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Sharpening

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1. Introduction

This is an attempt to give a brief summary of why we should do sharpening and of the different views about how and when it should be done.

I have given some references at the end. There are many more sources of information out there for you to consult. There is a lot of advice out there and much of it is conflicting. This is an attempt to look at the various bits of advice and assess what makes sense and what does not.

2. The human eye

Summarising a lot of articles, you can think of the eye as a 130 megapixel camera with a rather crude sensor. About 90% of the pixels are on-off gadgets sensitive to light intensity only (what Photoshop calls 'luminosity'). The higher the light level, the faster the stream of pulses the pixel sends to the brain. The other 10% contribute colour information. At higher light levels, colour sensors appear to take over most of the work

Given the rather crude data from the retina, it's a very good job that the eyes are connected to a *very* smart processing computer, the brain!

One, very important, effect of all this biology is that we are very sensitive to *changes* in luminosity and sudden changes in luminosity are seen as 'sharp' edges.

3. What is sharpening?

Whatever your photo editing program calls it, sharpening is done by increasing the contrast across edges in the image. As an example, think about a dark grey square on a light grey background. This would be sharpened by making the pixels just inside the border a little darker than they were and those just outside a little lighter. This increases the contrast across the border between dark and light areas and the edge would appear sharper to the eye than the original. Embroiderers have known about this for ages and have used the technique to make the pattern in their work stand out. (The modern tendency seems to be to outline in black which is not nearly as subtle.)

Roughly speaking, the three controls that you find in most sharpening tools work like this.

- The ‘amount’ controls how much lightening and darkening is done.
- The ‘radius’ controls how far from the border the change extends. (It is not a case of 1 pixel radius means one pixel each side is changed; there is a bit more to it than that but you really don’t want to know about the mathematics involved! Or, if you do, I am not going to tell you here.)
- The ‘threshold’ controls how much difference there has to be between neighbouring pixels before sharpening is applied.

4. Why sharpen?

Books by professional photographers [Evening, 2009b, Ang, 2008, Schewe and Evening, 2009] suggest three reasons to sharpen (though they do not all mention all three).

1. The physics of camera sensors (and scanner sensors) mean that there is a slight tendency to reduce contrast across edges, which softens them. This is quite different from film where the physics and chemistry can produce slight automatic sharpening. Sharpening to counteract this is called **capture sharpening**.
2. The photographer may want to emphasise edge contrast for creative reasons (**creative sharpening**).
3. The physics of inkjet and halftone printing also results in some softening of the image. Sharpening to counteract this is **output sharpening**.

If you always shoot in jpeg format and do not change the camera’s default settings, then you will not have to bother about 1. All current cameras automatically apply some capture sharpening before creating the image file. Some cameras offer a menu option to apply more or less sharpening, but the choices are quite limited. The more advanced compact cameras sometimes allow you to turn off capture sharpening entirely.

If you shoot raw, then the raw file does not have sharpening applied to the image although the file may contain instructions on what the camera thinks should be done. (The maker’s software often applies these instructions but you have full control and can change the settings.)

If you shoot raw, you may want to think about applying capture sharpening at the point where you convert the raw file to whatever format you use to edit.

I can offer very little about creative sharpening; even my best friend would not call me very creative! The only such sharpening I have ever used is the ‘large radius, small amount’ way to reduce unwanted haze; this can be very effective. I’d say that one book was worth its price for that technique alone.

Whether you shoot jpeg or raw, you do need to at least think about output sharpening. (Some programs like Adobe Lightroomtm will automate output sharpening [Evening, 2009a] but it is still useful to know what is going on.)

5. Capture sharpening

In theory, this could be automated if you know the details of how your camera (or scanner) sensor works. Since we do not usually have this information, we have to do it by eye (viewing the image at 100% or ‘actual pixels’). There are lots of

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suggestions around as to what to do but they all amount to variations on:

- whatever the subject, err on the side of under sharpening rather than over sharpening;
- portraits and other images with lots of skin tones probably need smaller amounts, larger radius and higher threshold than landscapes, cityscapes and the like;
- landscapes, cityscapes and architectural shots have lots of detail and can benefit from a bit more sharpening, a smaller radius and a lower threshold;
- if you get light haloes round dark areas, you have probably sharpened too much.

So, after all, capture sharpening and creative sharpening do overlap a bit because the suggestion is to make capture sharpening depend on content and purpose.

6. Output sharpening

This is one area where there is a bit more agreement (only a bit more) between authors. Output sharpening is designed to counteract the softening of detail caused by the printing process. This *can* be automated (see remarks about Lightroom) and there are some plugins for Photoshop that will do the automation.

Where there is more or less total agreement is that the way to control your printing is to prepare a file especially for printing. In fact, many authors suggest a file for each size that you want to print. Even Epson [Sheppard, 2008] suggest that you do not leave resizing the image to the printer driver!

Exactly what this print version should be depends a little on your printer. As an example, Epson drivers can produce high quality prints from images with between 200 and 360 pixels per inch. Any less *or any more* and quality suffers.

Example

I have a 4256 by 2832 pixel image and I want to print a 7 by 5 inch borderless landscape print. Now, $4256/7 = 608$ and $2832/5 = 566.4$ so I have a lot more pixels per inch than the driver can handle. I also have the wrong proportions because my original is 3 : 2 which is not the same as 7 : 5; my original is too long in relation to its height.

What to do? Resize to the maximum number of pixels in the height that the driver can handle, 360 pixels per inch for 5 inches is 1800 pixels. So, I use Photoshop (or other editor) to resize to 5 inches (and let the other come out at 7.5 inches) and resample to 360 pixels per inch. Because I am going down in pixels per inch, I use ‘bicubic sharper’ because all the books say so.

Then I crop to 7 by 5 inches. Now I have a print file at exactly the maximum pixels per inch (ppi) and exactly the right size.

The final stage is to sharpen according to one of the many recipes out there for 360 ppi printing and the details will also depend on whether the paper is glossy, lustre or matt.

7. The arguments

Rob Sheppard in his Epson printing book [Sheppard, 2008] does not mention capture or creative sharpening (but it is a book about printing). He suggests that any sharpening should be the final act on an image.

There are reasons to put sharpening last. It make drastic changes to the image and can emphasis noise and other undesirable features if done early on.

Others, including professional photographers like Tom Ang, Martin Evening and Jeff Schewe, go for the three stage sharpening scheme described earlier.

The various authors also disagree about how much sharpening to apply. Here I agree with one suggestion of Rob Sheppard's: the proof is always in the print, not what is on screen. He suggests that you should not expect your first print to be exactly right and he has a point, even if he is sponsored by Epson. Some paper suppliers can provide proofing papers which are really fairly cheap. (They are also usually fairly thin.) Most are matt to keep the price down but they can still be useful even for those who usually print on gloss or lustre.

It is quite revealing to print several copies of the same image on a single sheet of proofing paper with different degrees of sharpening applied.

References

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