

If you watch YouTube videos long enough, you will eventually find your favorite photographer doing some kind of review or comparison. Could be a new lens, new camera or new software.<sup>1</sup> These persons may not have deep experience with gear or reviews, and their content is often, "I have this new < something >, so I took some pictures and here's what I think."

One recent review was so bad, I felt compelled to say something about the whole on-line review experience. The photographer was comparing his current v4, 24MP digital camera to the new v5, 40MP model. Surprisingly, he found the new camera version less sharp, implying that the upgrade was some sort of scam ... and he had the pictures to prove it!

Science tells us such comparisons should be created with near identical conditions, except for the one item being evaluated, in this case, the camera body. In this review, the photographer indeed had the foot of his modest telephoto mounted on a tripod, and simply swapped cameras. He used the same f/stop, shutter speed and ISO. So far, so good. But the location was outdoors, the weather was windy, the tripod was on a sandy beach, and he noticeably jostled the tripod while changing cameras, all possible sources of image softness. Back in the studio, he compared the two images side-by-side in Lightroom. The screen clearly showed that the two comparison images were LR's low resolution preview images, not the ideal full size images.

To get truly comparable images you need to understand and manage every step of image creation. This should be part of the presentation: Were they hand-held, or locked down on a tripod? Was focus re-established before every shot? Were f/stop and shutter speed displayed? Were they appropriate to the subject? Did the photographer even know what he was doing? (This fellow once demonstrated how turning the polarizing filter 'polarized and unpolarized' the light. This is not how polarizers work!)

Image galleries accompanying on-line lens and camera reviews generally do *not* provide information on tripod use, status of lens and in-body image stabilization, what the actual focus point was, or post processing ... so mostly useless. DPR was notorious for this! However, they did have an excellent target scene to evaluate lenses, with resolution targets in the center and all corners. They also had an excellent tool to compare the same target scene across different cameras and lenses. Sorry to see DPR go.

Happily, most on-line reviews are not as awkward as the one I describe here. Many internationally recognized photographers provide excellent reviews of equipment they know well. If you are thinking about spending thousands of dollars on a new piece of gear, such reviews are well worth pursuing. I mention a few exceptionally good reviewers at the end of this document.

Every processing step from capture to portfolio image or print can affect quality. The data produced by the camera's sensor is subject to a huge amount of processing as it moves from the sensor to a digital RAW file, JPG, TIF, or print. Some of this is done in-camera, more is done in Lightroom or the Bridge/Camera Raw/Photoshop workflow. Almost all is done automatically before you even open the

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<sup>1</sup> I will not even touch camera bags, backpacks or filters as these reviews do not use images to evaluate quality. Surprisingly, filter reviews don't often talk about incompatibilities they introduce, e.g. lens hoods cannot be attached to magnetic filters. And only very rarely are ND filters evaluated for color neutrality. Too many of these reviews are for a 'donated' product, not one purchased by the photographer after personal research. A few years ago, four photographers who worked together all received, and reviewed, Shimoda backpacks. They even had a 'Shimoda dance'. Shimoda really 'owned' them! So sad ...

image on a computer and is likely to be different for different cameras. It is complex and needs to be understood and controlled if two images are to be truly comparable. Below, you will read about what happens to your image files in order for them to be properly displayed on your computer.

The two most common end-points of this digital pipeline are print or RGB files suitable for display on an electronic device. We need to understand how image quality is affected by the lens, the camera, the processing software and the printer/paper for a print. Even with prints, you will likely be evaluating and tweaking images on a computer before sending them to a printer.

To perform a useful test, you must use the best technique. Here are a few things to look for in a review:

- ✓ Was the camera hand-held or on a tripod?
- ✓ Was the tripod well locked down? Do the legs end in spikes or large rubber balls? Spikes can be pushed into sand, soil and leaf litter for firm support. I've seen camera movement when stepping near one of the tripod legs fitted with ball feet.
- ✓ Is the shutter speed fast enough to avoid wind effects? Use of higher ISO values helps. You may get increased grain, but images will still be comparable.
- ✓ Were exposure settings fully manual? You must avoid changes of focus point, f/stop, shutter speed, ISO and white balance that a camera's automatic modes might change.
- ✓ Was the camera refocused before every shot?
- ✓ Was an electronic front curtain or mirror-up option used? This avoids shutter and mirror slap blurring.

This setup is easily described concisely and should give you a nice set of images for comparison.

### Comparing Lenses

The ideal way to evaluate lenses is to use a dedicated 'optical bench' lens testing device. This takes all camera-related issues out of the equation. Websites like DXOMARK do this and make the results public. They do not test lenses as they are released; new lenses may never appear. LensRentals sometimes publishes these comparisons since they evaluate (and repair if needed) returned lenses before sending them to a new customer. But their lens tests are not generally available. Optical Limits is also worth a visit (but weak on Nikon Z glass.) Finding results for all current or newly released lenses is unlikely.

Before spending thousands of dollars on a new or exotic lens, think about renting one! Take images; run tests. I often rent a pricey lens to evaluate during my annual trip to Acadia NP. The cost of a rental is usually far less than the loss incurred by selling a newly purchased lens that didn't quite work for you.

### Comparing Cameras

The in-camera pipeline is extremely complex. Different camera versions may have different sensors, front or back illuminated, different color filter arrays, Bayer, Quad Bayer, Foveon, EXR, X-Tran, and a different photosite count, size or density.

Surprisingly, the camera's sensor is an analog device. Analog voltage values are converted to digital using a custom analog-to-digital converter (ADC). The sensor itself is color blind; it responds only to the intensity of light. But since each photosite is covered by one of the color filters in the color filter array,

the camera's firmware can produce an approximate value for each of the three RGB values needed for on-screen pixels. The process of converting RAW photosite data to RGB pixel data is called demosaicing.

Photosite data is linear, human vision is logarithmic. An exposure curve must be applied to the photosite data to get reasonable brightness and contrast for display on your camera's LCD. When saving a JPG or TIF image, the image file contains the RGB pixel values produced by demosaicing. Camera manufacturers may apply a 'look table' to the image so all their camera models will have nearly identical color interpretations. Some photographers may prefer Canon cameras for their nicer skin tones, or Nikons for their better greens in landscapes.

However, most digital cameras have a menu that users can use to adjust how that JPG or TIF looks: sharpening, saturation, contrast or hue adjustment. This ability to change some of these automatic in-camera color interpretations makes such preferences less critical.

The 'scene modes' or 'picture controls' of some cameras are merely presets of the color, contrast, saturation and sharpness of these adjustments. Unfortunately, these are applied directly to the JPG/TIF image. A B&W or Carbon choice may totally remove color data. Caution advised.

If you shoot RAW images, the file you save retains all the original photosite luminance and color data. The name of the scene mode or picture control you chose for the JPG is used to apply a matching profile when the image is opened. LR/ACR can change or remove these 'camera matching' profiles. You can preview all of your camera's scene modes on the same RAW file! Quite a good reason to shoot and save RAW images.

Note that all RAW files hold an embedded JPG image! The camera's LCD and/or viewfinder require an RGB image. This is often the preview image you first see in Bridge or LR's Library module. These preview images are low resolution, just a few megabytes; adequate for checking composition, but weak for deciding sharpness or depth-of-field.

### Comparing Images

Both LR and Bridge/ACR reinterpret your images when you open them: a profile, and possibly a preset, is applied! Adobe updates LR and ACR regularly with updated camera and lens profiles. If ACR recognizes my Nikon camera and lens, corrections for optical defects (barrel distortion, chromatic aberration) are applied automatically. I suspect this happens for other manufacturers as well. This software will recognize and correct known lenses, but not new or third party lenses. This may result in very noticeable differences during lens and camera comparisons!

LR and ACR will display the name of the automatically applied picture profile, but it may be difficult to know what changes are made. This is because applying a profile does *not* move the sliders! Presets do move the sliders, so may be easier to detect.

If you decide that additional slider adjustments, say sharpening, need to be applied by default, then save these as a preset. ACR and LR can then be instructed to set this as the default for all subsequent images. If you have more than one camera, you can tell LR/ACR to apply different profiles based on the camera's serial number.

So here are the first few issues concerning on-screen image comparisons.

- ✓ Don't compare preview images! Be sure you allow LR and ACR to generate full size images! These take up a lot of disk space but are only needed for comparisons. You can manage cache settings to delete these.
- ✓ When you make on-screen comparisons, do so at 100%. At 100%, image pixels match display pixels. This is why both LR and ACR have a one-click zoom to 100%! At less than 100% the software is effectively removing pixels. This results in a perceived increase in sharpness and reduced grain. At more than 100%, pixels are being added; images will look blurry. In either case, the process is not simply adding or removing pixels, but rendering a new image by blending color and luminance values.
- ✓ Take the time to determine what profiles are being applied, especially if you are comparing different cameras! They may have very different settings. The reviewer I mentioned above found that the 40MP image did not seem as sharp as the 24MP camera. This seems unlikely, but there was no check on what level of sharpening was being applied automatically. And I would repeat that there was no adherence to strictly identical setup, sandy beach, windy day, no timer delay. Just too easy for environmental issues to affect sharpness.

Both LR and ACR let you zoom in and out on an image. They both actually generate a new, temporary display version of your image for this purpose. These look especially good at integer fractional steps, e.g.  $\frac{3}{4}$ ,  $\frac{1}{2}$ ,  $\frac{1}{4}$ , etc. using the Ctrl+ or Ctrl- keystrokes. The Fit-to-Screen size is rarely one of these and will look slightly softer.

If the two cameras you are comparing have different sensor sizes, the 100% view of one will be larger than the other. The larger one definitely has more image data and will likely look sharper. This makes comparison more difficult. If you want to place your subject details on the same pixels, you need to use the same effective focal length for the test images. For example, APS-C sensors on Nikon cameras effectively increase the lens' focal length by 1.5. If you use a 30mm lens on the APS-C sensor, use a 45mm lens on the full frame camera. A 'normal' zoom can make this easy! (I believe the increase is 1.6 for Canon lenses.)

If you want to evaluate sharpness, use the 100% view. You definitely want to see the pixel level changes that sliders on the Detail panel are making! Here's a tip: Hold down the Alt key while moving the sliders. LR and ACR will change the image to grey scale, so the changes are more easily seen. As you move the sliders, you will see significant changes on-screen. The Noise Reduction sliders have the same feature. It will take time and experience to understand what the greyscale changes mean. Toggling the Alt button often can help.

Finally, here's why evaluating sharpness is complex. The proper amount of sharpening depends on the size JPG/TIF you will display. As we found above, reducing image size alone adds sharpness. Sharpening that looks good at 100% may look really harsh at 25% size. The 24MP landscape images from my Nikon Z6 are 6,000 pixels wide. For Flickr, I upload 2,048 pixel wide images that are not resampled on the server. That image is already well sharpened, no sharpening step needed!

Many photographers recommend a three part sharpening scheme: *Capture* sharpening, *Artistic* sharpening, and *Output* sharpening. Capture sharpening in LR/ACR should be modest as needed by larger or smaller sensors. This will be part of your 'master file'.

Artistic or Output sharpening will be applied after resizing for print or digital display. Artistic sharpening may be applied to the eyes in a portrait and softening in areas like skin. Artistic and Output sharpening should be applied *after* editing for the final size of display and medium. In addition to your master file, you may have a 'print file' version for each size.

### Third party tools

Third party tools compete well with LR/PS, with better results for specific tasks such as noise reduction, sharpening and resizing. For example, they may handle XTRAN sensor images better than LR/PS. If a trial version is available, it's well worth downloading and evaluating. The Topaz noise reduction tools are getting really good reviews.

I use both PS and Helicon Focus for depth-of-field stacks. Most of the time, the results are equivalent, but I occasionally find stacks that work better in one than the other. Helicon Focus has nice ghosting tools.

I have had issues with the NIK software modules. Seems that the current NIK tools applied to a PS Smart Object are not compatible with the same tools in earlier versions. NIK4 can't open NIK3 Smart Object Layers, NIK5 cannot handle NIK3 or NIK4 Smart Objects Layers. I now keep only NIK3 on my computer, solely to re-edit an image with a NIK3 Smart Object. I remove the NIK layer and use a Camera Raw adjustment to replicate the NIK3 effects.

Both of my luminance masking tools, TK8 and Lumenzia, create real masks and have never rendered an image un-editable. But I now treat all third party tools with some skepticism.

### Comparing Prints

The proper amount of sharpening for prints is also complicated. For inkjet printers, matte papers allow the ink drops to spread a bit more than glossy papers. More sharpening may be needed for matte prints. Your 'print file' version for matte papers may actually look overly sharp on-screen.

The recommended printer resolution for an image is 300 dpi (dots per inch). Thus a 6,000 pixel wide 24MP image will produce a print 20 inches wide at 300 dpi. This is based on human vision acuity at reasonably close viewing distances. Larger prints viewed from farther away may look good at 240 dpi.

Note that inkjet printers don't actually print simple dots. They sputter microscopically small amounts (less than 2 picoliters) of ink that blend together for a smooth look. They also have different print quality settings that place more dots per inch at higher quality. If you are evaluating print sharpness, you should know that consistent quality settings were used.

### Conclusions

As you now know, the images you see on-screen are always modified as their data has been moved from sensor, to camera, to software, to display or to print. In the case of the 24MP to 40MP comparison images described above, there was no attention paid to how much sharpening was applied, in-camera or by LR/ACR presets and profiles, or what environmental factors could have affected the results.

If you are completely happy with your current camera, lens and software, and the images you post on-line or print meet your strictest standards, you do not need any of this! Live long and prosper! But when you are considering the purchase of a new camera or lens, often well over \$2,000, finding excellent reviews is highly recommended! Be sure the reviewer:

- ✓ Actually has a good deal of experience with the camera you are considering. Un-boxing videos or other trivial content does not count! This may mean that a really good review may not be available for several months after the item has been offered for sale.
- ✓ Has reviewed several other models from the same manufacturer. This will reveal new, changed or removed features.
- ✓ Follows the guidelines above when showing images from the camera. Any adjustments of hue, saturation, contrast should be mentioned as part of the review.

I highly recommend the following:

[Thom Hogan](https://bythom.com/) (https://bythom.com/) does deep technical and hands-on reviews of Nikon gear (and a few others), and rigorously describes how his test images were made. His camera guides are hundreds of pages long and cover *all* camera settings, what they do, and which choices will be best. I'm not aware of anyone who reviews Canon or other brands at this deep level.

[Steve Perry](https://backcountrygallery.com/) (https://backcountrygallery.com/) does hands-on reviews of Nikon and Canon gear as used for wildlife photography. He also produces excellent e-books, including an amazing eBook on the Nikon Z focusing system – *all models!* (Videos on the site and YouTube)

[Simon d'Entremont](https://www.simondentremont.com/) (https://www.simondentremont.com/) uses Canon cameras and provides excellent videos on wildlife techniques. (Videos on the site and YouTube)

[Maarten Heilbron](https://maartech.com) (https://maartech.com) produces excellent hands-on reviews on many brands. Check his YouTube Playlists for cameras you are thinking about. His reviews are completely unsponsored and ad-free! (Videos on the site and YouTube)

[Andy Mumford](https://www.andymumford.com) (https://www.andymumford.com) is a FujiFilm brand ambassador. (Excellent YouTube videos)

Know of any other high quality reviewers? Send a URL to me: bob@wetbootphoto.com

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