



Photographic Food for Thought

Photographers of all genres face various issues from time to time. Sometimes they are controversial, sometimes philosophical, and sometimes scientific. The Photographic Food for Thought column will explore these various issues, giving us all something to think about the next time we are out shooting.

UNDERSTANDING HISTOGRAMS - By Colin Bell

This month, Colin Bell from Creative PhotoBook (and our last month's spotlight member) joins us to give us some insight into the Histogram. Histograms are especially useful in bringing proper contrast and adjusting tonal ranges in digital photography, although to the beginner they may be a tad intimidating. Once you learn how to read your histogram, you will be encouraged you to think about your images from a different perspective, both when shooting the image as well as in post processing. Histograms are this month's food for thought!

Histograms are one of the most useful tools that a digital photographer has at his disposal – both on the camera while taking and reviewing your pictures, and also during post processing on the computer. But before we get onto histograms, let's look at a few other terms related to a concept called tonal range.

Tonal Range, Shadows, Midtones and Highlights

Tonal range is a term used to describe the range of brightness levels in an image from the darkest to the lightest. For many pictures (but not all) you want this to cover the full range possible from jet black to brilliant white. If it does not, then the image can look flat. Look at these two black and white photographs - the one on the right has the greater tonal range as it has blacker blacks and whiter whites.



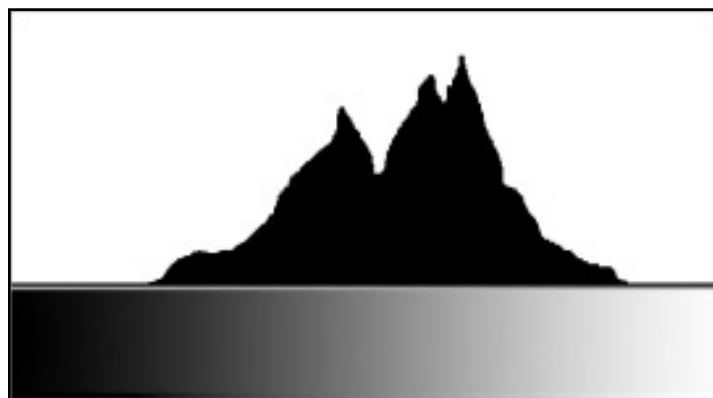
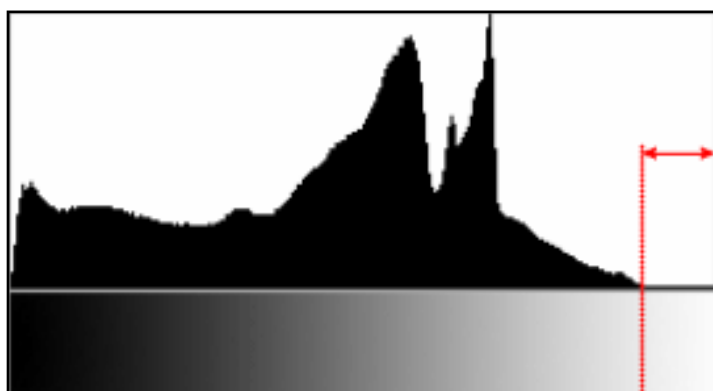
Photographers use the terms shadows, midtones and highlights when talking about different parts of the tonal range. The darker parts of the image are referred to as the shadows, the lighter colours as highlights, and the ones somewhere in the middle (mid-greys) are the midtones. Some of the tools you will come across in Photoshop allow you to apply the effect / brushstroke to just one of these three regions of the tonal range. For example to create a more dramatic black and white landscape, you may want to selectively darken just the shadows using the burn tool.

Histograms

A histogram is a visual way of representing the tonal range of an image. It is simply a graph that shows you the full tonal range along the horizontal axis – blacks/dark tones on the left through to whites/light tones on the right). The number of pixels at each point in the tonal range is indicated by the height of the graph.

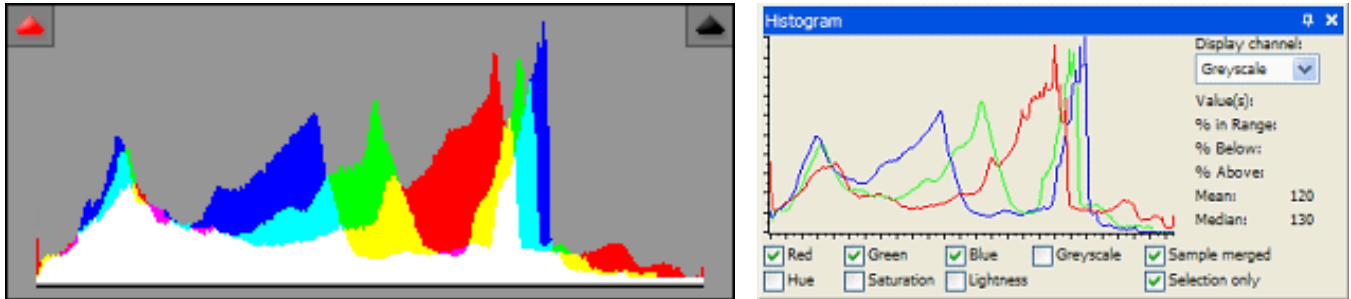
Most digital cameras have the option to display histograms, as do all decent photo editing packages (you may need to turn on the histogram palette or window to see this). It can be used to show you whether the image is under or overexposed and whether you are exploiting the full tonal range that's possible in the image. What it can't do is tell you whether the image looks good as sometimes an image needs to be over or under-exposed to create the desired effect. So use histograms as a guide to help you and not to govern all the decisions you make.

Here are some examples to get you used to looking at them. I've included a black to white gradient underneath each graph to remind you that the horizontal axis corresponds to the tonal range.



The histograms on the previous page show the range of luminance values in the image. Although this is great for checking the general exposure of an image, it is sometimes useful to be able to look at the histograms for individual colour channels. All good imaging software should enable you to do this.

The images below show the separate RGB histogram from Adobe Camera RAW (part of Photoshop) on the left and Paint Shop Pro on the right. As all three colour channels are shown on one graph, the combined colour is shown where two overlap, and white where all three overlap. The Paint Shop Pro histogram has the added flexibility of being able to display histograms for hue, saturation, lightness and greyscale (another name for luminance).



Regions where an individual colour channel have become clipped lose all texture in that colour. However if the other 2 channels have not been clipped, some luminance texture may remain.

On the Photoshop histogram, you will notice two small triangles in the upper left and right corners. These are the shadow and highlight clipping warnings. If they are anything other than black, then it means at least one of the colour channels has been clipped.

Using the Histogram while shooting

All digital cameras have some form of histogram display and it is a great tool to see if you are fully exploiting the dynamic range of your image sensor. If, when you review a picture you've just taken, you see a big gap at one end of the histogram, it means you are throwing away part of your potential tonal range. For many pictures, an ideal histogram covers the full range with a peak somewhere in the middle. Of course if it was as easy as just looking at a histogram to check the exposure, the camera would get it right all the time, and we'd never need to switch the camera out of the full auto modes.

Non-Standard Histograms

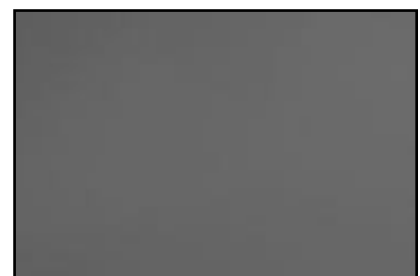
Try this experiment – put the camera into auto mode and take a picture of a white piece of paper, a grey card and a piece of black paper or material. If possible, use even lighting (e.g. outdoors in the shade). How will they come out? Here's a set I prepared earlier:



White paper

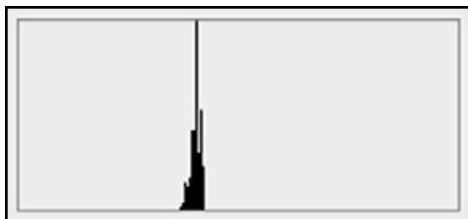


Grey card



Black Material

Is it what you expected? The camera has chosen different exposures for each image so that they all appear as mid-grey. These images are genuine photographs taken in aperture priority mode and taken out of focus to hide texture differences. They were also desaturated so that slight hue differences do not distract from the point being



illustrated. The histogram for these images will appear as a single spike somewhere near the middle of the histogram (left).

There are times however when you do not want an average histogram – the ‘correct’ exposure may require the histogram to be biased either to the right (a brighter image) or the left (a darker image). A classic example is a snow covered landscape. You probably want the snow to come out looking fairly white, but as you saw above with the photo of

the white piece of paper, this doesn’t happen automatically. When you look at the histogram for the snow scene, you want it to have a larger proportion of the graph in the upper half, and to achieve this, you will need to overexpose your image (using exposure compensation or manual mode). The example below (sorry it’s not a great image) shows the camera’s auto exposure on the left, and the overexposed image on the right - the latter being much closer to what I was seeing. (Histograms for these two images are shown below the image.

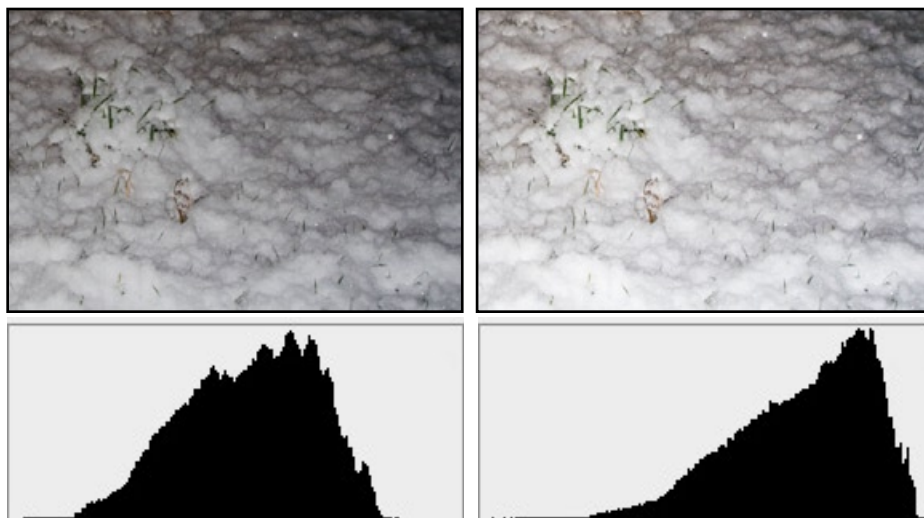
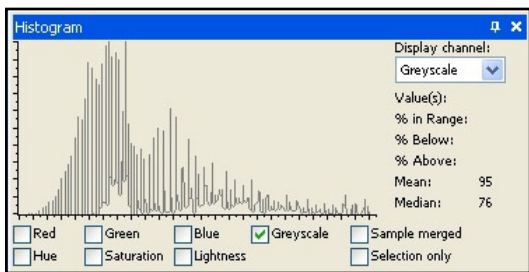
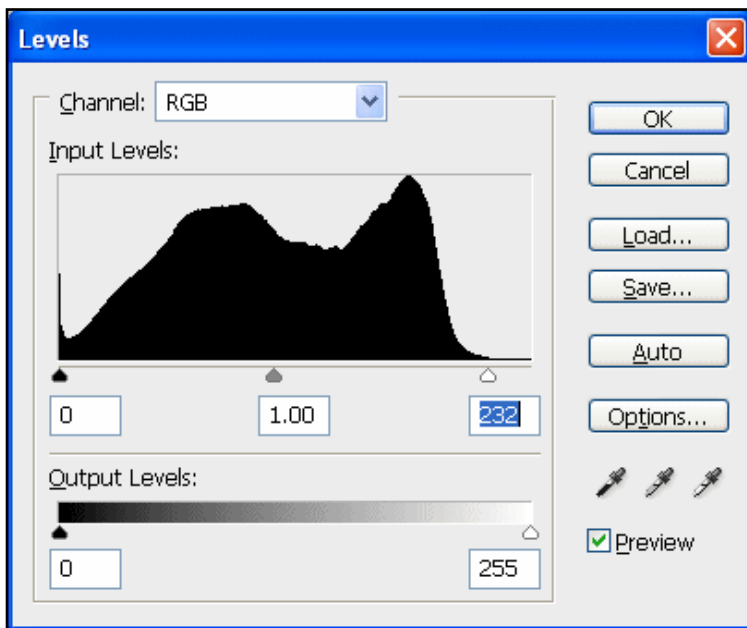


Image Manipulations Using Histograms

Many standard types of image manipulation rely heavily on being able to see the histogram. For example when using the Levels adjustment, it is important to see the histogram so you know how far to move the input sliders. In the example below, there is a gap on the right side of the histogram indicating a lack of bright highlights in the image. Therefore the highlight slider (the little white triangle) has been moved to the left to increase the tonal range in the image.

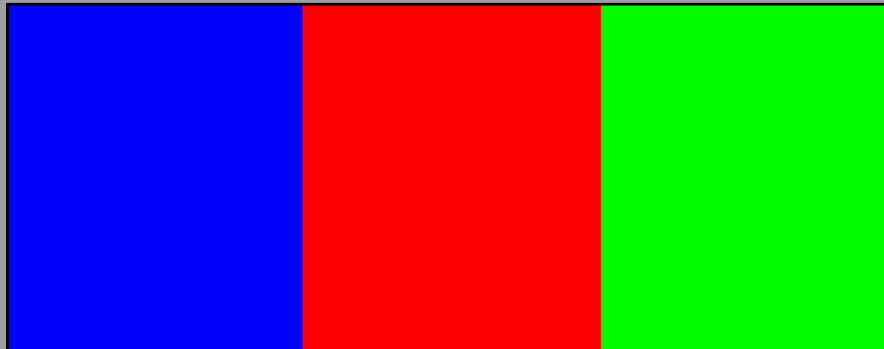
A word of warning though - if you are heavily manipulating images (especially JPEGs), you might start to see gaps or regular spikes in the histogram (see image below showing



the Histogram palette in Paint Shop Pro). This manifests itself as patches of colour in the photograph rather than smooth continuous tones so tread carefully when you see this effect appearing in the histogram. It’s also a big give away when someone tells you they never manipulate their image in post processing!

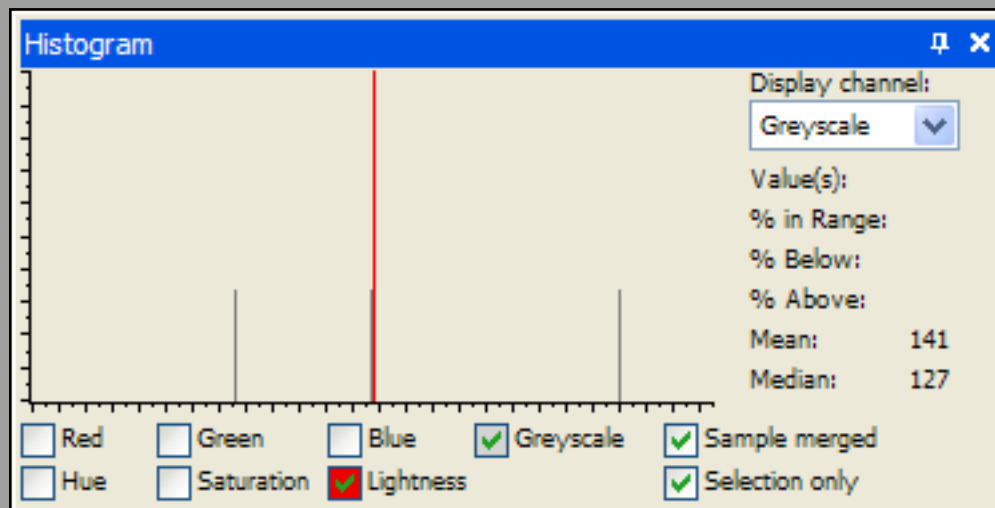
A Diversion : Luminance and Lightness - What's the Difference?

Although these terms are often used interchangeably, they are not the same. Lightness is the average value of the three colour channels. The following simple 3 colour image (consisting of pure red, green and blue) would give a lightness histogram with a single peak in the middle.

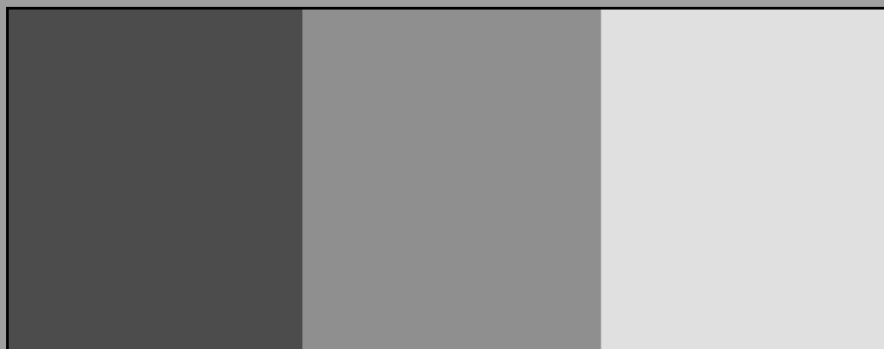


Luminance represents brightness as perceived by the human eye which is more sensitive to green light than to red or blue. To calculate the luminance value, the software will take a weighted average of the 3 colours. Green is usually given a 59% weighting, whereas red counts for 30% and blue for just 11%.

Therefore the luminance histogram will show three peaks, one for each colour (the grey spikes in the histogram below) whereas the lightness will show a single peak (the red spike).



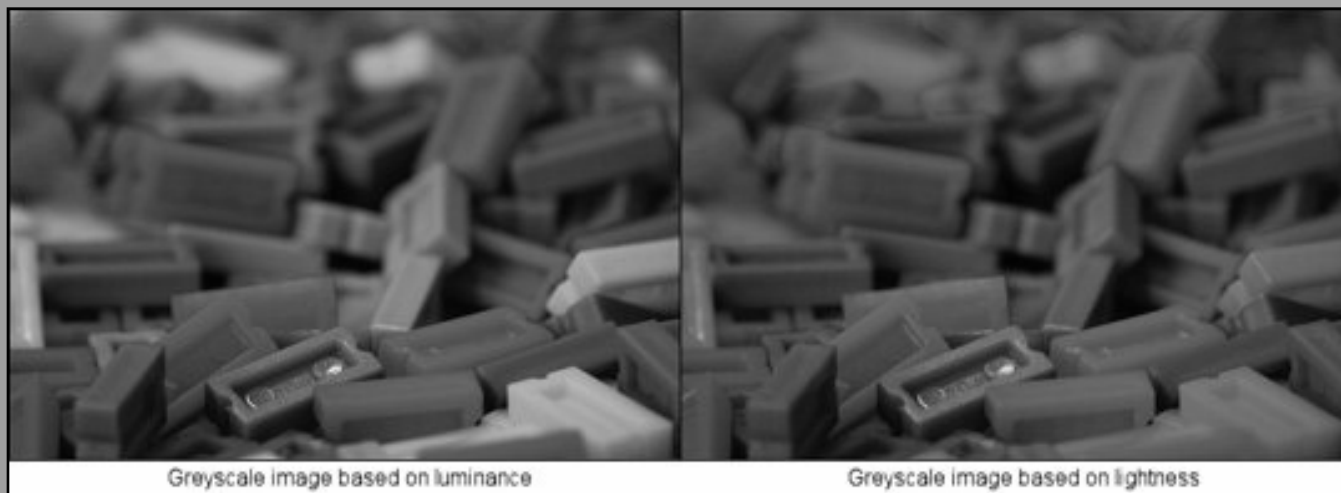
Luminance is important when converting to black and white images as this is what is used to decide on the shade of grey to assign to each pixel. The three colours converted to greyscale look like this:



You can see why the luminance histogram has three spikes – there are three different shades of grey. The rightmost histogram spike is for green which when converted to greyscale gives a much lighter colour than the other two.



I have converted this image of coloured blocks into a black and white image - the one on the left showing the conversion done using the luminance value (the correct way) and the one on the right using the lightness (which does not take account of the eye's sensitivity to the different colours).



About Colin Bell:

Colin Bell is an enthusiastic amateur photographer that works in the IT business. Colin works as a software developer for an environmental research institute and is a specialist in tidal theory and marine software. Colin has had an interest in photography since 1984 when he received a Chinon CE-4 one Christmas. In 1991 he upgraded to a Pentax P30T and spent a lot of time shooting black & white film and developing it in his loft based darkroom. He bought his first digital camera in 1999 (a 0.8 Megapixel Fuji DX-10) and now uses a Canon EOS 350D and 40D.

<http://www.creativephotobook.co.uk>

<http://www.flickr.com/photos/wirralbells>