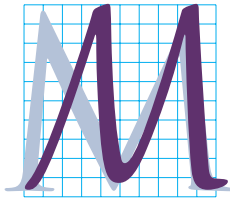


# Color Correction By the Numbers

When looking at an image for the first time, we often see what we perceive to be many small problems. Normally, they are all part of a bigger problem, which can be solved all at once with a single application of Photoshop's most powerful tool, curves.



Monkeying around with the color balance of photographic images is not a sport for the timid, or so goes the conventional wisdom. Believing this, people go through the most simian sorts of shenanigans trying to make their color look believable. They select this area, sharpen that one, call up histograms of the image, apply strange filters, and generally try to demonstrate that if an infinite number of art directors employ an infinite number of digital tweaks somebody somewhere may throw them a banana.

And yet, ninety percent of color correction could be handled by monkeys. That ninety percent, using a strict numerical approach with little room for artistic judgment, is what this chapter is all about. To console the creative, in the next chapter we will pick up the nine percent gained by intelligent image analysis. The final one percent comes only from practice and is beyond the purview of this book.

The rules for this ninety percent of color are so simple that they can be stated in one sentence.

*Use the full range of available tones every time, and don't give the viewers any colors that they will know better than to believe.*

To see how this deceptively simple concept works in practice, here is an imaginary problem that may at first seem ridiculous. Figure 3.1 is the black and white image of me that used to grace my magazine column. The question is, supposing the unsupposable, that it were in color, how would the rules apply? What would be our objectives in correcting it?

At this point you may say, how can we possibly know what a black and white image should look like in color, any more than we know how colors would look to us if we were Martians?

That attitude assumes that we know nothing about the colors of this image. Actually, we know quite a bit. True, we have no idea what color my tie should be, but what about my hair? As you can see, I don't use Grecian Formula. What color hair do you think I have, green?

Similarly, we have no clue as to what color my jacket is, but men in business attire usually wear shirts that are either white or some distinct other color, not some muddy combination. Here, it appears to be a *white* shirt.

And, though my skin is dark, there are limits to the range of normal skin tones.

These considerations are very typical. The giveaways of problems in color reproduction are almost always fleshtones and neutral colors—grays and whites.

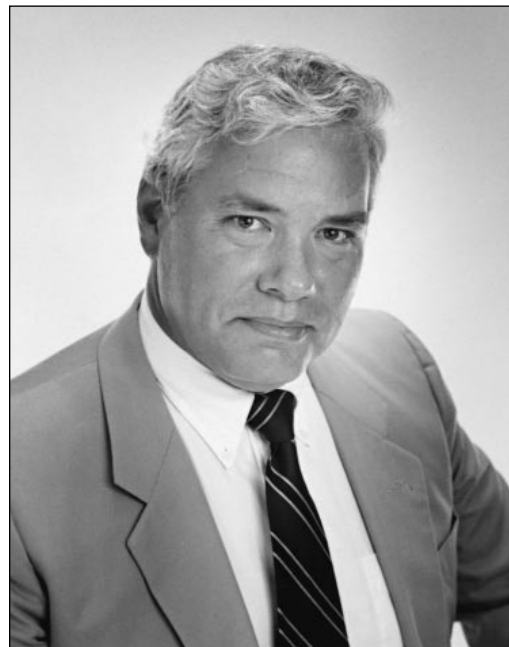
### A General Approach to Correction

If we are to use the full range of available tones, we must find the whitest and darkest areas of the image, and make them as light and as dark as we can, given our paper and printing process. Many pictures are complex enough that we must mosey around quite a bit to find these endpoints. Here,

though, the lightest point is evidently somewhere in my collar, and the darkest is in the stripes of my tie.

At this juncture, we make a decision about how strictly we will adhere to our general guidelines on highlight and shadow. This decision depends on how significant we believe the particular endpoints are to the overall picture. In the case at hand, I would say that preserving detail in the white shirt is important, so we should try to stick with a conservative highlight, but I am not particularly enamored of holding detail in the stripes of the tie, so I would not go to excruciating lengths to stay within normal shadow range.

All that remains is to enforce our numerical decisions by means of curves. Since there are both neutral colors in this picture (the hair and the shirt) and



**Figure 3.1** This image is in black and white, but we can make generalizations about how we would treat it if it were in color.

fleshtones, we must check, before applying the curves, that these colors stick to certain standards, which I am about to discuss.

Throughout the next two chapters, I will be assuming that the images begin in CMYK and that this is the colorspace we will correct in. This is for simplicity's sake. If, for the time being, you absolutely must use RGB, you can, by clicking on the eyedropper icon in the right side of the Info palette, display RGB and CMYK equivalents simultaneously. But if you do this, you are a sissy. Sooner or later you *will* correct in CMYK—why not now?

The standards change depending upon printing conditions. This isn't as tricky as it sounds. The production of this book is a typical example. As I put it together, I don't know who the printer will be, although I know it will be printed on coated paper on a web press. There are good and bad printers in this world. If we know we are going to be favored with one of the former variety, we can cheat a little. We can go with a darker shadow, suspecting that the superior printer will be able to hold detail in an area that his low-quality counterpart would not.

In my current situation, God knows whether the printer will be competent, but I, regrettably, do not. I must take a least-common-denominator approach and expect the worst while hoping for the best. I will, therefore, now and for the remainder of the book, assume magazine printing conditions. The numbers used throughout will reflect this.

## The Magic Numbers

As a first step, we must force the image to meet four numerical requirements. Three of these cater to the most illogical feature of CMYK: the weakness of cyan ink.

In RGB, a neutral gray, regardless of how dark it is, has equal values of red, green, and blue. One might suppose that the same would be true in CMY, but it isn't. Magenta and yellow must be equal, true, but cyan has to be higher. If not, the gray will actually print somewhat reddish, because the cyan ink is supposed to absorb red light, and it does a lousy job of it.

Correction by the numbers is the foundation on which all quality rests. The fact that further improvement is possible beyond merely setting numbers is why this book has more than 300 pages. Be that as it may, those whose basic numbers aren't correct condemn themselves to third-rate color, regardless of their Photoshop skills. A numbers-conscious monkey could do better; a color-blind person could do better.

In the first edition of this book, I backed this provocative statement up by actually training a color-blind person to color-correct. His work was impressive, better than that of many students with perfect color vision but the wrong mentality.

The point having been made, I see no reason to repeat those images here, but Figure 3.2, which didn't appear because it was one of his failures, is a fitting way to start the discussion. Although it is a failure, it is also a success in a way, due to his adherence to the following numerical rules.

- The **shadow** is the darkest significant neutral area of an image. Well over 99 percent of images have *something* we can use for a shadow. Figure 3.3 is the exception.

In principle, the shadow should be set to the heaviest value we believe that the press can hold with detail. Thus, for high-quality commercial printing, the shadow value should be higher than for this book, which in turn should be higher than for a

**Figure 3.2** The bottom version is a “correction” of the original, top. It was executed by a color-blind person, and it looks it. But this was a skilled person, who works by the numbers. Can you figure out how he went astray?



newspaper. If unsure, use what I’m using here:  $80^C70^M70^Y70^K$ . One or more of these numbers can be higher in a deep color. Navy blue, for instance, might be  $95^C65^M15^Y50^K$ .

Many printing applications put a set limit on the sum of all four inks, the better to allow ink to dry. The better the printing condition, the higher the allowable number. SWOP, the industry-standard Specifications for Web Offset Publications, mandates a maximum of 300, which most magazines tweak down to 280. My suggestion,  $80^C70^M70^Y70^K$ , sums to 290, close enough.

290 is not close enough, however, when preparing images for a newspaper, which is apt to ask for 240, or even for some desktop dye-sublimation printers. If a lower number is necessary, we reduce the CMY colors and increase black in roughly equal amounts.  $70^C60^M60^Y80^K$  would therefore also be an acceptable shadow.

People don’t have good color perception in areas this dark, so, if need be, we can take liberties with one or two of the ink values. Don’t do this without a good reason, though. An unbalanced shadow often is a symptom of a color cast that may be subtly hurting other parts of the image.

- The **highlight** is the lightest significant part of the image, with two qualifications. First, it cannot be a reflection or a light source. These things are called *speculars*, or *catchlights*, and we ignore them. Second, it must be something that we are willing to represent to the viewer as being *white*. Assuming that all these requirements are met, use a value of  $5^C2^M2^Y$ .

Other experts suggest different things. They may tell you  $4^C2^M2^Y$ ,  $3^C1^M1^Y$ ,  $5^C3^M3^Y$ , or  $6^C3^M3^Y$ . But everyone agrees that magenta and yellow should be equal, and

cyan a couple of points higher. There is such universal agreement because this highlight value is critical. Humans are quite sensitive to light colors, so a variation of two points in any ink could result in an unacceptable color cast.

Doubt the impact of an incorrect highlight? Then return to Figure 3.2. The “correction” by Ralph Viola, the color-blind person, has a lot to be said for it, as by-the-numbers corrections always do. There seems to be more depth, more snap, than in the top version. But the color is wrong.

That problem developed when Ralph was setting his highlight. He knew enough not to use the top of the wine glass: that’s a reflection. He was looking for something very light, yet nonreflective, and *white*. And he thought that the label of the wine bottle *was* white, because he can’t see yellow. So he arranged to set a highlight in the label, *making* it white. This created a blue cast throughout the lighter half of the image. Darker objects are not affected as much. The wine bottle isn’t that bad. But the wood is now gray.

Those with normal color vision have no trouble detecting that the label shouldn’t be white. A lot of people, though, fall into the same kind of trap when the off-color isn’t quite as obvious.

Figure 3.2 really doesn’t have a highlight, or at least not a highlight in all three CMY inks. You might say that there is two-thirds of a highlight in the label. We know it’s yellow. We don’t know *how* yellow. But we do know that cyan and magenta should be at a minimum. So, you might say that in this image we can set a highlight of 5<sup>C</sup>2<sup>M</sup>?<sup>Y</sup>.

Figure 3.3 certainly has a full highlight. Either the lightest area of the clouds or of the statue will do. Either one is definitely



**Figure 3.3** This image has no shadow at all, no point that can be considered to be a dark gray or black. Such images are rare—try to locate another one!

white. But how about Figure 3.4? The obvious light area is the letters on the sign. No doubt these were white when they were freshly painted, but are they really white today? I don’t think so, at least not in the sense that a marble statue or a cloud is white. I think we use the phrase *yellowed with age* for a reason. Force these letters to become a pure white, and you’ll create the same blue cast Ralph did in Figure 3.2.

- For an area that is supposed to appear **neutral**, that is, white, black, or any shade

**Figure 3.4** The classic highlight settings assume a highlight that is not only light but white. In Figure 3.3, it’s reasonable to assume that the statue and the brightest area of the clouds are, in fact, white. Here, the lettering of the sign is light—but can we guarantee whiteness?



of gray, the magenta and yellow values should be equal and the cyan higher. How *much* higher is an open question; two or three points ought to do it in the highlights, six or seven in the midtones, nine or ten in the shadows.

If there is a problem meeting this requirement, it is better to be too heavy in the cyan than either of the other colors, since bluish grays are less obtrusive than greenish or reddish ones.

Figure 3.3 offers some interesting reminders about neutrality. It tempts some people to set a highlight in the statue and then forget the rest of it. The statue has to be neutral not just in its lightest point, but throughout. The dark folds also need to be measured, and neutralized if need be. Compare that with the clouds. Those should be white at their lightest point, agreed, but they're in the middle of a very blue sky, and I don't know that they need to stay neutral as they get darker.

- **Fleshtones** should have at least as much yellow as magenta, and up to 50 percent more in extreme cases. Where the yellow is equal to or only slightly higher than the magenta, this implies a very light-skinned person, such as a small child or a blonde. For Caucasians, the cyan value should be a fifth to a third as heavy as the magenta, depending upon how bronzed a person is. For a dark-skinned person like myself,  $15^C50^M70^Y$  will do; lighter-skinned people can go  $8^C35^M40^Y$  or even lower.

Finding a typical fleshtone value is easy enough with experience, but if you haven't tried it before, there are some snares to avoid. Measure only areas that are in normal lighting, not a shadow or a semi-reflection. Also, avoid any area where an individual might be wearing makeup,

especially the cheeks of a woman. You may wish to make a small selection of what seems like an appropriate area, use Filter: Blur>Gaussian Blur at a high value to make the selection take on a uniform color, and then measure that before cancelling the blur.

Except in persons of African descent, it is not customary to have any black ink in a normal fleshtone, but it sometimes happens, particularly if we are using non-standard GCR settings (see Chapter 7 for more on this). If there *is* black in the fleshtone, count it as additional cyan, because it does the same thing: it pushes the fleshtone away from red and toward gray.

### Writing Curves: A First Step

To start, we open up the image and check the ink values, using the Info palette, in the highlight and shadow areas, plus the areas of known colors—in this case, the shirt, the face, and the hair. Before doing this, click on the Photoshop eyedropper tool, and set the sampling to  $3 \times 3$  rather than the default single pixel, which can give a false view of what is going on.

In simple pictures, we can keep these numbers straight in our heads, but as they get more complex, writing down the density values and what we propose to do with them can be helpful. To the extent the image does not meet our target numbers, we apply curves to force it closer to them.

To do so, open Image: Modify>Curves. Ignore the default curve. We never use it because it affects all four channels in the same way, and it is impossible that this could be right in CMYK. Go directly into the individual colors. To agree with professional practice and with the examples in this book, please set shadows to the right

and highlights to the left. This is done, if necessary, by clicking on the light-to-dark bar at the bottom of the curves panel.

The horizontal axis of the curve represents the original values of the image. The vertical axis is the values the curve will cause the image to take, when we click OK.

The default curve is not a curve at all, but a straight line at a 45° angle. If we decide that we are going to change it (and we may well decide to leave it alone) we can keep it a straight line by changing one or both of the endpoints. Normally, though, we insert one or more intermediate points and adjust them up and down. If we do so, the straight line will become a curve.

If the entire new curve falls below the original 45°, the corrected image will be lighter than the original. If it falls above the default, the new image will be darker. Most of the time, we will want to write curves that fit neither description, but that make some parts of the image darker and others lighter.

Parts of such a curve will wind up being steeper than 45°, and, to compensate, other parts will have to become flatter. When the curve is applied, areas that fall in its steeper parts will gain contrast, and objects located in the flatter parts will, sad to say, lose out.

To locate highlight and shadow, I personally prefer to run the cursor over several likely areas and watch the Info palette. This lets me choose the second-lightest area as a highlight, if I decide that the real lightest area isn't important to the image.

If you are uncomfortable with this, you can open Image: Adjust>Threshold and, with the Preview option checked, move its slider until it becomes obvious where the light and dark points are.

In the imaginary color image of me, suppose that we measure the lightest area of the white shirt and discover that it is 12<sup>C</sup>10<sup>M</sup>18<sup>Y</sup>. Measurements of the stripes of the tie find 70<sup>C</sup>65<sup>M</sup>85<sup>Y</sup>50<sup>K</sup>.

We start by adding two points to each curve. In the case of cyan, we want what is now 12<sup>C</sup> to become 5<sup>C</sup>, since we are shooting for a highlight of 5<sup>C</sup>2<sup>M</sup>2<sup>Y</sup>. We will also insert a point that brings 70<sup>C</sup> up to 80<sup>C</sup>. Similarly, we adjust each of the other colors so that we hit the targets for highlight and shadow.

Before clicking OK in the Curves dialog box, we run our selection tool across the neutral areas of the picture. The Info palette will now tell us both what the values are currently and what they will become after the curve is applied. Ideally, the neutral areas will be truly neutral (i.e., equal magenta and yellow and slightly more cyan); if not, we will have to make further adjustments to the curves.

If a major amount of work went into these curves, we should take advantage of the Save option in the Curves dialog box before doing anything else. If we do this and then decide that a slight modification is necessary (or, heaven forbid, if we make some big mistake and are forced to File: Revert to the last saved version of the image) we can cancel the changes we made, then reopen the Curves dialog box and choose the Load option to reinstate the curves. Or, we can save the curves within an Adjustment Layer, which will allow us to change the curves later even if there are other intermediate changes, such as airbrushing and/or cloning.

That is really all there is to color correction, and if you truly understand curves, you know how they can eliminate color

casts, increase contrast, and make the image more lifelike, all at once, without any local correction, without using any esoteric program functions.

So much for theory. Let's roll up our sleeves and correct some color.

## Many Birds with One Curve

As we have seen, it can be awkward if there is no obvious highlight or shadow. Figure 3.5 has no such problem: the original has plenty of choices for each.

There are four reasonable guesses for

highlight: the top of the small truck in the foreground, the street signs, the jacket worn by the woman in the lower left, and the trailer at the extreme left. The unreasonable guesses would be the reflections on the cars, which are catchlights, and the sky, which we can't guarantee is white.

Measuring all four of these likely suspects, the street signs turn out to be much darker than the other three, so they're out. The truck is typically 3C3M7Y, the jacket

*Figure 3.5 Concrete buildings are normally neither pink nor blue. By forcing them to become neutral with curves, and by proper adjustment of highlight and shadow, the original, top, gets transformed into the image at bottom.*





5<sup>C</sup>4<sup>M</sup>4<sup>Y</sup>, and the trailer 6<sup>C</sup>8<sup>M</sup>8<sup>Y</sup>. So much for the trailer, which is slightly darker in all three colors. Our choices are to set a white highlight either in the truck (in which case the jacket is slightly blue) or in the jacket (in which case the truck is slightly yellow). The second alternative seems more logical.

This shows how sensitive we are to variations in light colors. There's very little difference in the two values—but doesn't that truck look yellower than the jacket?

At 5<sup>C</sup>4<sup>M</sup>4<sup>Y</sup>, the highlight is pretty good to start with. The shadow is another story.

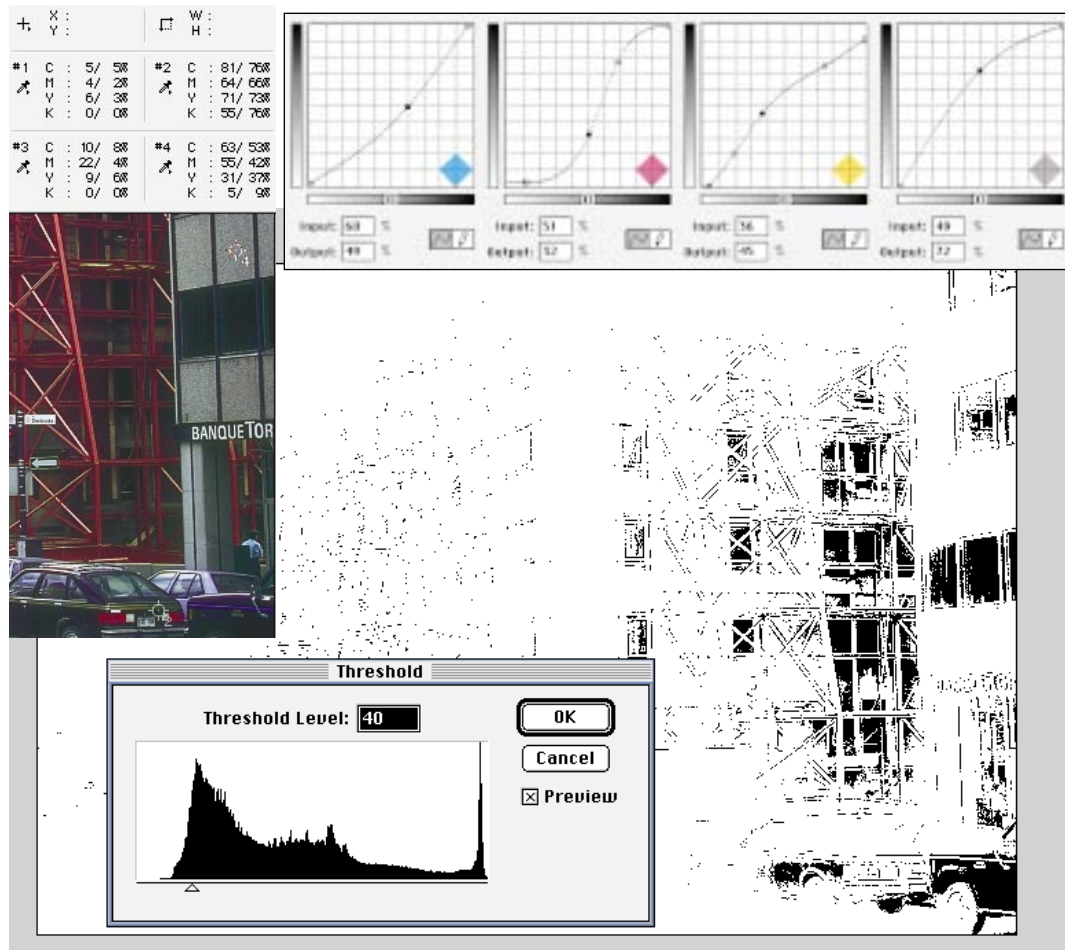
The choices appear to be the tires of various cars, the windows in the darkest

area of the building under construction, and the body of the black car at lower right.

You may well ask how I know that the car is *black* and not navy blue. If I set a navy blue car as a neutral shadow, the picture will turn yellow, just as the picture turned blue when Ralph thought a yellow label was neutral.

The answer is, I *don't* know just by looking at it. But I do know that tires are black, not navy blue. So, whether this car is darker or lighter than the tires, if it is a black car there will be the same relation of the CMY colors as there is in the tires. If it's a blue car, the yellow value will be much lower.

**Figure 3.6** The basic tools of curvewriting. Background, below: using the Threshold command to identify the shadow of the image. Top left: establishing sample points in highlight, shadow, and the two buildings at the sides of the image. Top right, the final curves used in Figure 3.5.





Upon investigation, this car turns out to be black. It's also darker than the tires or the windows, which makes it the shadow. But its values aren't good shadow numbers at all:  $89^C69^M55^Y47^K$ . That is, in fact, about halfway to navy blue. As the tires are halfway to navy blue as well, we know this is a cast, and not a real color. There is too much cyan, not enough yellow: this is a blue shadow.

There are still two more things to find out about this image before we start writing curves. One of them, fleshtones, we don't have to worry about, because there aren't any. But how about neutral colors? It's true that there's nothing that has to be a pure gray in the sense that my hair, or the statue of Figure 3.3, have to be. But there are things in this picture that should be *close* to gray: the street itself, and the buildings at left and right. Are they?

Not hardly. The street is  $51^C45^M11^Y$ —very blue. The light building at left is  $21^C30^M8^Y$ , midway between blue and magenta. And the right-hand building is  $62^C53^M29^Y5^K$ , blue, but not quite as blue as the street.

If this were the old days, now would be a good time to look for the scanner operator, with the objective of shoving this image down his throat. Regrettably, such remedial action is no longer possible. Fortunately, we can compensate for this inadequate art. Photoshop 5 adds a feature that makes doing so by the numbers a lot easier.

**Figure 3.7** In Figure 3.5, the cast was obviously undesirable. That isn't always the case. Is the blue cast above an aesthetic choice, or should we balance the image as at bottom?

By clicking on the eyedropper tool in the toolbox and changing it to the sampling tool, we can expand the Info palette so that it shows the color values from each of up to four fixed spots in the image, as shown in Figure 3.6. With something as complex as this street scene, this is a big help. I'd plant a point in the highlight, one in the shadow, and the other two in the buildings at the sides of the image.

Incidentally, at this point, one can turn the monitor to grayscale. It is all monkey work from here on in. Now that we have a general read of the picture, we can color-correct in black and white just as easily—and the screen display refreshes ever so much faster.

Whether you are willing to take that particular plunge or not, it's pretty clear what has to happen here.

The cyan is a point or two too low in the highlight. In the light building, it's maybe OK, but in the street and the dark building, it's too heavy, and in the shadow it's seven points too high.

The magenta is the major headache. It's one point too high in the highlight, way too high throughout the quarter- to midtone range, but three points too *low* in the shadow.

The yellow needs a big boost, especially in its quartertone, so as to neutralize the street and the buildings. A bigger boost there, in fact, than in the shadow, where it's 13 points too low.

And the black is simplest of all. It's too weak. We need to bring 47<sup>K</sup> up to 70<sup>K</sup>.

The curves that do these things are shown in

Figure 3.6. The improvement speaks for itself, but I'd like to make two points.

First, notice how much better the color of the scaffolding, and of the reddish building itself, are. And yet, no attention was paid to these objects, or even to other objects of approximately that color. This is very characteristic of this method of correction. If the basic colors are right the others fall into place, as if by magic.

Second, try doing this with Levels.

### The Intent of the Photographer

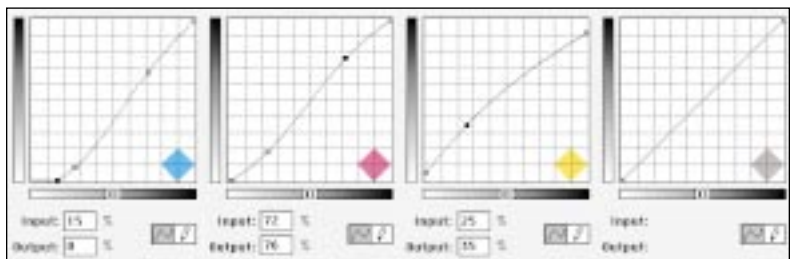
At this point, you may throw up your hands in disgust and ask why photographers never get it right. Actually, they do. The incredible human optical system is what causes problems.

Everybody knows that when we are in a darkened room, our eyes adjust to the environment and become more sensitive. When somebody turns the light on suddenly, it dazzles us.

Not everybody realizes that the same thing takes place in color perception. Our brains want to reference everything to a neutral environment, so when we are flooded with light of one color we compensate by making our eyes less sensitive to it—all unconsciously.

The quick summary of what just happened is that we corrected the image to

**Figure 3.8** The curves used to create the bottom version of Figure 3.7.





**Figure 3.9** This type of the image has no neutral colors other than the highlight and the shadow. This allows more flexibility in correction than was the case, say, in Figure 3.5.

be what human observers would have seen had they been where the camera was. Humans ignore color casts. Cameras don't. We found a cast, so we deep-sixed it. Obviously, that is not “matching the art.”

Perhaps you can think of a reason why the photographer might have wanted, for artistic reasons, the look of the original of Figure 3.5. I surely can't. Figure 3.7 might be something else again. The blue cast sets mood. I would like to think that the photographer did it on purpose.

But suppose that the decision is made that the cast is incorrect, that we are to do exactly what we did with Figure 3.5.

The analysis works the same way. Highlight? There isn't one. The pants are the lightest nonreflective thing in the image, and they aren't white.

Shadow? Pretty clearly in the black door

to the left. Currently  $81^C66^M68^Y68^K$ , which isn't bad.

Fleshtones? For sure. A typical value in the woman's arm is  $29^C45^M44^Y1^K$ . By the standards I set out earlier, this is an illegal value, cyan being twice as high as it should be, and yellow being slightly low.

Neutrals? Yup, virtually everything that's made of stone. The front part of the first step reads in its lightest area  $24^C9^M1^Y$ , a heavy cyan cast, as if we didn't know.

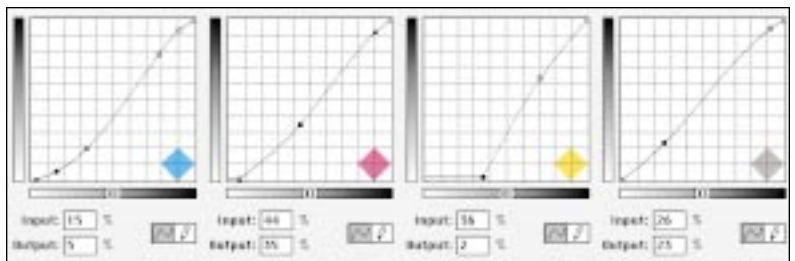
What to do? That's easy. We have to blow away the cyan that contaminates the highlight. The yellow has to come up sharply in the lighter part of the image, and the magenta come down slightly, so as to get neutral stone. Note that this will also correct the balance between magenta and yellow in the fleshtone. And the black plate appears to be OK as is.



**Figure 3.10** In the correction curve, below, note the dips in the magenta and black plates. This is to reduce the contaminating colors in the trees above.

So, we now have an interesting blue cast version, and a nice-looking normally lit one. You can take your pick, but there's no need to limit yourself to these two choices. Photoshop allows us to split the difference any way we like: 90–10, 50–50, whatever.

I am not a professional photographer myself, but I am given to understand by some of my friends who are that this business of shooting something with an intentional subtle cast is not as easy as a simian might think. If I were a photographer, and if I wanted the image to look more like the top half of Figure 3.7, I think I'd deliberately shoot the image too blue. Color-correcting a copy of it by the numbers as in Figure 3.8,



and then blending the two versions together, is a useful safety net to have.

And there is a flip side for the curve-savvy photographer: certain difficult lighting conditions can now be ignored. For example, suppose you are shooting a hockey game. Odds are, you have to shoot through glass, which will donate a slight green cast to the resulting image. For my money, it's a lot easier to apply curves in Photoshop later than to experiment with magenta filters. The results will look better, too, trust me.

## You Oughta Be in Pictures

In these first two images, the presence of so many neutral colors and fleshtones compels the use of curves very similar to the ones I've shown. That is to say, the pictures are complicated enough that we are basically handcuffed, forced to use a certain shape of curve and no other.

In the next chapter, we'll talk about what to do when there *is* a choice of shape. Figure 3.9 gives us more room to maneuver

**Figure 3.11** *The pink horses below are clearly wrong, but are merely the most obvious of many problems.*



because it has no fleshtones and really nothing neutral either. (In the western United States, roads are not as gray as they are in the east, for reasons I can't explain).

Therefore, there's not much to do here except pick a highlight and a shadow. The highlight might be in the marquee, the sign, or the second large poster. Not in the first poster: even though a large area seems white, it may not be in real life.

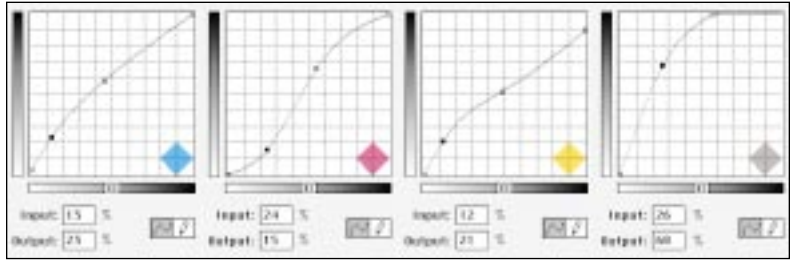
In fact, the marquee, at  $11^{C4M29Y}$ , is the lightest, but all three are ridiculously yellow. The shadow, on the left side of the marquee, verifies the yellow cast that pervades the image, reading  $75^{C66M77Y67K}$ .

With only two points to correct, we enjoy unexpected freedom to shape the curves. Therefore, we can start catering to other items on the agenda.

In this case, it seems to me that the trees are not green enough. It's not that they are missing the yellow and cyan that are the dominant colors in any green. Instead, there is too much of the contaminating inks, magenta and black. This is a purely subjective decision, of course. Some of us can read the green values and know immediately that they are too gray, but if you aren't that familiar with the numbers, by all means rely on the screen—if reasonably calibrated—to advise you. The danger of relying on monitor display, as pointed out in Chapter 2, is in neutral colors, and trees aren't neutral.

Assuming you agree that something should be done to liven up the greens, putting dips into the center of the magenta and black curves, as I have done here, seems like the way to go. Such a

move would not be possible in the first two exercises, which were full of neutral colors in which the three CMY inks had to interact precisely. But here, all we *have* to do is get the highlights and shadows right. We can do that whether or not we indulge in monkeyshines in the midtone areas of any or all curves. Figure 3.10 is one of many possible solutions.



**Figure 3.12** Since magenta starts out too high in the light areas and too light in the darks, the shape of the correction curve is eccentric. Cyan and yellow have to increase in the quartertone to eliminate the pink cast in the horses, while the magenta drops. And the black plate increases drastically throughout.

### Behold a Paler Horse

If you have never seen a purple cow, nor ever hope to see one, you should probably find another field of endeavor. For a final variation on the same old theme, we'll do battle with a purple horse.

In Figure 3.11, we begin by rounding up the usual suspects. Highlight: the forehead of the near horse,  $2^C2^M2^Y$ . Shadow: blinder of the far horse,  $71^C57^M71^Y30^K$ . Known colors: the horses obviously should be white, but the readings are  $7^C26^M7^Y$ ,  $10^C31^M16^Y$ , and  $15^C32^M18^Y$ . Also, in the background is a Canadian flag that reads  $10^C70^M75^Y2^K$ , although I happen to know it should have more magenta than yellow. And several of the flags should have neutral white areas as well.

Fixing the color balance here is straightforward. We need to set highlight and shadow and then twist the curves somewhat to make sure that the horses become neutral.

The cyan is slightly too low throughout. We know this because in three nicely neutral areas—the highlight, the shadow, and the horses—the cyan is roughly equal to the yellow, whereas it is



supposed to be a few points higher. Since there is no specular highlight in this image, we can start our correction curve by making  $0^C$  move to  $3^C$  and keeping all other values correspondingly higher.

Rather than increase the cyan shadow directly, we place a point at  $13^C$  and raise *that*. The horses need a bigger boost in cyan than the shadow does, so this should work well.

The yellow's highlight and shadow are OK as is. But we still need to reshape it in the quartertone, because in the horse, it needs to be equal to the magenta, which starts out around 15 points higher.

The magenta behaves peculiarly. It is correct in the highlight, too heavy in the quartertone, and too light thereafter. That sounds more difficult to fix than it actually is. We construct a curve that gives a minimum value of  $2^M$  and is completely flat for a while, meaning that anything that was  $9^M$  or lower will now stabilize at  $2^M$ . It starts its climb slowly, so that  $30^M$  becomes  $15^M$ , and then skyrockets so that the midtones will in fact increase.

And the black plate gets very steep very fast. So, now we have correct highlights and shadows, and neutral horses. That's what Figure 3.12's numbers say, and good numbers usually mean a good picture.

### Of Values and Judgments

In the corrections to these four images, we made almost no "artistic" judgments. It was all numbers, numbers, numbers. There was no need even to use a color monitor. And every single change was made to the image as a whole.

In short, once he got the hang of curves, there is absolutely no reason that an orangutan could not get these results. Years of retouching experience, artistic talent, and mathematical aptitude wouldn't hurt him, but they are not really needed.

Notice how these numerical adjustments have the habit of helping areas of the image that we never even thought about. Things like the red scaffolding on the brick building, the cars on the Hollywood road, and the flags behind the horse.

Artists who worry their images to death tend to see such shortcomings immediately and plunge happily and vigorously into a morass of individual moves. They isolate the horses and work on them; they fix up the flags one by one; they tediously darken the harnesses, and after eight hours or so of work they have 12 layers, 18 alpha channels, an 800-megabyte file, and an image that's not nearly as good as what the curvewriting orangutan would have gotten in 35 seconds.

Neutralizing our artistic judgment along with the color casts gave us images that came out much better than the originals—yet not as good as they might have been.

Determining that the horses are more important than the building, or that the statue is more important than the sky, are the kinds of logical decisions that are too difficult for either apes or calibrationists. In the next chapter, we will exploit our superior intellect, and with a combination of good numbers and curves that improve contrast in the critical areas of the image, we'll get the color correction monkey off our backs forever.





## COLOR CORRECTION BY THE NUMBERS

- ✓ For 90 percent of the correction work we face, the rules can be stated in one sentence: Use the full range of available tones every time, and don't give the viewers any colors that they will know better than to believe.
- ✓ In each uncorrected image, we must find the highlight—the lightest white with detail—if there is one. Also, we must find the darkest area, or shadow. We will use curves to move these areas to the minimum and maximum values we expect to be able to hold detail with on press. Absent specific information to use different numbers, use  $5^C 2^M 2^Y$  for highlight and  $80^C 70^M 70^Y 70^K$  for shadow.
- ✓ In choosing a highlight, speculars, meaning areas that are reflecting light or portraying a light source, should be ignored. Values of zero are acceptable for them. Similarly, dark areas without important detail can be allowed to print heavier than the recommended shadow values.
- ✓ Most pictures have some colors that are known to the viewer. The known colors are generally either fleshtones or areas that must logically be neutral.
- ✓ Neutral colors, of which there are plenty in nature, should have equal amounts of magenta and yellow, and slightly more cyan. The amount of black, if any, is irrelevant. As a bluish gray is less offensive than a reddish or greenish one, if you must depart from this, use more cyan.
- ✓ Photoshop 5's improved curve interface permits placement of up to four fixed measuring points in an image. Using this, we can see how a proposed curve will change values in all the significant areas: highlight, shadow, fleshtone, neutrals.
- ✓ Except in small children and other very light-skinned persons, yellow is always higher than magenta in fleshtones. Cyan is always at least a fifth of the magenta value. As skin tone gets darker, these imbalances increase. A dark-skinned individual may have a third more yellow than magenta, and cyan a third the strength of the magenta.
- ✓ Do not be seduced into a local selection of an area where the color is obviously wrong. Whatever is causing the undesirable color is also doing it in the rest of the picture, but it may not be apparent. Applying correction globally will cause overall improvements that you might not anticipate.