

# Image resolution, size and quality

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*These notes were written to accompany tuition at Amersham Photographic Society, focusing on just the key facts needed to master each aspect of digital image manipulation with Photoshop Elements.*

## 1. What is an image made from?

A visible image is made up of a grid of black or coloured dots. The more dots in an image, the more detail it can contain. Typically we see our images either as a print or on a screen. These have very different characteristics: prints use the reflection of light from dots of coloured ink on white paper, whereas screens emit light from a grid of glowing spots of colour. Digital images are stored as files on computer disks and the dots are called *pixels*. A digital image file is just a grid of numbers, each one representing the colour of a pixel.

## 2. Resolution

Resolution is simply the number of dots that a print or screen displays in an inch and (not surprisingly) is measured in *dots per inch* (dpi).

*Prints:* the human eye can distinguish about 300 dpi, so that's the practical upper limit for prints. Although professional printers can produce 300 dpi for high quality purposes such as art reproduction, typical inkjet printers can manage about 200 dpi.

*Screens:* you can easily see the dots on a screen with the naked eye – typically only about 70 to 100 dpi due to mass-production limitations.

I have often read the following plea in magazines '*... please send us 300 dpi image files to ensure high quality reproduction in our magazine...*'. **This is nonsense!** If I send them an image file that is (say) 900 × 900 pixels (i.e. 810,000 pixels) then they can choose what size to print it in the magazine. If they print it 3 × 3 in then it will indeed be 300 dpi and will look excellent. However if they need to fill a page and choose to print it 9 × 9 in then it will only be 100 dpi, and it won't look good at all because the individual pixels will be large enough to become visible.

So there is a fixed relationship between file size, physical size and resolution. For a given image (file size) if the physical size gets bigger, the resolution gets smaller, and vice-versa. Higher resolution normally equates to higher quality although this depends upon the viewing distance. It's important to remember that images only have a resolution when they are reproduced. An image file cannot have a resolution – it's just a grid of numbers.

## 3. Technical stuff

Any colour can be produced by mixing red, green and blue. Computers use 256 shades of red + 256 shades of green + 256 shades of blue for each pixel giving a possible  $256 \times 256 \times 256 = 16.7$  million colours. 256 shades can be represented by one BYTE (B) – a unit of computer storage. Consequently each pixel needs 3 bytes for the three component colours. This is a fixed relationship so, for example, a 3 Megapixel camera produces a 9 Megabyte file when it has been opened in Photoshop for editing. In Photoshop (but not in Photoshop Elements) you can see the Red, Green and Blue components of an image in the *Channels* palette. The use of 256 shades of red, green and blue is called 8 bit colour (because one byte is made up of 8 bits) In recent years greater depths of colour (12 or 16 bit) are being increasingly supported by cameras and software. Unfortunately printers remain 8 bit, so the benefits cannot be fully realised and may be ignored by the beginner.

## 4. Advertised resolutions

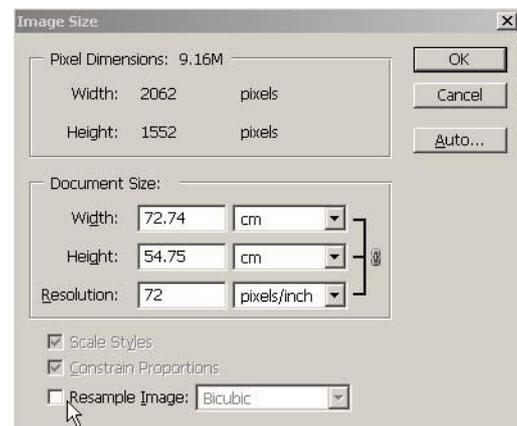
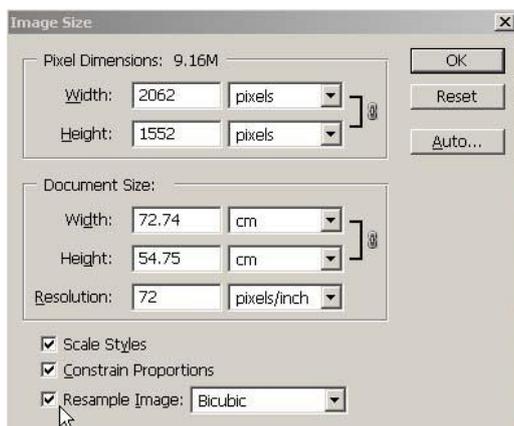
Confusingly, inkjet printers can be advertised with as much as 5,000 dpi capability. This number is often called resolution but really it's not. It should really be called 'Spots per inch'

because it's a measure of the number of spots of ink per inch that the printer can put on the paper. Many spots are used to represent each pixel in order to create a smoother effect to the eye. Above 1440 spots per inch the benefits are marginal.

Scanners are often advertised with an *optical* (or hardware) resolution and an *interpolated* (or software) resolution. Ignore the interpolated number – it may be bigger, but **it's useless hype**. Why do scanners have a higher resolution than the human eye? The answer is partly because a bigger number sells more scanners and partly because we may want to scan something small and print it large. In this case the magnification has to be taken into account. The best example of this is film scanning where the 35 mm film frame being scanned is tiny but we may want to print it very large. For this reason you should look for an optical resolution of 2400 dpi or more when buying a film scanner.

## 5. The most important box in Photoshop?

*Image>Image Size* (or *Image>Resize>Image Size* in Photoshop Elements) reveals the *Image Size* dialogue box above. It's important to fully understand this box as it is central to understanding resolution, file size and quality.



The number at the top (9.16M in these examples) is the file size and the number of pixels in the image is shown below ( $2062 \times 1552 = 3,200,224$  pixels).

The *Resample Image* tick box at the bottom is critical. With this box ticked (shown left) you can change the number of pixels and the image will be permanently changed, so only do this on a copy, e.g. to make a smaller image to e-mail. With this box un-ticked (shown right), the file cannot be changed or damaged at all and you can play with the *Width*, *Height* and *Resolution*. For example, if you type 200 for the *Resolution* the *Document Size* jumps to 26 × 19 cm (10 × 7 in), which indicates the maximum size for a good quality inkjet print. If you set a smaller size the resolution will jump to more than 200 but this is not a problem – the printer will ignore any excess data.

If you now try setting the *Resolution* to 72 (typical screen resolution) and you will see that the screen size would be huge – too big to send for screen viewing purposes only, so the image would need to be re-sampled. **Remember to keep an eye on the Resample Image tick box. When it is ticked you will permanently alter your image file.**

## 6. Rules of thumb

When we capture a digital image using a camera or scanner we are given a choice of how many pixels to record and we need to make an intelligent decision. Capture too many pixels and we will incur unnecessary storage costs and processing delays. Capture too few pixels and we may not be able to produce high quality results at the required size. The important thing is to capture enough data for the most demanding future need for that image file: an A3 inkjet print printed at 200 dpi will require ~ 7 Mpx (file size 21 MB), whereas for screen display at 75 dpi only 0.75 Mpx is needed. (file size 2.25 MB).