

# STEVE CAPLIN'S **A** TO **Z** OF DESIGN

## C: Colour spaces

Steve Caplin walks us alphabetically through the concepts essential to success for any jobbing or aspiring designer.



### ABOUT THE AUTHOR

**Steve Caplin** is a designer and illustrator working for a range of national newspapers. His best-selling *How to Cheat in Photoshop*, now in its fourth edition, is published by Focal Press.  
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**Few concepts confuse designers as much as colour spaces.** It's not just a question of choosing between RGB and CMYK: there are different flavours of RGB, for one thing, and then there's that rather baffling Lab colour that crops up in Photoshop occasionally. What on earth are they all for?

The problem arises from the fact that computer screens and printed items display colour in precisely opposite ways. Computers work by starting with a black screen onto which they add combinations of red, green and blue pixels – just as if you were shining coloured torches onto a sheet of paper in a dark room. The more light added, the brighter the image gets. Adding maximum amounts of all three colours produces pure white. Where the primary screen colours – red, green and blue – overlap, you get cyan, magenta and yellow (01).

Ink on paper, however, works the other way round. Starting with white paper, the more ink that's added, the darker the result. Print overlapping circles of cyan, magenta and yellow, and where they overlap you'll

find red, green and blue. Mix them all together, and you get black (02). Well, not quite – in actual fact, you end up with a rather muddy brown, which is why commercial printing always includes black as a fourth colour to fill in deep shadows and give depth to images.

Given that additive colours (RGB) and subtractive colours (CMYK) work in the opposite way, it's surprising that monitors can display CMYK with any accuracy at all. When working in Illustrator or FreeHand, always work in CMYK (unless you're designing exclusively for web work), or you'll encounter problems when your illustrations are imported into XPress or InDesign. When using Photoshop, you should generally work in RGB: the files are three-quarters the size, because there are only three channels, and many of the filters don't work in CMYK. But be sure to turn on CMYK Preview frequently (use command-Y) to check that the colours are compatible: images that look bright and well contrasted in RGB will often turn out dull and flat in CMYK.

This is because RGB is a much wider colour space (known as the 'gamut') than CMYK. This simply means RGB can display far more colours than CMYK (03). One problem is that, by default, Photoshop uses a special colour space known as sRGB, which is a space designed to make business graphics look better under the Windows operating system. As the gamut chart shows, it's a very limiting space: for preference, designers will always change their working colour space to Adobe RGB, which gives a far more faithful representation of the way an image will look when it's printed.

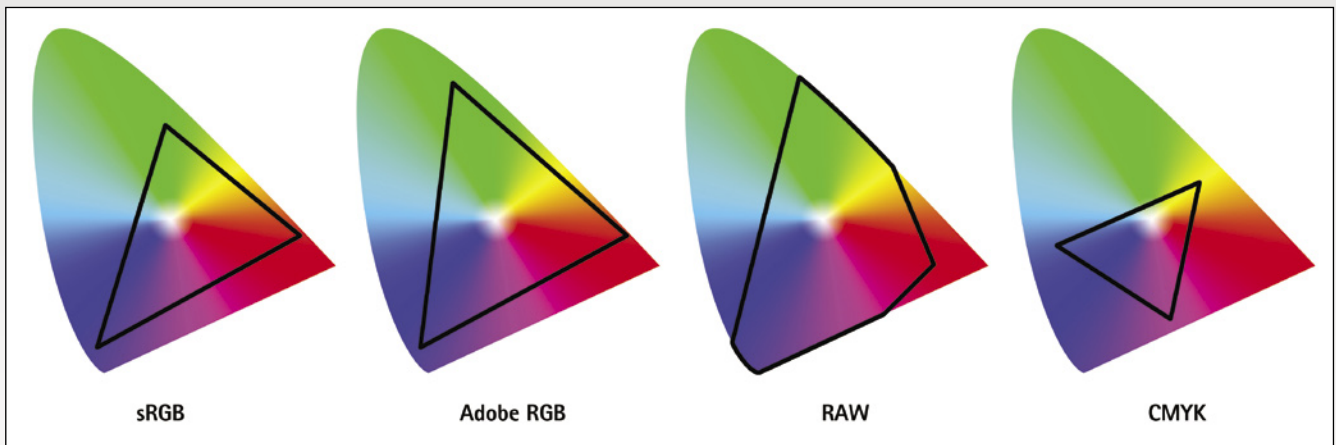
The widest colour space of all is used in Raw, which is the format captured by high-end digital cameras. It's good for tweaking photographs, but is wasteful of resources, as the files tend to be very large. The Raw



▲ 01 Monitors use additive colours, throwing light onto a dark screen. The more lights added, the brighter the result. Note that red and blue make magenta, red and green make yellow, and blue and green make cyan.



▲ 02 Printing inks start with white paper: the more ink is added, the darker it gets. Cyan and magenta make blue, yellow and magenta make red, and blue and yellow make green.



▲ **03** The overall shape shows the range of colours visible to the human eye. The range of colours in each of the different colour spaces lies within the black lines.

sRGB (far left) is the narrow colour space used by default in Photoshop. Most designers change sRGB to Adobe RGB (second from left), which has a much

wider colour gamut. The Raw space (second from right) is wider still. Note how the CMYK (far right) colour space is very narrow in comparison.

space is used mainly by professional photographers, rather than by designers.

To guarantee that the colour shown on your monitor matches printed output as closely as possible, ensure that it's well calibrated. We recommend the Gretag Macbeth Huey as an ideal first step: available for about £50, this is a tiny device the size of a pen, which you place on your monitor at regular intervals in order to calibrate it for the most realistic colour. In addition, the Huey sits on your desk in front of your monitor, constantly monitoring the ambient light in the room and adjusting your monitor to ensure consistent image display.

One colour space found only in Photoshop is Lab (sometimes written  $L^*a^*b^*$ ), which is the space in which Photoshop performs all its calculations before converting them to either RGB or CMYK. The closest to the range of colours visible with the human eye, Lab is by far the widest colour space, but it's also one of the most confusing.

The word describes the three components that define the space. The brightness of an image comes from the luminosity (L) component, which is effectively a greyscale version of the image. The colour is made up of two separate channels labelled 'a' and 'b'. The 'a' channel contains colours varying between blue and yellow, while the 'b' channel contains colours between green and red. It's a tricky space to imagine, as there's no real-world model on which to base a solid understanding of the space.

There are only a few instances in which you'd convert an image to Lab colour. The most common is when trying to eradicate colour noise of the kind frequently produced by digital cameras shooting in low light. The limits of the CCD chip in the camera means that odd pixels of the wrong colour are created, which can be tricky to get rid of

by conventional means. When converting an image to Lab space, however, it's possible to blur each of the 'a' and 'b' channels independently in order to smudge the stray pixels out of existence. Because all the sharpness and definition comes from the 'L' channel, you can blur the other two by a large amount without losing any detail in the original image.

Some applications, such as Painter, use a colour space known as HSV in their colour pickers. The three components here are Hue (the type of colour – that is, red, blue, green and so on); Saturation (the strength of the colour); and Value (the brightness of the colour). This space is also sometimes known as HSB, for Hue, Saturation, Brightness.

If all this seems rather baffling, don't despair. For routine work, the colours remain the same in RGB, HSV and Lab spaces; it's just a different way of measuring and manipulating them. It's rather like a tin of beans, which could cost 44p, or 86 cents: the beans are just the same, it's only the measuring system that changes.



▲ Each of the red, green and blue channels that makes up an RGB image is shown at the top, with the result of combining them below. Notice how the green and black on the shirt are identical on the red channel; the red and white are virtually indistinguishable here as well, because there's no red at all on either of the blue or yellow channels.



▲ Each of the cyan, magenta, yellow and black plates that make up printed colours are shown at the top, with the result of combining them below. It would be possible, in theory, to stop after adding just cyan, magenta and yellow, but the image is rather washed out. It takes the black plate to add definition and shadow.