How to Shoot: Setting Exposure

I started writing a blog post on exposure - how to achieve good exposure, what the settings are, what effect they have - twice. Both times, I made it three or four paragraphs into the post before I realized it was just too complicated a subject to do it justice in a blog post.

Instead of shoehorning my little tutorial into the blog, I've decided to try something different - more of an eBook sort of document. We'll see how it goes. Your feedback will be welcome. My goal here is to not leave you with a cookbook. The *do this, do this, then do that* approach is popular, and sometimes it works well. But sometimes knowing the whys is helpful. And that's especially true of the fundamentals of photography such as exposure.

I'm reminded of my kids taking drivers ed. The instructor taught parallel parking using landmarks on the car. "Back up until this lines up with that, then turn the wheel all the way to the left." It works great - for that one model of car. But in any other car the landmarks are different. I'd tell them, forget everything the instructor said. This is what you are doing and how it works. I'd demonstrate with a toy car. Once you understand the concept, you can park nearly any vehicle. (And they both did great in the parking test!)

My mission, then, is to provide this foundation to allow you to, with practice, achieve any exposure-related goal, and do it even when the conditions aren't what you are accustomed to.

Under exposure, normal exposure, and over exposure

Fundamentals - Starting at the Beginning

Exposure determines how bright or dark the photograph will be. So, the first question might be, "is there one right exposure." This is a tougher question than it sounds. There is certainly a range of settings to give you an acceptable result, something you might call a proper exposure. But whether it's right or not will depend on what you envisioned and what you wanted.

Let's start with the main controls we have available: **shutter speed**, **aperture**, and **ISO**. These form what is often called the *exposure triangle*. See, there are three interrelated controls, so it's a triangle, right? I'm not sure this really helps one grasp it, but just remember there are three. If a triangle helps you do that, great! We'll take them one by one and then see how they interact.

Shutter speed determines, as you might have guessed, how quickly the shutter opens and closes. The longer the shutter is open, the more light gets through to the sensor (or film). It works very logically. If you allow it to be open for twice as long, you get twice as much light. Half as long provides only half the light. In photography, we like to use powers of two - two times, four times, eight times, half, quarter, eighth. You'll see that a lot.

Effects of shutter speed on capturing motion

How might we want to use the shutter speed to affect our photo? If it's dark, I might want to leave the shutter open for a longer time to allow more light in. But what happens when the subject is moving and you let the sensor see the movement for too long? Blur! When a kid is running for the soccer ball and kicks it perfectly, and we hit the shutter button at just the right moment, leaving the shutter open too

long, we take a photo of a kid with no leg. Just a mess of color where his leg should be. What we might want to do is stop that action to get a clear sharp shot of him flying through the air and striking the ball. Or, perhaps, we want just a tiny blur to show that motion to the viewer of the photo. We look at that photo and think, yes, perfect.

Another day, we're on vacation in Kauai, photographing one of the many beautiful waterfalls, and we'd like to produce a photo with that silky smooth water. Instead of a snapshot, we want a piece of art that someone will look at and wish she could be there, hearing the falling water, seeing it rush down the mountainside. Slow, slow shutter speed. Blur is our friend.

Shutter speed is measured in seconds, but most of the time, we only use fractions of a second. Instead of showing the fraction on the camera, you'll see just the denominator. So, 1/30 second is shown as 30. 1/250 second shows up as 250. A higher number means a faster shutter: 1/1000 of a second is much less than 1/30 of a second. Of course, this can be confusing if you really do want 2 full seconds or even 30 seconds. The camera makers then use the double quote notation. 30 seconds is shown as 30".

Aperture is a measurement of the size of the opening through which the light passes. In video, they call it the iris. That's a good term because it's like the iris in our eyes. When we walk outside on a bright, sunny day, our irises close down to just allow a little of that bright light in. When we walk back indoors where the lights are dim, they open wide, giving us big black pupils letting in all the light they can. The camera's aperture is used the same way. It's built into the lens.

Have you ever noticed that focusing your eyes at night is more difficult than during the day? This is partly due to our pupil sizes, our apertures. (If you haven't noticed it yet, wait a few years!) When the opening is small (bright sunlight), it's easier to see things clearly. Some early cameras used a pin hole - literally a pin hole - instead of a lens. Almost everything was in focus. It's a physics thing. Lens aperture works the same way. As the opening becomes smaller and smaller, more and more of the scene is clear. As the opening becomes very wide, then the focus becomes critical until only the subject or part of a subject within a small distance range will be in clear focus.

If you remember old cheapo cameras with fixed lenses and no focus control, they worked by having small apertures so if your subject was at least a few feet away, it would be reasonably clear. But, you could only take photos on bright days or with a flash. My first camera, a Kodak Instamatic, worked like this.

This control over how much of our scene or subject is in focus is the primary motivation for adjusting the aperture. In some ways, it's the most important artistic control we have. Imagine we're taking a photograph of an expansive, beautiful landscape. We'll probably want the entire scene to be crisp and clear. We might choose a smaller aperture. Or, a big group shot - I want the people in front and the people four rows back to all be clear. Later, I'm taking an individual portrait and I want the subject's eyes to be razor sharp. I might choose a wide aperture that allows the distracting background to be blurred beyond recognition. That background provides no value to the shot, so just make it go away.

Effects of aperture on background

We measure aperture using f-stops. This is a funny sounding number like f/2.8 or f/4 or f/22. F-stop is a measured as the focal length divided by the opening size, so it's a fraction. It's not something you need to know, but the f-stop number is the denominator making bigger numbers represent smaller openings. Again, the smaller the number the bigger the aperture and the more light gets through. The bigger the number the smaller the opening, and the less light gets through. Eventually, you may just start learning the numbers. F/8 will be a value you just sort of know. The advantage of representing the aperture this way, as a ratio with the focal length, is that f/8 means the same amount of light making it to the sensor with a wide angle 20mm lens or a long 400mm telephoto lens. You don't have to do any math, just dial in f/8.

In the figure above, I purposely composed this image with an ugly background (a fence). It helps show how using depth of field, one can make the ugliest background less of a concern. Sometimes you can't eliminate such elements, but there is a tool we can use to make it less of problem.

(Geek moment: The aperture opening at f/8 for a 20mm lens would be 2.5mm, less than 1/8 inch. The opening at f/4 for a 400mm would be a whopping 50mm, or almost 2 inches.)

ISO is a bit different. Alone, it's not really something we use to achieve a look. I like to think of it as a volume control. Imagine instead of taking a photo, we're recording audio. An opera singer walks up to the mic and begins her aria as though she were singing with no mic in an opera house and wanted to ensure the balcony patrons could hear her clearly. You'd better turn down the volume or you'll blast everyone out of the place.

Next up to the mic is a tiny child with a whisper of a voice. Now, you crank it up (maybe to eleven!) or no one would hear the child. But you notice something that wasn't there before. When the child is silent between words, there's this noise emitted by the speakers. It's especially noticeable in these otherwise silent times, but after a while, you realize whenever the child is quieter, the noise seems to be worse.

Using ISO to allow a higher shutter speed

In your camera, this is ISO. When it's bright, there's plenty of light, and the diva is singing - you turn it down. When the light fades, becomes quiet like the child, you have to crank it up. You might crank it way up. But, you unfortunately notice in doing so, there is noise - visual noise. It's noise nonetheless, and it's there for essentially the same reason. And it's worse in the darker, quieter, parts of the photograph. It's an electronics thing. Engineers are busy making it better, but it will always likely exist. As it improves, we just keep increasing our expectations, wanting our cameras to see like cats, where we cannot.

Basically, then, we use ISO to help us adjust the other two controls, shutter speed and aperture, to achieve the photograph we want. At 1/60 second in the figure, camera shake isn't too bad, but we can still make it sharper with higher ISO. I made big jumps to help illustrate the discussion. ISO 3200 might be the perfect compromise.

Camera and Lens

We now have three controls to help us achieve the look and exposure we want. Our camera and lens provide what you might consider limitations to those controls. Our lens has a minimum (smallest) and

maximum (largest) aperture it will allow. Lenses that provide a large maximum aperture, say f/2.8 or even f/1.4 (remember, smaller number, bigger aperture) are often called *fast* lenses. Seems sort of odd, but that's photographers for you. Basically, it means with this lens, you can use a faster shutter speed to achieve an exposure than you could with a slower lens.

We now have this working range of f-stops within which we can play. If your maximum aperture is f/5.6, you can't use anything larger. If you want more background blur, you don't have that choice without changing to a faster lens. You must work with what you have.

We talked about blur caused by a moving subject earlier, but there is another cause: the photographer. Camera movement can blur the photo. If someone in your photo is blurry, but everything around him is sharp, the cause is the subject's movement. If the whole image is blurry, it may be a focusing problem or it may be caused by you shaking the camera. (Hint: Hold your breath as you squeeze the shutter release, and always squeeze it, don't whack it silly.)

The lens may have a feature to help prevent slight movement of the camera and lens causing blur. Nikon calls this Vibration Reduction (VR), and Canon calls it Image Stabilization (IS). Some other manufacturers build this feature into the camera which lets it work with any lens. The effect is allowing us to slow down the shutter further before camera shake becomes noticeable. It's a great feature and, as you might guess, the best system is in the newest and most expensive lenses. But any help is appreciated

Image Stabilization enabled on right side (105mm at 1/40 s)

The camera also enters the picture, so to speak, by the quality and performance of its sensor. In the old days, this role was that of the film. The advantage was you could unload one type of film and load another. And when a film manufacturer produced a new, better film, it would work instantly in any film camera you owned. Now you are stuck with what the camera itself can do. However, cameras today are incredible and can do things we never dreamed of doing with film.

Noise reduction applied on right side

As you bump up the ISO to 1600, 3200, or even 6400 and higher, noise can become a real problem. It just becomes ugly. We have some good tools to help reduce noise - the camera's own noise reduction will apply if you shoot jpeg, Lightroom has pretty good noise reduction, and other tools and plug-ins also do a fair to excellent job smoothing out noise. In the process, though, fine details in the photo are also smoothed away. The software can't tell exactly what is detail that's supposed to be there such as fine strands of hair and what is detail that is really noise. Like the sensors, this software technology is also improving.

The camera provides us with an absolute ISO limit - it can only go so high or so low on the ISO scale - and a limit of acceptable noise. That is, one camera may look fine at ISO 3200, while another camera may produce horribly noisy shots at that setting, even though it lets you set it. You have to decide for yourself what is acceptable and what isn't. And sometimes, if it means getting the shot or missing it because it's too dark, what is acceptable might very well change. The figure above was taken from the ISO 1600 example earlier. The loss of fine details isn't bad, and the noise reduction produces a very nice image.

Finally, the camera has a range of shutter speeds it will allow. On the fast side, it might shoot up to 1/2000 or 1/4000 or maybe even faster. But there will be a limit. Similarly on the slow end, maybe it can shoot 1 second or 5 seconds or 30 seconds. On this end, we have another option usually. Most DSLRs will have a bulb setting, usually represented by a B on the mode dial or settings menu. This goes back to the really old days when cameras didn't have a shutter setting. You fired the shutter manually using a bulb that fit in your hand. Squeeze it to open the shutter, release to let it close. So, if we want to expose for a minute, set the camera on B, press the shutter release and keep it pressed while counting to 60. Some cameras let you press and release to open the shutter and press and release to close it again, but the idea is exactly the same.

Setting an Exposure

Here we are, then, with our three controls, shutter speed, aperture, and ISO, and with a subject in front of us and an image in mind. Where do we begin?

Is our subject moving? Is it a mountain - hopefully it's pretty still - or a friend posing for us? Or maybe a kid running with a basketball? What are the lighting conditions? Broad daylight, or a moonlit night? Stage lights or a lamp in the corner? The movement of the subject combined with our desire to either stop any motion or to specifically allow some blur tells us what range of shutter speeds would be ideal. The light conditions tell us if we need to worry about photographer-induced blur. Even if the subject is a rock, given a low enough shutter speed, camera movement may be a problem. We then adjust the acceptable range we've determined from all these factors if we are using a stabilized lens.

How do we want to treat the focus in the shot? Do we have a subject we want crisply defined against a blurry background? Is this a group shot that we want to ensure is sharp for everyone, from the folks sitting on the floor in front to the people standing on chairs in back? Is the subject a mile away where it will easily all be sharp regardless of the aperture? Or is there a rock in the foreground that we want as sharp as the subject behind? Or do we intentionally want that rock blurry?

Answering these questions leads us to a range of shutter speeds and a range of apertures appropriate for the shot and how we want it to look. The bigger the ranges, the more flexibility we have. Now, how does ISO fit into this?

Remember, when ISO is low, we obtain a cleaner photograph. Better cameras with more advanced sensors allow you to push the ISO higher, but it is still true that the noise at 3200 will be greater than at 100. It might be acceptable, but we'd like to have the very best possible quality for our image.

Given the shutter speed and aperture ranges, we select an ISO that will allow us to fit into those ranges. We'll usually try to use the lowest ISO that works.

Sure Sounds Complicated!

Is it all really this complicated? How does one ever arrive at a threesome of settings - shutter speed, aperture, and ISO - let alone settings that actually produce the desired photograph?

Nobody really goes through a long set of calculations for every shot. We have some rules of thumb, we have an exposure meter in the camera, and we have that most valuable of all pieces of information - experience. Experience tells me that on a bright sunny day, ISO set to 100 is probably going to be all I need. In fact, for some shots, it may be too much and I'll have to use some techniques for dealing with exposure extremes.

I shoot a lot of theatre photos. I know that ISO 3200 works really well for me, giving me some flexibility in shutter speed and aperture, and my camera produces low enough noise to be acceptable. Some cameras won't, so one would use a lower ISO setting and try to cope with other issues.

On a cloudy, rainy day, I might try 400 or even 800 as a place to begin. And that's really the key. Judge the lighting, pick an ISO, and now work on shutter speed and aperture. Are you able to produce a good image? Am I shooting much higher speeds than I really need (say, 1/2000 second shooting a landscape on a calm day)? If so, then perhaps lowering the ISO makes sense. Am I having to try to hold the camera steady and having trouble with blur? Or am I shooting a fast-moving subject that's producing blur I don't want? If so, perhaps raise ISO.

The more you shoot, the more comfortable you'll be picking a good starting ISO. Back in the film days, every film type had an ISO (or ASA as it was commonly called then). To change it, you unloaded the film and loaded a different film. That's assuming you even had more than one film type with you. There were some other tricks you could use when developing the film, but you still had to shoot an entire roll at one setting. Take a deep breath, set an ISO, and thank the engineers who developed digital photography!

We set ISO and then sort of forget it. We can then focus on the other two settings. Which of them is primary and which is secondary? That is, which do you set first? The answer depends on what you're shooting and how important each setting is to achieve the look you want.

It's also worth saying that we sometimes worry too much about noise. If the noise from high ISO isn't distracting the viewer from the subject, then perhaps it's just fine. The people who complain most about noise are other photographers. If you need to raise the ISO in order to capture an image, my mantra is a noisy image is better than no image. It's okay to be concerned about the noise and to attempt to keep it at bay, but don't obsess.

One Down, Two to Go

Much of the time, aperture is the first setting to adjust. There are situations where shutter speed is first, and they tend to be a few special categories. Examples: sports and moving water. Motion is the common thread. If something is moving, you either want to stop its motion or exaggerate it. You select a shutter speed to do that.

But even in sports, we often want to draw attention to a player and make the background go fuzzy. Aperture is the key to that, but we still do have to keep a close eye on shutter speed. In other words, sometimes we can be less conscious of shutter speed if it's fast enough to avoid the effects of camera shake or subject movement. Other times, it needs to be monitored closely.

Let's proceed then to aperture and work back to shutter speed. As discussed earlier, aperture will be limited by our lens. It can open only so wide and close down only so small. I could write an entire eBook on aperture, so let's try to generalize it a bit here. Wide open produces shallow depth of field, with only the subject (or maybe only part of the subject) in clear focus. Closed down produces a deep depth of field. Let me use f/5.6 for a portrait. For a group, maybe it's f/11. For a big landscape, maybe f/8 up to f/16 or more. Starting points - we can always adjust to suit our tastes.

I'll decide what I want to use and set the camera to that f/stop. Now, I can use the meter built into the camera to help me find the right shutter speed.

What is the camera's brain trying to do? In the simplest terms, it's guessing that if brightness of the image is averaged (take everything you see in the viewfinder and throw it into a blender), it will be about 18% gray. That works more or less well depending on the scene. Knowing nothing else (and your camera really doesn't know anything else), that's a good place to start.

The lack of knowledge by the camera causes the problems you've probably seen in your photos all the time. Little Sally's face is so dark you can barely tell it's her, but the background - trees and sky and buildings - looks just right. Or Frankie is making his stage debut at school and he looks like a ghost - just a white blob. These are extremes, but they show the problem. The camera just doesn't know what it's looking at.

There are often several possible settings for how the camera meters the situation, but let's just consider the most sophisticated of those. Canon calls it *evaluative*, Nikon calls it *matrix*, Olympus calls it *ESP*. Other manufacturers have their own names. The camera looks at the area within the viewfinder, figures the most important thing is in the center, then uses some math to add in other parts of the image in different ways before it presses *Purée* on the exposure blender. Then, if you are using an automatic mode, it uses the results to set one, two, or all three settings: shutter speed, aperture, and ISO.

If your camera is set to manual mode, it will still meter the image and show you the result. It's up to you, though, to adjust your settings using the information it provides. There is typically a bar along the bottom of the viewfinder with a zero mark in the middle. If you adjust the controls to hit that middle mark, the camera thinks you have a good exposure. If you move to the right, you are overexposing and to the left, underexposing, based on what the camera is seeing.

Besides experience, you have some tools to help. Being digital, you can take a photo and look at the result on the LCD. If you're grossly over- or underexposed, it's usually pretty obvious. Also, being the intelligent human actually taking the photograph, you can look at the scene and think to yourself, "self, this scene looks overly bright, and the camera is going to think it's too bright and will try to make it darker (toward that 18% gray)." Or, "gee, this stage is all dark except for Frankie in the spot light and the camera is going to try to make that blackness 18% gray." You can then take a guess as to how far off that meter is from where it should be and adjust your settings accordingly.

In manual mode, you make this adjustment by directly changing the settings. If you have the aperture you want, you will adjust shutter speed faster or slower than the camera's suggestion to compensate for the scene. In aperture-priority automatic mode, you use the exposure compensation control to tell the

camera to either brighten or darken the exposure from what it wants to use. It does this by adjusting the shutter speed setting. If you are using shutter-priority automatic mode, you again use the exposure compensation control, but the camera will change the aperture to adjust the exposure.

Some Final Words

You might be thinking, "exposure is so complicated, Tony wrote over ten pages about it!" Certainly it's not a simple topic to explain. In simplest terms, more light gives a brighter photo, less light gives a darker one. Maybe that's all some people need to know. But I wrote so many pages not so much because of its complexity but because of its importance. The exposure controls are the first step in setting the mood of a photograph. Master those controls, and you can use them to help achieve your vision, and then work on composition and lighting.

Where should your mode dial be set? Setting your camera on Manual mode is a great way to learn exposure, learn how the different controls affect the image. I suggest you at least run through a few exercises this way. Look at my various examples and shoot some of your own. Set an ISO, select an aperture, and let the camera's meter help you set a shutter speed. (Not sure where to start? Put your camera on Program mode and take a shot letting it choose all three. Set your ISO, shutter speed, and aperture to match those as your starting point.) Then make changes to aperture, adjusting shutter speed to keep the exposure balanced. Do this several times. Make big changes and see the effects on depth of field.

Find a moving subject and do the same exercise but change shutter speeds, adjusting aperture to keep the right exposure, and look at how the motion is affected. Make ISO changes and use shutter speed to compensate. See how the noise in the image changes.

The idea is to select one of the three settings to play with and only one of the other two to compensate for the exposure. Pick several subjects, vary the settings a lot so you can really see the differences.

Reread the earlier sections if you're unsure what to look for. When you feel comfortable that you understand how these controls affect your photos, you may graduate to Aperture or Shutter priority automatic mode. Try some experiments there, too. Find a scene that's dark and learn how to use the exposure compensation. Find a bright scene and do the same.

Eventually, you might be able to dial in your exposure and be nearly right most of the time. But even if you aren't to that point, I want you to be able to look at your LCD, see that the white dress is muddy gray, and realize how to fix it without much thinking. Or, notice all the background clutter in your photo and know how to blur it out or at least make it less sharp. I want ***you*** to make the decisions that affect how your photographs look, not your camera. Be in control!