

Brightness, Contrast, Saturation, and Sharpness

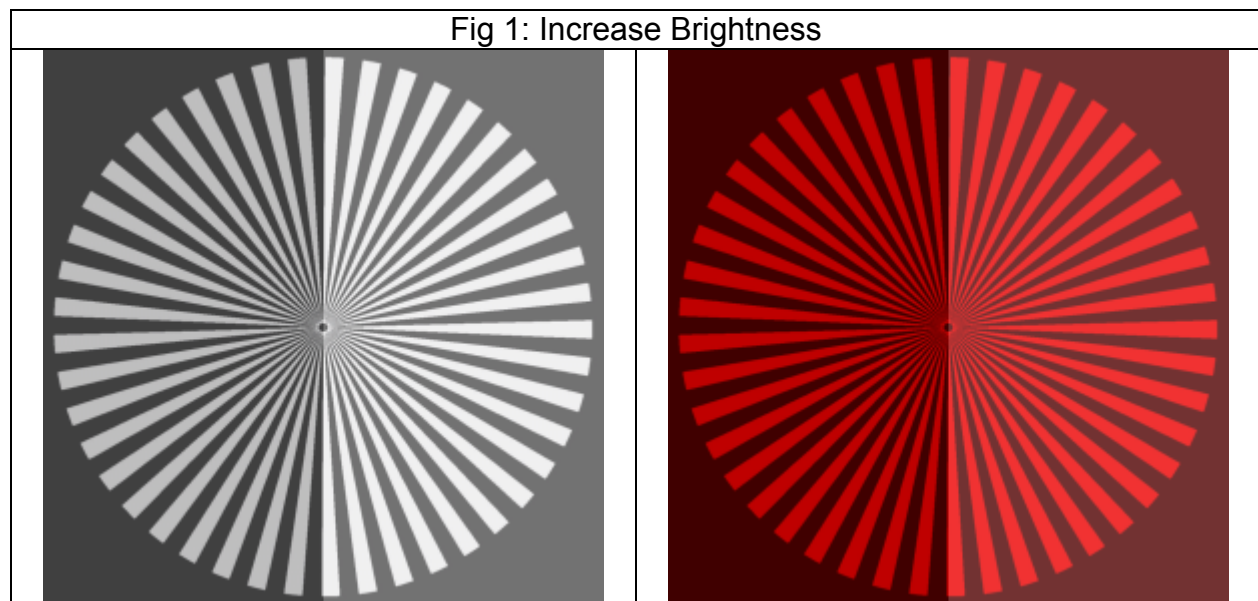
By Mike Chaney

Used With Permission

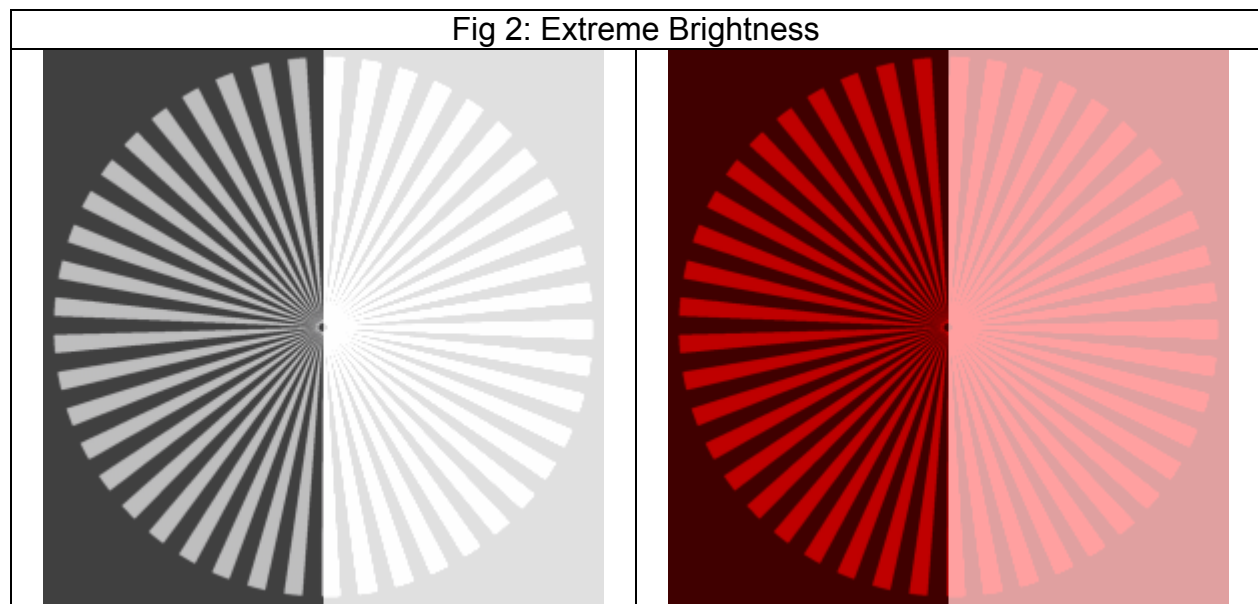
At first glance, it might seem that doing an article on the four most common image controls would be a waste of time. After all, brightness, contrast, saturation, and sharpness are often thought to be the simplest controls as they've been around as long as the color TV. People often overlook the fact that all four are related, however, and changing any one of them can change the other three. Do you know how they are related and how you are changing the balance of brightness, contrast, saturation, and sharpness by only changing one of the three parameters? Let's take a look.

Brightness

Brightness is generally thought to be the simplest in concept. Just make the image brighter or darker by a specified amount, right? First we must distinguish between true brightness and something else called "gamma". Increasing gamma by moving a mid-tone slider on a histogram is not the same as increasing brightness. Increasing Gamma/mid-tones can make an image look brighter, but it is non-linear in that it only increases brightness of the shadows and mid-tones in an image without affecting the highlights. Traditional brightness on the other hand, simply brightens the entire image from the shadows to the highlights equally. Let's see what happens when we add some brightness to an image. The following test image is designed to bring out some of the effects we will refer to in this article.



In figure 1 above, we have increased brightness on the right half of both the B/W and color images. In this case, we didn't increase brightness enough to clip the highlights (brightest colors) so we've only affected brightness here.

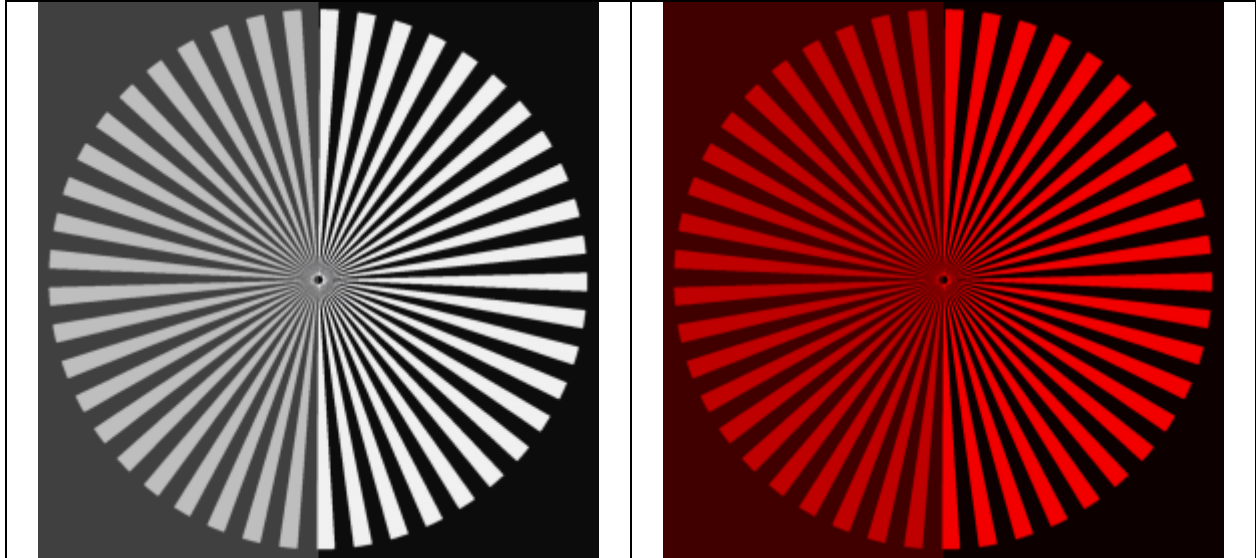


If we had made a more drastic change such as the one shown in figure 2 where we added even more brightness, we may have clipped the white/red spokes in the wheel which would have affected contrast, saturation, and sharpness! In the extreme case shown in figure 2 above, we have added so much brightness that the shadows have "caught up" to the highlights because they are already as bright as they can get. Now we have reduced saturation, reduced contrast, and reduced sharpness as a result. The same effect can be seen if we had reduced brightness to the point that the shadows had nowhere else to go and the highlights started catching up to the shadows. Depending on how close your shadows/highlights are to their endpoints already, you don't need an extreme change in brightness to affect the other parameters either. When increasing brightness, you may find that you lose some contrast on the brightest details in the image while the rest of the image has the same contrast as before. Again, this is due to the clipping that is caused in the highlights.

Contrast

Contrast is defined as the separation between the darkest and brightest areas of the image. Increase contrast and you increase the separation between dark and bright, making shadows darker and highlights brighter. Decrease contrast and you bring the shadows up and the highlights down to make them closer to one another. Adding contrast usually adds "pop" and makes an image look more vibrant while decreasing contrast can make an image look duller. Here is an example where we add some contrast.

Fig 3: Increase Contrast



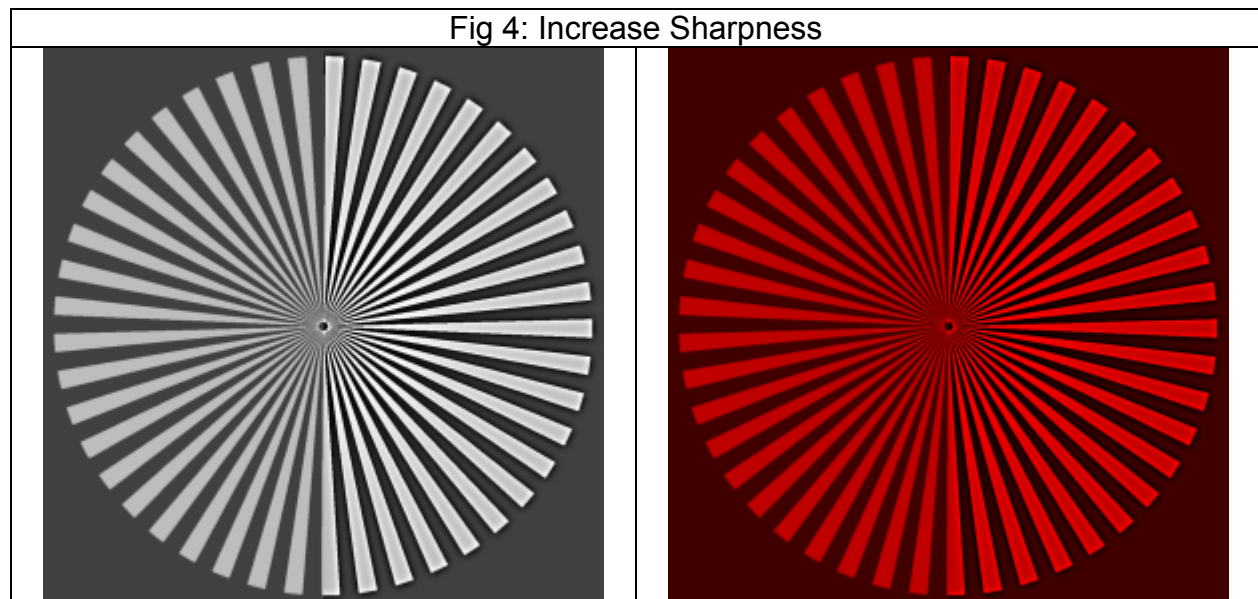
In figure 3, we have added contrast to the right half of both images. As you can see, the white/red spokes have gotten brighter while the background has gotten darker. This causes the image to look more defined. By making the highlights brighter, however, we've also increased the brightness of the spokes, causing the image to appear brighter since the spokes are the main focus of the image. On the red image, increasing the brightness of the spokes has also increase saturation (defined below). Finally, sharpness has also been increased on both images (also defined below). Here, we have increased brightness, contrast, saturation, and sharpness simply by adding contrast! Note that not all areas of the image will be affected equally and a lot depends on the content of the image itself. Saturation effects, for example, will be less noticeable in images that don't show bright colors because there is very little saturation to begin with. As an extreme example, take a look at the B/W image above. Since B/W images have zero saturation by definition, changing contrast cannot change saturation in B/W (gray) areas of your image.

Saturation

Saturation is similar to contrast, however instead of increasing the separation between shadows and highlights, we increase the separation between colors. An example showing increased saturation would show the same effect as figure 3 above for the red image but the B/W image would not change at all because B/W or gray detail has no saturation. As a result, an increase in saturation results in an increase in contrast, brightness, and sharpness on the red image as in figure 3 and no change to the B/W image. Again, a change in saturation normally has a more noticeable effect on vibrant colors and less on dull colors or colors that are almost neutral. This is because to change saturation, there must be some color saturation to work with in the first place.

Sharpness

Sharpness can be defined as edge contrast, that is, the contrast along edges in a photo. When we increase sharpness, we increase the contrast only along/near edges in the photo while leaving smooth areas of the image alone. Let's take a look at an example with increased sharpness.



The right half of the above two images has been sharpened using unsharp mask. By only sharpening the edges, we've actually created several different effects in the above image. Near the outer edge of the spokes, where the spokes are thicker, they simply look sharper without looking brighter or more contrasty. As we approach the center of the wheel, however, where the spokes get very thin, our edge contrast enhancement has actually caused the center of the wheel to get brighter, more contrasty, and more saturated (on the red photo). This is due to the fact that most of the data near the center is edge data so the effect increases in that area. Here, we see that increasing sharpness can cause the appearance of increase saturation, contrast, and brightness in areas of the image that contain fine detail where other areas (areas with broader detail) seem less affected except for the added sharpness.

Different effects for different parts of an image

The overall effect of brightness, contrast, saturation, and sharpness will vary depending on the content in each photo. Consider increasing contrast as an example. Increasing contrast makes shadows darker and highlights brighter. If we increase contrast on an image where most of the detail in the photo is very bright, say an overexposed sunset, we may actually end up with **less** contrast! Why? Because there are no (or minimal) shadows in the photo so separating the shadows and highlights in an image that only contains highlights will just compress the highlights, making them less contrasty. Similarly, taking a soft focus shot and increasing saturation may cause bright/vivid colors to appear sharper than gray or near gray detail and that may cause an unwanted change in overall balance of the photo. As an example, increasing saturation on a shot

of a cricket sitting on a red rose petal may increase the sharpness of the red rose petal, taking focus off the less colorful subject (the cricket) because it will be less affected by the change in saturation. The end result may be that the rose petal now looks sharper than the cricket, making the cricket appear to be out of focus, all because you increased saturation. Being able to control these linked effects when using simple controls like brightness, contrast, saturation, and sharpness is a bit of an art, but understanding **why** we sometimes get unexpected results is half the battle!

Summary

While brightness, contrast, saturation, and sharpness may appear to be the simplest of image controls on the surface and may appear to be mutually exclusive controls, they are related and intertwined in such a way that changing any one of them can create quite complex effects in your photos. Understanding how they are related can be a big step in understanding how to use them and more importantly **when** to use them. Before adding or reducing brightness, contrast, saturation, or sharpness, think about this article and ask yourself what you are really trying to accomplish. Hopefully this article will help you pick the right control or the right situation.