the Ink Colors menu, you can select one of the preset Ink Colors settings that are suggested for different types of printing. For example, European Photoshop users can choose from Eurostandard (coated), (uncoated), or (newsprint). These are just generic ink sets. If your printer can supply you with a custom ink color setting, then select Custom... from the Ink Colors menu. This will open the dialog shown in Figure 12.37.



**Figure 12.37** Here is a screen shot of the Custom Ink Colors dialog. For special print jobs such as where non-standard ink sets are used or the printing is being done on colored paper, you can enter the measured readings of the color patches (listed here) taken from a printed sample on the actual stock that is to be used. You could measure these printed patches with a device such as the Gretag MacBeth Eye-One and use this information to create a custom Ink Colors setting for an individual CMYK press setup.

### Dot gain

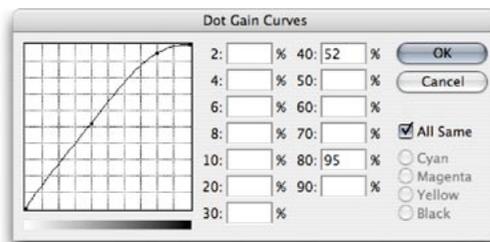
Dot gain refers to an accumulation of factors during the repro process that will make a dot printed on the page appear darker than expected. Among other things, dot gain is dependent on the type of press and the paper stock being used. The dot gain value entered in the CMYK setup will determine how light or dark the separation needs to be. If a high dot gain is encountered, the separated CMYK films will need to be less dense so that the plates produced will lay down less ink on the paper and produce the correct-sized printed halftone dot for that particular type of press setup.

You can see for yourself how this works by converting an image to CMYK using two different dot gain values and inspecting the individual CMYK channels afterwards and comparing their appearance. Although the dot gain value will affect the lightness of the individual channels, the composite CMYK channel image will always be displayed correctly on the screen to show how the final printed image should look.

If you select the Dot Gain Curves option, you can enter custom settings for the composite or individual color plates. In the preparation of this book I was provided with precise dot gain information for the 40% and 80% ink values (these are shown in Figure 12.38).

### Advanced CMYK settings

There is not a lot you can do with the standard CMYK settings: you can make a choice from a handful of generic CMYK profile settings or choose Custom CMYK... If you check the More options box, you will readily be able to select from a more comprehensive list of CMYK profile settings in the extended menu, depending on what profiles are already in your ColorSync folder.



**Figure 12.38** If you select Dot Gain: Curves... from the CMYK setup shown in Figure 12.36, you will open the Custom Dot Gain dialog. If your printer is able to provide dot gain values at certain percentages, then you can enter these here. Dot gain may vary on each ink plate. If you deselect the All Same box, you can enter the dot gain for each individual plate. Note that when you select Custom Dot Gain... from the Grayscale work space menu, a similar dialog appears. If you are preparing to save a color setting designed for separating prepress CMYK and grayscale files, you will want to check that the black plate dot gain setting is consistent. Note that dot gain can vary for each plate and that the black plate dot gain may be slightly different.

### Gray Component Replacement (GCR)

The default Photoshop setting is GCR, Black Generation: Medium, Black Ink Limit 100%, Total Ink Limit 300%, UCA Amount 0%. If you ask your printer what separation settings they use and you are quoted the above figures, you know they are just reading the default settings to you from an unconfigured Photoshop setup and they either don't know or don't want to give you an answer. If you are creating a custom CMYK setting it is more likely you will want to refer to the table in Figure 12.40 for guidance. Or if you prefer, stick to using the prepress Adobe CMYK setting that most closely matches the output (such as: US Sheetfed/Web Coated/Uncoated, or European Pre-Press/Sheetfed/Web/Coated/Uncoated).

### Undercolor Removal (UCR)

The UCR (Undercolor Removal) separation method replaces the cyan, magenta and yellow ink in just the neutral areas with black ink. The UCR setting is also favored as a means of keeping the total ink percentage down on high-speed presses, although it is not necessarily suited for every job.

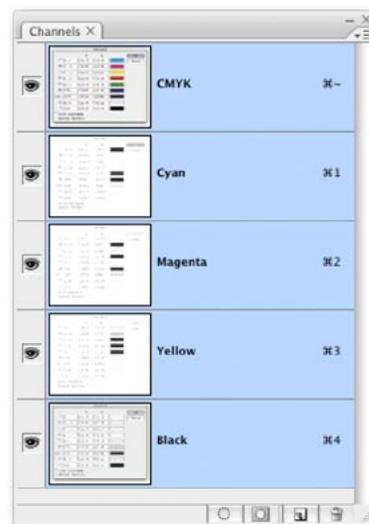
### **Undercolor Addition (UCA)**

Low key subjects and high quality print jobs are more suited to the use of GCR (Gray Component Replacement) with a small amount of UCA (Undercolor Addition). GCR separations remove more of the cyan, magenta and yellow ink where all three inks are used to produce a color, replacing the overlapping color with black ink. The use of UCA will add a small amount of color back into the shadows and is useful where the shadow detail would otherwise look too flat and lifeless. The percentage of black ink used is determined by the black generation setting (see below). When making conversions, you are better off sticking with the default GCR, a light to medium black generation with 0–10% UCA. This will produce a longer black curve and improved image contrast.

### **Black generation**

This determines how much black ink will be used to produce the black and gray tonal information. A light or medium black generation setting is going to be best for most photographic images. I would advise leaving it set to Medium and only change the black generation if you know what you are doing.

You may be interested to know that I specifically used a maximum black generation setting to separate all the dialog boxes that appear printed in this book. Figure 12.39 shows a view of the Channels palette after I had separated the screen grab shown in Figure 12.37 using a Maximum black generation CMYK separation. With this separation method only the black plate is used to render the neutral gray colors. Consequently, this means that any color shift at the printing stage will have no impact whatsoever on the neutrality of the gray content. I cheekily suggest you inspect other Photoshop books and judge if their palette and dialog box screen shots have reproduced as well as the ones shown in this book!



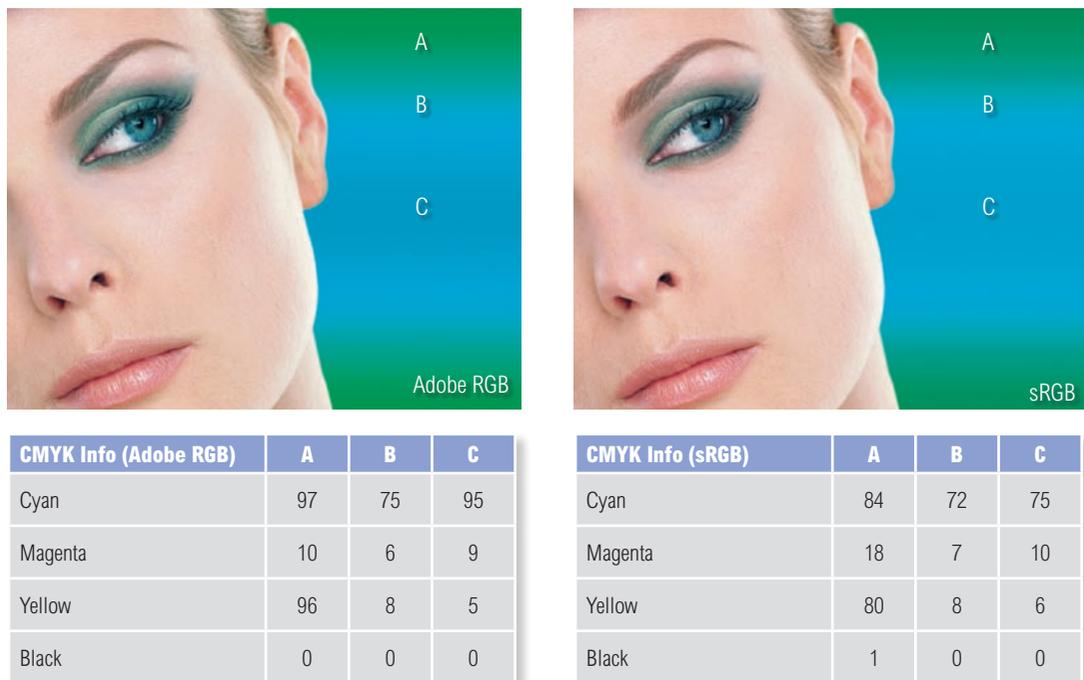
**Figure 12.39** Here is a view of the Channels palette showing the four CMYK channels after I separated the screen grab shown in Figure 12.37 using a Maximum black generation CMYK separation. Notice how all the neutral gray information is contained in the Black channel only. This is a good separation method to use for screen grabs, but not so for any other type of image.

Separation settings	Ink colors	Separation method	Dot gain	Black generation	Black ink limit	Total ink limit	UCA
<b>US printing</b>							
Sheetfed (coated)	SWOP coated	GCR	10–15%	Light/Medium	95%	320–350%	0–10%
Sheetfed (uncoated)	SWOP uncoated	GCR	15–25%	Light/Medium	95%	260–300%	0–10%
Web press (coated)	SWOP coated	GCR	15–20%	Light/Medium	95%	300–320%	0–10%
Web press (uncoated)	SWOP uncoated	GCR	20–30%	Light/Medium	95%	260–300%	0–10%
Web press (newsprint)	SWOP newsprint	GCR	30–40%	Medium	85–95%	260–280%	0–10%
<b>European printing</b>							
Sheetfed (coated)	Eurostandard coated	GCR	9–15%	Light/Medium	95%	320–350%	0–10%
Sheetfed (uncoated)	Eurostandard uncoated	GCR	15–25%	Light/Medium	95%	260–300%	0–10%
Web press (coated)	Eurostandard coated	GCR	15–20%	Light/Medium	95%	300–320%	0–10%
Web press (uncoated)	Eurostandard uncoated	GCR	20–30%	Light/Medium	95%	260–300%	0–10%
Web press (newsprint)	Eurostandard newsprint	GCR	30–40%	Medium	85–95%	260–280%	0–10%
<b>Asian printing</b>							
Sheetfed (coated)	Toyo Inks coated	GCR	8–15%	Light/Medium	95%	320–350%	0–10%
Sheetfed (uncoated)	Toyo Inks uncoated	GCR	15–25%	Light/Medium	95%	260–300%	0–10%
Web press (coated)	Toyo Inks coated web offset	GCR	12–20%	Light/Medium	95%	300–320%	0–10%
Web press (uncoated)	Toyo Inks uncoated	GCR	20–30%	Light/Medium	95%	260–300%	0–10%
Web press (newsprint)	Toyo Inks uncoated	GCR	30–40%	Medium	85–95%	260–280%	0–10%

**Figure 12.40** These separation guidelines reflect a typical range of settings one might use for each type of press output. These are guidelines only and reflect the settings you will already find in Photoshop. For more precise settings, consult your printer.

## Choosing a suitable RGB work space

The RGB space you choose to edit with can certainly influence the outcome of your CMYK conversions, which is why you should choose your RGB work space wisely. The default sRGB color space is widely regarded as an unsuitable space for photographic work because the color gamut of sRGB is in some ways smaller than the color gamut of CMYK and most inkjet printers. If you choose a color space like Adobe RGB to edit in, you will be working with a color space that can adequately convert from RGB to CMYK without any significant clipping of the CMYK colors. Figure 12.41 below highlights the deficiencies of editing in sRGB compared to editing in Adobe RGB.



**Figure 12.41** For the purposes of demonstrating the difference between two RGB color spaces. This example illustrates a Lab mode color image that was converted to CMYK once via Adobe RGB and once via sRGB. The color gradient was chosen to highlight the differences between these two RGB color spaces. The master image was converted to Adobe RGB and then to CMYK. A duplicate of the master was also converted to sRGB, and then to CMYK. As you can see, if you compare the separations shown above, the sRGB version is weaker at handling cyans and greens and there is also a slight boost in warmth to the skin tones.

**Which rendering intent is best?**

If you are converting photographic images from one color space to another, then you should mostly use the Relative Colorimetric or Perceptual rendering intents. Relative Colorimetric has always been the default Photoshop rendering intent and is still the best choice for most image conversions. I do also recommend that you use the Soft proofing method, described in the following chapter, to preview the outcome of any profile conversion and check to see if a Relative Colorimetric or Perceptual rendering will produce a better result.

**Rendering intents**

When you make a profile conversion such as one going from RGB to CMYK, not all of the colors in the original source space can be expected to have a direct equivalent in the destination space. RGB is mostly bigger than CMYK and therefore those RGB colors that are regarded as 'out of gamut' will have to be translated to their nearest equivalent in the destination space. The way this translation is calculated is determined by the rendering intent. A rendering intent can be selected in the Color Settings to become the default rendering intent used in all color mode conversions. But you can override this setting and choose a different rendering intent when using Edit ⇨ Convert to Profile, or View ⇨ Proof Setup ⇨ Custom.

***Perceptual***

Perceptual (Images) rendering is an all-round rendering method that can also be used for photographic images. Perceptual rendering compresses the out-of-gamut colors into the gamut of the target space in a rather generalized way, while preserving the visual relationship between those colors, so they do not become clipped. More compression occurs with the out-of-gamut colors, smoothly ramping to no compression for the in-gamut colors. Perceptual rendering provides a best guess method for converting out-of-gamut colors where it is important to preserve tonal separation. But Perceptual rendering is less suitable for images where there are fewer out-of-gamut colors.

***Saturation (Graphics)***

The Saturation rendering intent preserves the saturation of out-of-gamut colors at the expense of hue and lightness. Saturation rendering will preserve the saturation of colors making them appear as vivid as possible after the conversion. This is a rendering intent best suited to the conversion of business graphic presentations where retaining bright bold colors is of prime importance.

### Relative Colorimetric

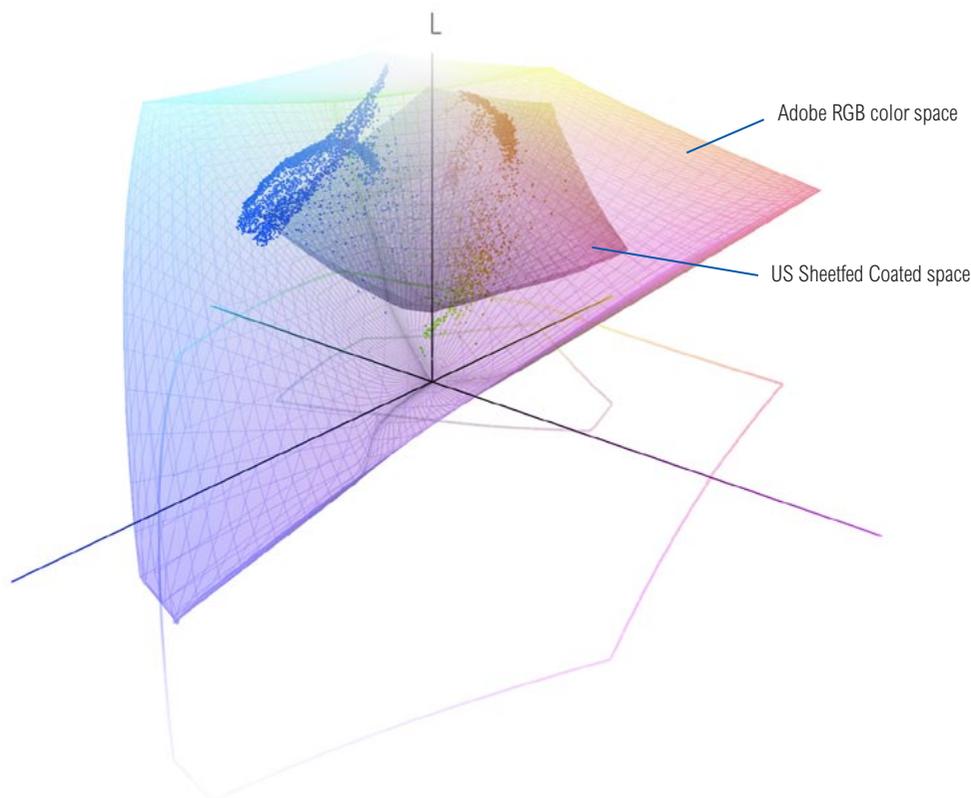
Relative Colorimetric is the default rendering intent utilized in the Photoshop color settings. Relative Colorimetric rendering maps the colors that are out of gamut in the source color space (relative to the target space) to the nearest ‘in-gamut’ equivalent in the target space. When doing an RGB to CMYK conversion, an out-of-gamut blue will be rendered the same CMYK value as a ‘just-in-gamut’ blue. Out-of-gamut RGB colors will therefore be clipped. This can be a problem when attempting to convert the more extreme range of out-of-gamut RGB colors to CMYK color. But if you are using the View ⇨ Proof Setup ⇨ Custom to call up the Customize Proof Condition dialog, you can check to see if this potential gamut clipping will cause the loss of any important image detail when converting to CMYK with a Relative Colorimetric conversion.

### Absolute Colorimetric

Absolute Colorimetric maps in-gamut colors exactly from one space to another with no adjustment made to the white and black points. This rendering intent can be used when you convert specific ‘signature colors’ and need to keep the exact hue, saturation and brightness, like the colors in a commercial logo design. This rendering intent is seemingly more relevant to the working needs of designers than photographers. However, you can use the Absolute Colorimetric rendering intent as a means of simulating a target CMYK output on a proofing device. Let’s say you make a conversion from RGB to CMYK using either the Relative Colorimetric or Perceptual CMM and the target CMYK output is a newspaper color supplement printed on uncoated paper. If you use the Absolute Colorimetric rendering intent to convert these ‘targeted’ CMYK colors to the color space of the proofing device, the proofer will reproduce a simulation of what the printed output on that stock will look like. Note that when you select the Proof option in the Photoshop print dialog, the Absolute Colorimetric rendering is applied automatically to produce a simulated proof print.

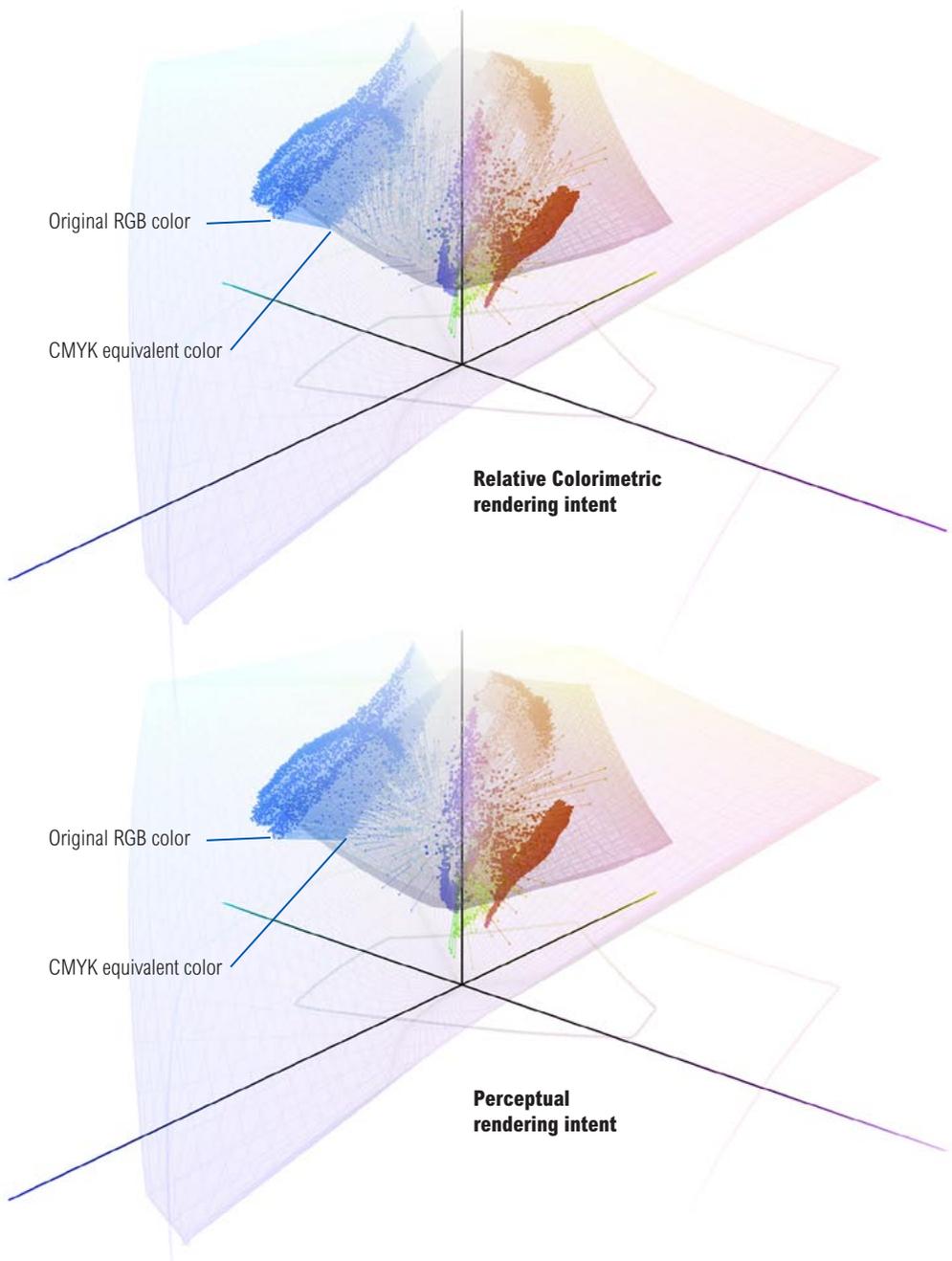


**Figure 12.42** The default rendering intent is set by choosing More Options in the Color Settings dialog and mousing down on the Intent menu in the Conversion Options. This default setting can be overridden when using the Convert to Profile command. You can also change the rendering intent in the Custom Proof dialog. This allows you to preview a simulated conversion without actually converting the RGB data.



**Figure 12.43** To illustrate how the rendering intent can influence the outcome of a color mode or profile conversion I used Chromix ColorThink 2.1.2 to help me create the diagrams shown on these two pages. The above diagram shows the Adobe RGB color space overlaying a US Sheetfed Coated CMYK color space. As you can see, Adobe RGB is able to contain all the colors that will be squeezed into this smaller CMYK space. The photograph opposite has been plotted on this diagram so that the dots represent the distribution of RGB image colors within the Adobe RGB space.

When the colors in this image scene are converted to CMYK, the rendering intent will determine how the RGB colors that are outside the gamut limits of the CMYK space will be assigned a new color value. If you look now at the two diagrams on the opposite page you will notice the subtle differences between a relative colorimetric and a perceptual rendering. And I have highlighted a single blue color in each to point out these differences. The upper example shows a relative colorimetric rendering. You will notice that the out-of-gamut blue colors are all rendered to the nearest in-gamut CMYK equivalent. Compare this with the perceptually rendered diagram below and you will see that these same colors are squeezed in further. This rendering method will preserve the relationship between the out-of-gamut colors but at the expense of producing a less vibrant separation.



### **CMYK to CMYK**

It is not ideal for CMYK files to be converted to RGB and then converted back to CMYK. This is a sure-fire way to lose data fast! I always prefer to keep an RGB master of the image and convert to CMYK using a custom conversion to suit each individual print output. Converting from one CMYK space to another is not really recommended either, but in the absence of an RGB master, this will be the only option you have available. Just specify the CMYK profile you wish to convert to in the Convert to Profile dialog box. Remember, the Preserve Embedded Profiles policy will ensure that tagged incoming CMYK files can always be opened without converting them to your default CMYK space (because that would be a bad thing to do). This means that the numbers in the incoming CMYK files will always be preserved, while providing you with an accurate display of the colors on the screen.

### **Lab Color**

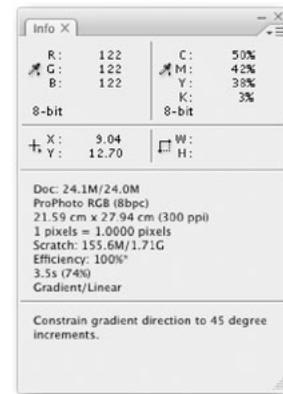
The Lab Color mode is available as a color mode to convert to via the Image ⇨ Mode menu and the Convert to Profile command, but does not use embedded profiles. Lab Color mode is assumed to be a universally understood color space, and it is argued by some that saving in Lab mode is one way of surmounting all the problems of mismatching RGB color spaces. You could make this work, so long as you didn't actually do anything to edit the image while it was in Lab mode. But overall, I would not really advise it. In fact, these days I see little reason to use the Lab Color mode for anything in Photoshop. Now, a few people did take me to task over these comments that were made in the previous edition of the book, so I suppose I should clarify my views. In the early days of Photoshop I would use Lab mode to do things like sharpen the Luminosity channel only, but in my view this, and the other Lab mode tricks I had learnt, soon became redundant as Photoshop started introducing things like layer blending modes and people devised better ways to apply image sharpening, such as the Bruce Fraser techniques I described earlier in Chapter 4.

### Info palette

Given the deficiencies of the color display on a monitor, such as its limited dynamic range and inability to reproduce colors like pure yellow on the screen, color professionals will often rely on the numeric information to assess an image. Certainly when it comes to getting the correct output of neutral tones, it is possible to predict with greater accuracy the neutrality of a gray tone by measuring the color values with the eyedropper tool. If the RGB numbers are all even, it is unquestionably gray (in a standard/linearized RGB editing space such as Adobe RGB). Interpreting the CMYK ink values is not so straightforward. A neutral CMYK gray is not made up of an even amount of cyan, yellow and magenta. If you compare the Color readout values between the RGB and CMYK Info palette readouts, there will always be more cyan ink used in the neutral tones, compared with the yellow and magenta inks. If the CMY values were even, you would see a color cast. This is due to the fact that the process cyan ink is less able to absorb its complementary color – red – compared to the way magenta and yellow absorb their complementary colors. This also explains why a CMY black will look reddish/brown, without the help of the black plate to add depth and neutrality.

### Keeping it simple

Congratulations on making it through to the end of this chapter! Your head may be reeling from all this information about Photoshop color management. But successful color management does not have to be complex. Firstly, you need to set the Color Settings to the prepress setting for your geographic region. This single step will configure the color management system with the best defaults for photographic work. The other thing you must do is to calibrate and profile the monitor. As I said before, if you want to do this right, you owe it to yourself to purchase a decent colorimeter device and ensure the monitor display is profiled regularly. Do these few things and you are most of the way there to achieving reliable color management.



**Figure 12.44** When you are editing an RGB image, the Info palette readings can help you determine the neutrality of a color. If the RGB values are all equal, and the RGB color space you are editing in is one of the standard linear spaces, such as Adobe RGB, sRGB or ProPhoto RGB, etc., then the even RGB numbers will equal gray. But notice how the corresponding CMY numbers are not all even. A greater proportion of cyan ink is required to balance out with the magenta and yellow inks to produce a neutral gray color in print.