

Controlling Noise and Maximizing Image Potential

You have far more control
than you might realize!

Bill Welch

- The biggest difference between shooting film and shooting digital is the way each type of media responds to light.
- Film responds the same way our senses do – nonlinear!
 - If you double the power going to your stereo speakers, the sound does not become twice as loud.
 - If the number of photons reaching your eyes, double, you don't see the scene as twice as bright.
- Sensors in digital cameras lack the nonlinearity of human perception.
 - They count photons in a linear fashion.

If you expose with digital the same way you would expose film, you are:

- Not taking full advantage of your camera's dynamic range, and
- Creating exposures with shadow areas noisier than they need to be.

A typical sensor measures the amount of red, green and blue light and combines the three to give a value that can be interrelated as hue, saturation and lightness of that pixel.

- It is not just the amount of each individual color present, but the relative amounts as well.

You want to capture as much information as you can!

- Typical DSLR sensors can capture seven stops of dynamic range and produce 12-bit raw image files that are:
 - Capable of recording 4,096 tonal levels in each red/green/blue channel.
 - This means it can assign 1 of $2^{14}=16,384$ different tonal values to each pixel.
- However, each of the 7 stops in the range of the sensor, do not record an even number of tones throughout the dynamic range.
- F-stops are logarithmic in nature meaning that each stop records half of the light of the previous one.

- Therefore, if you underexpose an image and then correct the exposure in post processing, the tonal transitions in the darker areas will be moved into zones to the right of the histogram.
- Data that resides in the zone that only contains only 32 tones will be moved into the zone that contains 64 tones, and so on.
- There is not enough information to occupy the next zone to the right. Noise and posterization fills in the missing data.
- If you overexpose your image (without clipping the highlights), by pushing the histogram to the right, you will capture much more tonal information that results in much better image quality when correcting the exposure in post processing.
- You will be taking a zone, for example, that contains twice as much information and moving into a zone that only requires half as much information.
- You have more tonal information than you need to do this, so there will be no loss in image quality!

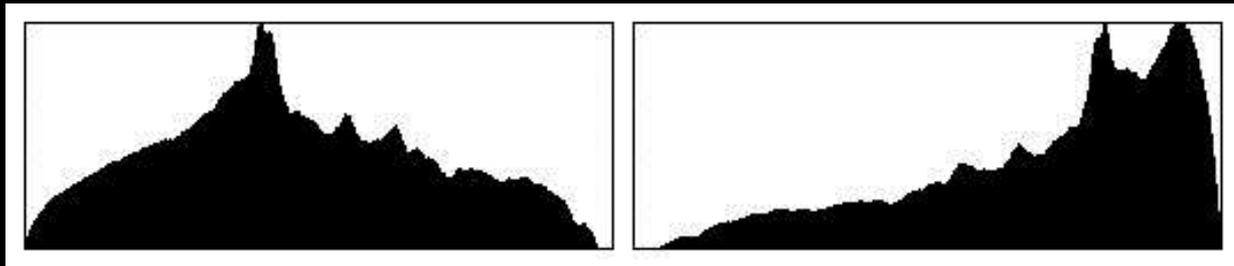
This means the more exposure you can give to the image without blowing the highlights, the more tonal information you'll have in your image!

Saying it in a different way:

If you do not use the right-hand side of the histogram, for recording some of your image, you are wasting fully half of the available encoding levels of your camera!

Exposing to the Right

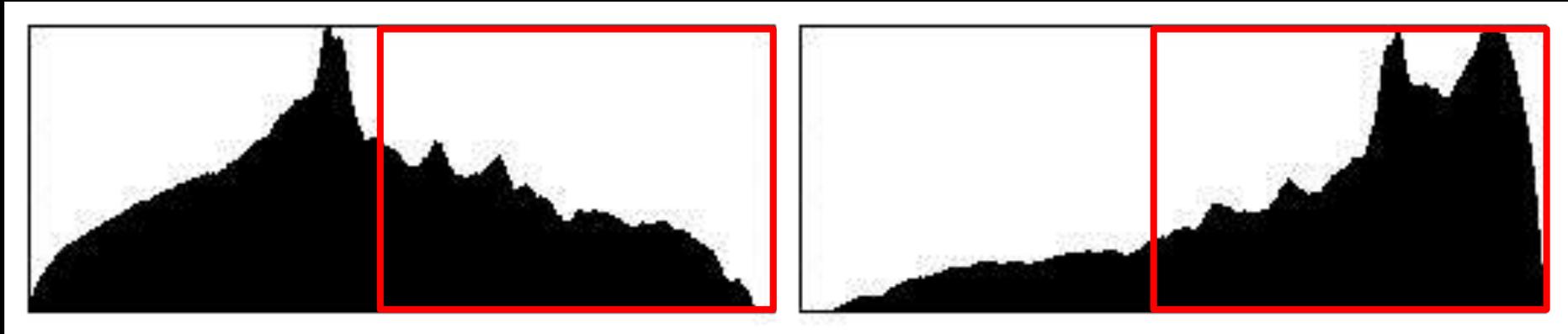
- Expose to the Right refers to the histogram associated with an image.
- Initially, a well exposed image has an even spread of tones across the histogram (histogram on the left).
- Exposing to the Right means to push the histogram as far to the right side as possible without clipping any highlights (histogram on the right).



- The resulting file, when processed back to the correct exposure, will contain more tonal information and less noise in the shadow areas, maximizing your image quality!

Exposing to the Right

Here is the same histogram showing how much more information is captured by pushing the exposure to the right, just in the brightest zone!



- Note: that the on-camera histogram shows the histogram of the in-camera's conversion to JPEG:
- A raw histogram would be rather strange-looking, with all the data clumped at the shadow end,
- Camera show the histogram of the image after processing using the camera's default settings.
- Most cameras apply a fairly strong S-curve to the raw data so that the JPEGs have a more film-like response,
- With the result that the on-camera histogram often tells you that your highlights are blown when, in fact, they aren't.

- One of the great strengths of Adobe® Camera Raw, in this area, is the extended highlight recovery feature,
- Which kicks in when you set the Exposure slider to negative values.
- Most raw converters give up on highlights once a single channel is driven to clipping,
- But Camera Raw does its best to reconstruct highlight detail from a single channel.
- Depending on the camera model and the color temperature settings, you may be able to recover as much as one stop of highlight detail, though one-third stop is more typical.
- If you use Camera Raw, it's worth spending some time conducting exposure tests to see just how far you can comfortably push the exposure.

- When you look at the RAW file in your RAW processing software, like Camera RAW, the image will likely appear to be too light.
- That's OK. Just use the available sliders to change the brightness level and contrast so that the data is spread out appropriately and the image looks "right".
- This will accomplish a number of things. The first is that it will maximize the signal to noise ratio.
- The second is that it will minimize the posterization and noise that potentially occurs in the darker regions of the image.

- For proper results you need to make these corrections while working in 16 bit (12 bit) mode in the RAW converter.
- Unlike what some people think, in RAW mode the camera is not doing any non-linear processing.
- All non-linear processing is done in the RAW converter.
- This is why if you're going to do this you must shoot in RAW and then manually readjust the image in the RAW converter before exporting the file into Photoshop.
- By doing this you'll be maximizing the data bandwidth of your entire system.
- Another reason to be working in RAW mode whenever possible.

- Though it theoretically maximizes available information and therefore, image quality, it's not always appropriate to use ETTR.
- The pitfall of pushing your histogram as far to the right as possible is pushing it too far and blowing the highlights.
- Once a highlight is blown, there is little to be done.
- ETTR is best used in situations where lighting is relatively controlled or unchanging and there is a margin for error if you don't get it right the first time.
- Nature, landscape, architecture shots, portraiture, and most studio work can benefit from it.
- Genres like wedding photography, where there are little options for do-overs, are likely taking a bit of a risk by using ETTR.

Other Reasons to Shoot Raw

- All digital cameras are taking Raw images 100% of the time.
- When you select JPEG as the image type, the camera's on-board software is processing the image based on the settings you have selected in the menus – like image quality, white balance, etc..
- It is time consuming to try to change these parameters on an image by image basis.
- You are locked into the camera's interpretation of the scene.
- JPEGs offer very limited editing headroom.
- The camera's on-board software compresses the image using JPEG compression.

Other Reasons to Shoot Raw

- The software in your camera is nowhere near as smart as you, nor is it anywhere close to as powerful as your computer.
- JPEG records 256 levels of brightness.
- Raw records between 4,096 (12bit) to 16,384 (14bit) levels!
- With RAW you have additional information in the file, so it's much easier to correct the image without a drastic reduction in quality. You can also recover more blown highlights and clipped shadows.
- With RAW the white balance is easy to adjust on an image by image basis.
- When you make adjustments to a RAW file, you're not actually doing anything to the original data. What you're doing is creating a set of instructions for how the resulting file-type version should be saved.

Other Reasons to Shoot Raw

- JPEG files lose quality every time you open them, make adjustments, and save again. It's what is known as a "lossy" file format.
- Because of the finer gradation of tones and colors you'll get better prints from RAW files.
- With RAW you can choose from any color space when you are exporting it out, so you can adjust depending on the situation!
- In Raw, you can selectively sharpen areas of you image. The entire image rarely needs sharpening – like the sky or areas of the image that has been rendered out of focus on purpose.
- JPEGs are pre-sharpened in the camera, including areas that you may not want sharpened!

Raw + JPEG?

Well, should you shoot raw and jpegs?

Not if you utilize the benefits of “Exposing to the Right”.

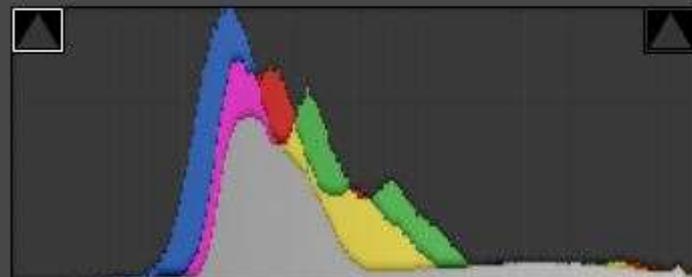
JPEG images that are captured along with RAW images, that are “Exposed to the Right” are rarely useable.

BW72004089.dng

1/6400 sec at $f/11$, ISO 6400
600 mm (EF600mm f/4L USM)



Histogram ▾



ISO 6400

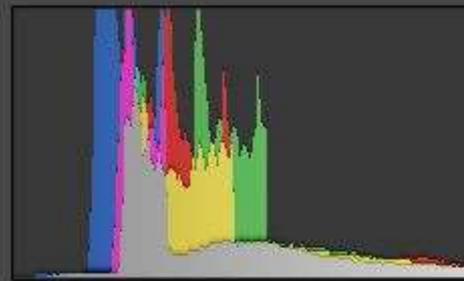
600 mm

$f/11$

1/6400

BW72004089.psd

1/6400 sec at $f / 11$, ISO 6400
600 mm (EF600mm $f/4L$ USM)



ISO 6400

600 mm

$f /$