



Aperture and Digital Photography

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Most digital cameras, especially SLR (single lens reflex) and many higher quality non-SLR cameras, have an adjustable lens feature called the aperture. The aperture is an opening in the diaphragm of the lens. It has one basic function—let in more or less light to achieve the correct exposure. At the same time, it creates some very interesting effects. The primary effect is what it does to the depth-of-field. Depth-of-field refers to the amount of a picture, in front of and behind the subject, that is in (or nearly in) focus.

Shutter speed and film speed settings are usually better features for achieving correct exposure. This gives us greater flexibility to use the aperture setting for more artistic purposes. Savvy photographers will learn how to adjust these three elements (aperture, film speed, and shutter speed) to achieve a desired effect. (For more information on shutter speed and film speed settings see other fact sheets.)

For practical purposes it is important to be aware of how the aperture does regulate the light coming into the lens. However, this fact sheet discusses how to use the aperture setting for more creative photography. The following sections will discuss how and why the aperture can be used to increase or decrease the amount of foreground and background that is in focus.

How the Aperture Functions

In modern camera lenses, light is directed through a complex series of convex and concave lenses which magnify distant objects clearly. At some point in the

lens the light rays from that image must pass through the diaphragm aperture (Figure 1) to get to the photosensitive surface.

The aperture functions according to the same principal as the pupil of an eye. As it opens wider more light will be exposed to a photosensitive surface. Figure 1 shows the similarities between the aperture and the human eye.



Figure 1. This diagram compares a diaphragm aperture's function in relation to the pupil of an eye.

The iris of the human eye will alternately constrict or relax as the level of light increases or decreases. When a camera is on auto mode it will balance the shutter speed, film speed and aperture to achieve a programmed effect.

Aperture Settings

The aperture opening on lenses may range from the setting of 1.4 to 32. Most good quality lenses range from 2.8 to 22. A lens that has a maximum aperture of 3.5 may still take good photos but will not be as good for low-light situations because the aperture is not open as wide. For purposes of this discussion we will consider a lens that has an aperture range from 2.8 to 22.

It is important to remember this is actually a ratio of the focal length inside the lens and the aperture size. These numbers are frequently referred to as the “*f*-stop.” Since the number is a fraction the smaller of the two numbers is $f/22$, which indicates the smallest diameter of the aperture. An aperture setting of $f/2.8$ would be the largest diameter of the aperture. The following images serve as a guide on the ratios of the openings.

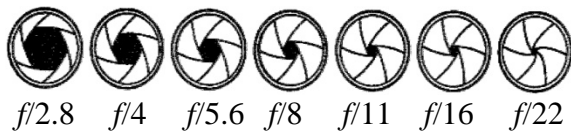


Figure 2. This diagram shows the difference in sizes of the aperture settings.

Depth of Field and the Aperture

While the aperture refers to the size of opening in the lens diaphragm as shown above, it also is the sole camera adjustment used to determine the depth-of-field. For example, a landscape shot that is clear for many miles has a deep depth-of-field or deep focus. Conversely, a portrait with a blurred background has a shallow depth-of-field or shallow focus. This is determined by the aperture setting.

There is a lot of calculus involved in calculating how the aperture controls the depth-of-field. Because of the inverse relationship between aperture and depth-of-field, a large aperture has a shallower depth-of-field, and a small aperture makes the depth-of-field deeper. Thus, more of the background and foreground may be blurrier, or clearer, depending on the aperture setting.

A way to remember how the aperture setting affects the depth-of-field is to consider just the number itself. The *f*-stop 2.8 ($f/2.8$) has a shallower depth-

of-field and the *f*-stop 22 ($f/22$) has a deeper depth-of-field.

So with an *f*-stop of 2.8 the foreground or background will quickly become blurry. With an *f*-stop of 22 objects in the foreground and background lose focus much farther away from the actual focal point.

Blurred Versus Clear Background

The photographer needs to determine how much focus or blur is best for any given picture. There are some basic principles that may help make the decision easier.

A few suggestions would be:

- Keep the background clear when there is a beautiful backdrop.
- If the background or foreground helps to tell the “story” of the picture, keep it in focus.
- When the lines naturally lead to the subject keep the background clear.
- If the contours of a picture don’t lead to the subject of the photo, consider blurring the background.
- Blur the background if there is a lot of unnecessary junk that detracts from the photo.

When a photographer is intentionally trying to blur the background and/or foreground, it is imperative that special attention be given to the focus on the lens. The main subject must be in focus or the shot will likely be ruined. Automatic focus on cameras can sometimes find the wrong focal point and blur the desired subject. Using the manual focus mode, if available, can be helpful. It takes practice and patience to ensure that a desirable depth of field is attained.

Figures 3 and 4 are examples of the difference aperture settings can make.



Figure 3. Aperture f/5.6. The blurry background makes the flowers stand out.



Figure 4. Aperture f/22. The smaller aperture shows the cluttered background to be in better focus and can distract from the subject of the photo.

Figure 5 is an example of a picture that was blurred to focus strictly on the desired object. The aperture was set to a wider opening and the lens zoomed in very close to the subject of the grasshoppers on the stalks of barley. Though the surrounding stalks of grain are only a few inches away, the grasshoppers at the top are the subject with the most clarity.



Figure 5. This diagram shows only a few grasshoppers in focus on a stalk of barley.

The aperture and focus can also be used to blur the foreground and background of a close-up photo. This process ensures that only a middle section is in focus. This occurs when aperture is set opened to a wide setting, and the camera focused on a point in the middle of the shot. The foreground and background blur in figure 6 so that only the desired portion of the subject stays in focus.



Figure 6. The lens was focused on the water droplets and the depth-of-field was narrowed with a mid-range aperture

Conversely, a very deep depth-of-field can be an asset when the entire background is relevant to the picture such as the photo in Figure 7.



Figure 7. This landscape shows a deep depth-of-field.

Another factor that will affect the actual depth-of-field is the distance from the camera to the subject. Even with a wide-open aperture, as the distance from the camera to the subject increases the depth-of-field will also increase. So, the depth-of-field

effects created by the aperture setting are much more evident in close-up photos.

Summary

The aperture is a very useful feature for special photographic effects. It also does regulate lighting. But that is done more easily with shutter speed and film speed. The easiest way to remember the f-stop effect on depth-of-field is that the higher number (22) will have more foreground and background in focus than the lower number (2.8).

In dark situations where a flash is not appropriate, such as at an indoor party, it may be necessary to

use a larger aperture setting. Indoor images taken with a smaller aperture opening require the shutter to remain open longer and increase the possibility of the entire image becoming blurred through movement of the camera or the subject. Mastery of the aperture settings takes a lot of practice.

References:

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This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Noelle E. Cockett, Vice President for Extension and Agriculture, Utah State University.