Lighting for Digital

Optimum Digital Exposure

By Dave Montizambert

We've heard it a million times, and here it is one more time: Ansel Adam's golden rule for optimum capture in his black-and-white Zone System is, "Expose for the shadows and develop for the highlights." This makes sense for black-and-white film, where all contrast control can be applied in the darkroom after the exposure. However, it makes no sense with digital capture, if you expose for the shadow you run the risk of pushing the highlight tones over the edge into white without detail.

Now once all detail is lost in the highlight, and I mean really lost—255 levels in all three channels—there is nothing to work with, no chance of rescue with Lightroom or Adobe Camera RAW's highlight recovery slider, and since it is digital, no resurrecting silver halide crystals hiding deep in the emulsion. Furthermore, there is less chance of these fix-it methods turning out with images processed "in camera" (i.e., JPEGs) than there is with RAW images processed after the fact in your favorite RAW-processing software. In-camera processed JPEGs contain less data than RAW files and so highlight recovery is more unlikely.

With RAW digital files the number of stops from middle gray to pure white is less than the number of stops from middle gray to pure black. In fact, where detail in the shadow ends is a matter of some

Figure 3: *6 side by side grayscale images of Sarah 1 bit to 8 bit .*

Understanding Bits, Bitmap, and Bits Per Channel

Pixel stands for picture element. Digital cameras and scanners create bitmap data. A bitmap is a representation of an image using pixels as opposed to vector data that is used to represent graphics, which it does using a series of lines or curves that are stored as mathematical formulas rather than pixels. Therefore, a digital camera or scanner cannot create vector data, only pixel data. Pixels are made up of bits, hence the term bitmap, meaning that a digitized image is a map of a series of bits.

A bit is a single binary digit—0 for off, or 1 for on. This provides a limited choice of tones: white or black. The grayscale image of model Sarah Madro on the top left side of Figure 3, confirms that an image made up of one-bit pixels cannot create any tones between pure white and pure black, and so cannot create the illusion of continuous tone.

Two-bit pixels are strictly that, two-bit, or pretty much worthless for making images. Looking at the top row center image of Sarah in Figure 3, I think you will agree that this image is better than the previous, but still a long way from looking like continuous tone. A two-bit pixel can only be one of four possible tones; zero and zero for white, zero and one for light gray, one and zero for dark gray, and one and one for black. For any sort of real quality we need greater pixel depth, which means more bits per pixel. As you can see from the bit depth image progression of Figure 3, increasing the pixel depth by one-bit doubles the possible tonal or brightness levels—so from 2 to 3 bits goes from 4 to 8 levels, from 3 to 4 bits goes from 8 to 16 levels, and so on. Jumping up in bit-depth to a more usable level, we find that an image made of 8-bit pixels breaks the grayscale down into 256 brightness levels; 256 levels easily fools the eye into believing that it is seeing continuous tone as in the image of Sarah on the bottom far right side of Figure 3. And so it seems that a greater pixel depth such as 8-bit and up is needed if we are to fool the eye into believing that a mosaic of square pixels is a continuous tone image.

debate, it really comes down to how much noise and banding of tonal gradation you are willing to risk. In addition to this, digital favors the highlight; it assigns more bits to describe the highlight than it does to describe the shadow. Don't know what a bit is? See sidebar (pg. 147) entitled, "Understanding Bits, Bitmap, and Bits Per Channel."

In Figure 3, we've established that we need at least 8 bits to create a believable looking grayscale image, but what of color? Creating color digital images, we need at least 8 bits for the red channel, 8 bits for the green channel and 8 bits for the blue channel. 8+8+8 equals 24-bit color as seen in the top graphic of Figure 4. You will often hear the two interchangeably, 8-bit color means 8 bits per channel, and 24-bit means the accumulation of 8 bits per channel in red/green/blue composite color.

With 24-bit image files we end up with 16.8 million possible colors; each channel has 256 possible levels of tone—256x256x256=16.8 million as seen in bottom graphic of Figure 4. This is a lot of color! In fact, it is more than enough to create the illusion of the full visible spectrum.

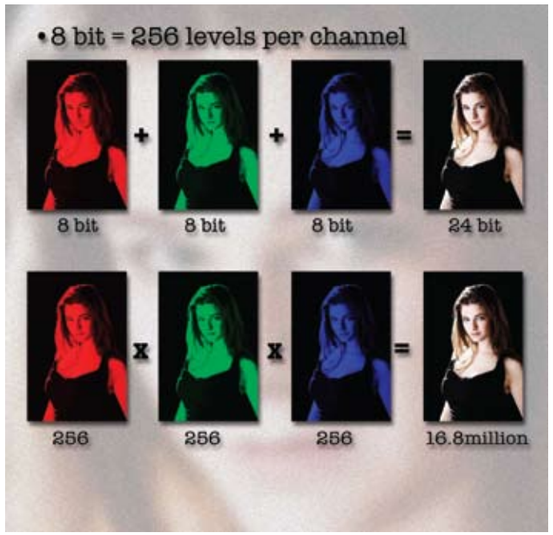

Figure 4: *2 sets 4 images of separate RGB channels of Sarah.*

Most professional DSLRs today create at least 12-bit-encoded data. 12 bits describe or break down the grayscale into 4096 discrete steps or levels of brightness. An increase of one digit in bit depth, say from 12-bit to 13-bit, will double the possible levels of brightness. Some newer DSLRs are now 14-bit. If this is truly a 14-bit camera, it should have in the neighborhood of four times more levels of brightness to play with than a 12-bit camera! See Bit Depth/Tone correlation in Figure 5.

A grayscale has pure white at one end and pure black at the other end. In between these two extremes we have 4094 levels of brightness with 12-bit, that is to say that the intermediate tones of the grayscale are broken down into 4094 separate steps or levels of tone. We are using slight variations in brightness to simulate a continuous tone grayscale and if the steps of that progression are fine enough, we can fool the eye into believing that it is seeing a continuous tone progression.

Figure 5: *Bit Depth/Tone correlation*

In fact, we don't really even need this many levels to create the illusion, it can be done with considerably less. Your printer dumbs down bit depth to about 6 bits for printing and when you work on your image in Photoshop at 8 bits or when you create a JPEG image, you are only using 256 levels of brightness to describe the whole grayscale. 8-bit is considered low-bit and 10-bit and above is considered high-bit; at any rate more bits equal more levels of brightness which equals more editing headroom—an important factor when processing images, as well as correcting or manipulating files in Photoshop.

As I mentioned earlier, digital assigns significantly more bits to the highlight than the shadow. Expressed in brightness levels, digital applies 2048 levels to the first stop down from pure white at the highlight end of the grayscale (see top graphic in Figure 6). This is ½ of the available 4096 levels possible from the 12-bit encoded data. The second stop down uses ½ again of the available levels, 1024. The next stop 512, the next 256, the next 128, leaving only 64 levels to describe the 6th stop in the shadow.

64 levels sounds pretty bad, but it is more than enough to describe the shadow. However, at 64 levels, you may run into trouble if you try to lighten up the shadows to show more detail. Many digital photographers play it safe underexposing their captures to ensure highlight detail, then in their RAW-processing software or by opening their image in Photoshop, they use the appropriate controls to brighten the image to bring back the mid and shadow

Figure 6: *2 graphics of 8 swatch grayscale w/ breakdown of levels assigned per stop.*

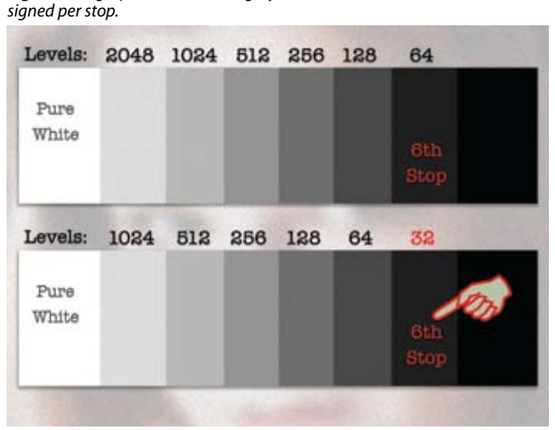

Figure 1: *Sarah Madro*

Dramatic backlit lighting: Look at Figure 1 of model Sarah Madro. She is illuminated by light reflecting off a 1.3x2 meter white nylon fabric stretched over a panel frame placed in front of her on the camera left side of the image frame (see lighting diagram Figure 2). The origin of the light energy for this main light source comes from a mono block strobe/flash placed behind her on the camera left side of the image frame. This light origin also provides heavy dramatic backlighting for Sarah giving her separation from the dark background. I often use this one light dramatic backlit technique indoors on rainy days to simulate outdoor sunlight. To fill in the shadows a second reflector panel was placed to the camera right side of Sarah, this fill light source caught stray light from the backlight and redirected it onto her dark side. This fill reflector was placed farther away than usual to create darker shadows.

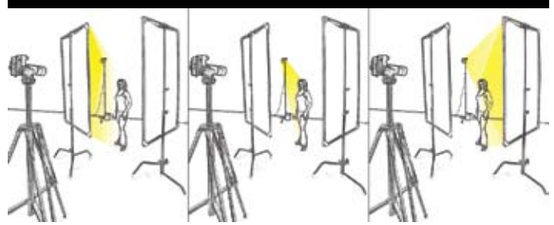

Figure 2: *lighting diagram of Sarah Madro one light setup.*

tones. This method may be a necessary evil in uncontrolled lighting situations, but be aware that if you go too far with "playing it safe," you can wreak havoc with shadows. When you lighten a file in your image-editing software, you are pushing the distribution of bits further up the grayscale, in other words if you lighten the file by one stop, where you once had 64 levels of brightness in the shadow at the 6th stop, you now have half (see bottom graphic in Figure 6). In addition to this, noise, which typically resides in the darker tones, will be emphasized. If you wish to maximize the available bits your camera has to offer, it makes more sense, whenever possible, to place the brightest significant highlight as close to burnout as possible and then place the shadow ¼, mid and ¾ tones to taste during processing.

In Figure 1 of model Sarah Madro, the shadows are intended to create a dramatic look and are quite dark. If you had a change of heart after the fact and decided to lighten the shadows of this 12-bit capture by one stop using curves or levels, the 6th stop shadow tones would only have 32 of the original 64 levels (see bottom graphic in Figure 6). In Figure 7, we see a before and after close-up of where the transition from lighter shadow into darker shadow occurs in the cheek to hairline area. In the lightened version, we see this shadow gradation breaking apart (over-emphasized for teaching purposes), the subtle gradations from one tone to the next are too far apart to create the illusion of continuous tone. This bit of ugliness is called posterizing or banding, and is as undesirable as cracker crumbs in bed. If you are not sure how dark you want your shadows, then I suggest a higher fill ratio during lighting and then darkening the shadows after the fact during RAW processing or in Photoshop with curves.

Therefore, to capture the optimum exposure in digital, it makes sense to reverse Ansel's rule to read, "Expose for the highlights and process for the shadows." Now that is a pretty bold black-and-white statement that forgets to mention the ¼ tones, mid tones and ¾ tones, and it really does not fully address the extended capabilities of photographers who physically create lighting for digital capture. It's all about contrast, more specifically contrast control. Ansel Adams did it with exposure and development because he could not affect the lighting contrast before capture. Studio photographers do it with lighting since they can physically alter the lighting contrast before capture. Therefore, I am compelled to make a new big bold black-and-white statement for those who do control contrast prior to capture, "Place the scene's tones with lighting and then set this manufactured contrast at the optimum exposure by making a hypothetical gray card read middle gray in the RAW capture—113–118 levels for a 2.2 gamma color space such as Adobe RGB or sRGB or 93–96 levels for a 1.8 gamma color space such as Colormatch RGB. Huh, that's funny, that is pretty much how I did it with film—I lit for tones and then exposed for middle gray.

Dave Montizambert lectures internationally on lighting, digital photography, and Adobe Photoshop. He is also a published author having written two books on lighting and digital photography (publisher Amherst Media) plus numerous magazine articles on these topics in North America and in Europe.

Dave will be teaching a platform class at this year's WPPI, entitled "Dramatic Portrait Lighting," which will be held on Wednesday February 23 from 8:00 a.m. to 10:00 a.m.

Figure 7: *Close up of banding at hairline before & after a lightening curve.*